A Review of Incidence and Injury Patterns of Equestrian-Related Accidents in Children and Adolescents

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Authors’ contributions

This work was carried out in collaboration between all authors. Author GAA designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors NAA and AGA managed the analyses of the study and literature searches. Author AGA supervised the writing of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Horse riding represents a globally popular activity for people of all ages for recreational, sport or professional purposes. Among these individuals an increasing number of young people, children and adolescents has been recorded. This activity is also associated with a significant number of accidents ranging from relatively innocent injuries up to more serious ones which can even endanger the life of the horse rider. In this article review, international literature was thoroughly studied focusing on the analysis of mechanisms leading to these injuries as well as of the risk factors that increase their frequency and the prevention strategies which may reduce their incidence. Horse riding is an activity associated with a significant frequency of accidents mainly due to falls off the horses, accompanied by a large number of accidents, mainly head and upper limbs injuries. These injuries impose considerable socio-economic costs, with unbearable consequences for the life and health of young riders. For these reasons, prevention strategies as well as the appropriate equipment and particularly the use of a special helmet is of particular importance.

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1. INTRODUCTION

Horse riding is a popular world spread activity encompassing recreational, athletic and professional activity in which people of both sexes and various ages are involved. In the US and the UK there are more than 30 million and 3 million people respectively riding horses [1]. A population of 470000 work in the equestrian environment in Canada [2]. It is also reported that about 80 million people ride horses at least once in a year and even nearly 2 million of them are younger than 20 years of age [3]. Horseback riding is the eighth in the rank in sport participation in Sweden reaching 200,000 riders namely 2% of Sweden citizens [4].

Unfortunately, horseback riding is though a common source of injury [2]. In every 1000 hours of horseback riding, 0.49 hospital admissions have been reported [5]. A significant number of accidents concerns young people, especially children and adolescents [6]. Children and predominantly young girls wish to ride, leading to increased rates of injury. Furthermore, the level of injury is higher in horseback riding than other athletic activities [7]. So, horseback riding is more dangerous than motorcycle riding and various other sports such as skiing, football, and rugby [2]. Of note head injuries ranging from mild injuries to catastrophic lesions such as severe brain contusion or intracranial bleeding represent a great proportion of horse-related trauma in children as high as 19-24% [4].

According to a study, the total cost for consultation and treatment for children was found to amount up to 210000 Euro, which means approximately 1400 euro per accident [4]. Besides the significant socio-economic cost related to horse riding injuries, they are also associated with long lasting disabilities and unbearable consequences for the overall health and quality of life of young riders [8]. This permanent sometimes disablement has a significant influence to the younger population taking into consideration the number of productive future life years which are affected [9].

Within the international community, a number of deaths is also associated with this popular activity. The mortality reaches a death rate of approximately one death per million population per year [10].

For these reasons the importance of the analysis of mechanisms leading to these injuries as well as of the risk factors that increase their frequency becomes obvious. An additional important factor is the development of effective strategies to prevent accidents during the equestrian activity in order to reduce health damages of children and adolescents and their impact on the overall quality of life of the injured.

In this study an article review was conducted with the purpose to analyze the existing scientific data on the incidence and injury patterns of equestrian-related accidents in children and adolescents. Publications relating to the epidemiology and mechanisms of injury, in English and French language were identified from a Medline, database search between January 1970 and December 2016 with “equestrian injuries”, “children”, “adolescents”, “epidemiology”, “injury pattern”, “prevention” and “injury severity” keywords and with MeSH (Medline/PubMed’s article indexing terminology) subject headings. Journal hand searches were also utilised to enhance the research of related literature. Case series reports were included in this study. Due to the heterogeneity of methodologies utilised in the existing literature regarding equestrian-related accidents in children and adolescent, a systematic review or a metaanalysis of the existing data was not feasible and for this reason an article review was instituted. Another limitation of this review is that the analyzed data were based mainly on old published manuscripts and retrospective studies as there is a relative lack of recent studies dealing with this topic.

2. MECHANISM OF INJURY

Most injuries occur during horse riding and only a few during the care of the horse [4]. The main injury mechanisms include the fall off the horse, the kick of the fallen rider by the horse and, to a lesser extent, the biting by the horse, trampling by the horse or being dragged by the reins after the fall. Worldwide the largest percentage of injuries in both children and adults takes place after falling off the horse [1,2,4,8]. Comparing the injury mechanisms between children and adults we see that 85% of the children had fall accidents, 7% were kicked, while 65% of the adults had fall accidents and 16% were kicked [4].
It should be noted that the injury mechanism of the horse rider is complex and sometimes it is impossible to identify just one discrete injury mechanism which caused the injury such as falling off a horse or being kicked by the horse. For example one rider during a sport activity may fall off the horse and at the same time get trampled by the horse, or get dragged by the reins or suffer further injury due to impact with a hard object such as a fence.

2.1 Type of Injury

Minor injuries such as sprains and soft tissue injuries which do not warrant hospitalization are the most common type of injury in both children and adults [2,4]. Lesions are often located at the upper half of the body in comparison with the lower half [11]. The injuries of upper limbs are the most common, followed by head injuries as well as facial and body injuries. It is noteworthy that a significant percentage, equals to 18%, has to do with multiple traumatic lesions [11].

In a retrospective study reviewing 240 horse-related injuries in 212 children under 18, as regards the localization of injury the upper extremity and more specifically the wrist or hand with 36 injuries were most commonly affected, followed by the head/neck region, and the trunk [11].

In a recent study by Altgärde et al. [4] Including 147 individuals under the age of 19 years who sustained 177 injuries, a total number of 33 fractures as well as 93 minor sprains and light soft tissue injuries were recorded. Twenty two of these fractures were related to the upper extremities. Twenty six patients required hospital admission which lasted at least for three days in 9 of them [4].

Spinal injuries although not very common, are injuries in which children participating in horse riding activities may face. In a study analyzing 303 accidents of children younger than 15 years, in 7% of them a spinal injury was confirmed [7]. In another retrospective study including 315 children aged 0-19 years old who required hospital admission after a horse related injury, 4 thoracic spine, 1 lumbar spine, and 2 sacral fractures and a C4 dislocation were recorded [8].

A significant proportion of the injured children experience long lasting disabilities. In 100 children under 17 who sustained horse related injuries, Dekker et al. [9] in 41 of them, recorded long term morbidity for four years post injury. The authors of this study also report absenteeism from school lasting 2 weeks, as well as horse riding inability for a 4 months period following a horse related accident.

2.2 Risk Factors

2.2.1 Gender

Women have higher injury incidence with the peak recorded at the age of 14 [4,6,12]. In particular, younger women with less experience in horse riding seem to have an increased number of injuries. This incidence is as high as 98% in children which is probably due to the greater involvement of girls in general with horse riding [4].

2.2.2 Training experience

It has been argued that older horses are involved in accidents to a lesser extent than younger horses [13]. It also seems that of particular importance is the horse rider’s training which should be conducted under the guidance of an experienced teacher [13].

2.2.3 Seasonal variation

Horse-related accidents are more common during warm weather [14]. The frequency of these injuries in UK appears to be higher between March and October with the peak for women being in July [6], which reflects the greater involvement of women with horse riding during that period when they have more free time. This large seasonal variation during spring and summer is confirmed by a study which included 260 patients, 164 of which suffered injuries that occurred during these seasons [12]. Bad weather conditions do not seem to affect the frequency of accidents and injuries, as the largest number of injuries is recorded during summer, under good weather conditions [2], probably due to the greater involvement of children at that time, as mentioned above.

2.2.4 Surface

The majority of these accidents occur on relatively good footing surfaces. More specifically 38% of them are recorded on dry dirt and 37% on uncultivated land [2].
2.3 Preventing Strategies

2.3.1 Helmets for the prevention of head injuries

Equestrian activity is related to a significant number of head injuries. The injuries are even more common in adolescents and children in comparison with the general population [5]. Despite the high incidence of head injuries during this activity, the protective helmet does not appear to have been generally adopted worldwide, and only a part of the participants, less than 20%, is recorded in the literature wearing protective helmet [8,15,16]. Fortunately, in later studies this figure appears with increasing frequency and in a study regarding children was found to be 80% [9].

In a study by Barone et al. which included young people aged less than 19 years, only 5% of patients who were admitted to the hospital because of a head or facial injuries wore some kind of protective helmet compared with the 10% of all the participants in the study who wore helmet and suffered another injury according to the evidences [3]. In an earlier study which also included 110 horse riders, less than 20% wore a protective helmet, while 10% of the patients with a serious head injury, which represented the most serious injury during the equestrian activity, wore this kind of equipment. The authors of this study correlate the severity of head injuries with the lack of helmet use [17].

According to Chitnavis et al. in a retrospective study that included adults and children, 24% of which were admitted to the hospital, the increased use of helmets reduced the severity of head injuries. The authors of the study in a period of 20 years recorded an increased use of helmets from 42-72% to 73% and an improvement of the equipment quality, as well as a reduction in the frequency of these serious injuries which is 5 times lower [18].

In a retrospective study that included 32 children who had an accident during horse riding, 20 of them wore helmets. For the children who did not wear a helmet, the frequency and severity of the head injuries they suffered were higher. The frequency of hospitalization was significantly higher for those not wearing a helmet [19].

Finally, in another study in 24 adult patients with head injury, the patients who wore helmet had statistically significantly fewer intracranial injuries, namely 1/19, compared with those who suffered an injury and didn’t wear a helmet, where three intracranial injuries were recorded in 5 patients in total [1].

Apart from the use of helmet which provides protection against head injuries, the proper use of this equipment is equally important. It is reported that a large number of horse riders who wear helmets without chin straps, loses the protection which is provided by the equipment against the fall off the horse in a higher percentage than the horse riders who have incorporated safety helmet straps [3].

To avoid these unfortunate events, chin straps should fit properly and always be fastened. The type of the protective helmet is also alleged to affect its effectiveness concerning the prevention of serious injuries and deaths, especially during horse riding. A simple helmet which comprises only two layers according to Ingemarson et al. [13] cannot provide adequate protection to the horse rider in the case of an impact fall which can be only ensured by a helmet with multiple layers that absorb the energy upon impact of the head with the ground. In a research on the evaluation of the design and materials of simple horse riding helmets with a reproduction of the accident conditions during horse riding, it was found that their ability to absorb lateral impacts was reduced compared to the most bike or motorcycle helmets [20].

2.3.2 Gloves for the prevention of hand injuries

Rein entrapment has been implicated in several serious injuries of the upper limbs namely fingers [21]. In a series of horse riding accidents, a total of 8 cases of traumatic amputation of fingers were presented due to the improper use of the reins. In this series of injuries, half were related to the thumb and the other half to other fingers. In another series of 177 patients who suffered 236 injuries, two traumatic digital amputations and five phalangeal fractures were recorded [22].

To reduce the frequency of hand injuries it has been proposed by Regan et al. [22] the reins and halter rope or leading rope to be held without wrapping them around the fingers or thumb. In fact, the authors of this study suggest that these instructions should be added to the Riding and Road Safety Manual. The use of gloves with an extra grip which prevents slipping has also been proposed in order to protect the hands [18].
although this is not an international standard practice.

### 2.3.3 Boots for the prevention of lower leg injuries

In a series that included 258 children who were injured and were admitted to hospital in a period of 12 years as a result of horse riding, 8 of them suffered a serious foot injury that required hospitalization [23]. The severity of such injuries indicates the necessity to use protective equipment such as specially designed footwear. This approach unfortunately is followed, as indicated, only by a minority of horse riders since the majority seems to use inappropriate boots for this activity. The importance of custom made equipment for each horse rider is reinforced by the recorded case of the Acute Peroneal Compartment Syndrome caused due to very tight and therefore inappropriate boots [24]. This uncommon and occasionally unrecognized entity is attributable to activities requiring prolonged physical endeavour and is a pathology of lateral or peroneal compartment, which contains the peroneus longus and brevis tendons enclosed in a single synovial sheath [24,25].

### 3. DISCUSSION

Equestrian activity is associated with a large number of accidents. This is expected, taking into account the fact that the horse rider handles a big and very strong animal whose weight reaches 500 kg and its speed reaches 65 km/h. While the rider is in a disadvantageous position, 3 meters above the ground, and can receive a kick with great force of almost 1 ton [26].

These horse riding injuries can range from minor and relatively harmless injuries to serious ones requiring admission to the hospital, which may have significant long-term consequences on the health of the rider or can even endanger his life [8-10,13].

Horse riding is a popular activity among children and adolescents in particular for sporting or recreational purposes. Unfortunately it is combined with a significant number of injuries. In fact, when using the mean Injury Severity Score (ISS) per injury to compare horse-related injuries with other childhood injuries, horse riding injuries rank second compared to car accidents [11].

The accidents related with horse riding are more frequent during the summer months [2,6] when children have more free time in order to practice their favorite activity. Accidents in females are more frequent [6,11,12,18,27], which is explained by the fact that women are more involved in horse riding than men.

The most common mechanism of injury in children and adolescents when riding is the fall off the horse, followed by a kick or, to a lesser extent, other mechanisms such as biting by the animal [1,4,11]. Of course, in many cases, the horse rider injury mechanism is complex because not only one particular mechanism is identified but the combination of more than one.

Injuries of children during horse riding involve mainly sprains and soft tissue injuries. These injuries are more frequent in the upper limbs [12,17]. An important number of injuries is also related to head injuries [3,8,18,27] which can be explained by the frequent mechanism of injury when the child falls off the horse, taking into account the horse height, its speed and the impact of his head with the ground which occurs in a frequency even higher than in adult horse riders [4].

The prevention of injuries during equestrian activity is of major importance since the young horse riders may deal with significant and lasting effects for their health and quality of life and to a lesser extent may even endanger their life.

The necessary and appropriate equipment contributes significantly to the reduction of the frequency and severity of head injuries and should always be mandatory for any young horse rider. Particularly, each custom made helmet of appropriate quality for each child is an essential element of the equipment in order to perform this activity [2,19,26,28]. The importance of this protective equipment is enhanced by the fact that increased use has led to reduced number of head injuries. Even though its frequency of use seems to increase in recent years, however, a significant percentage of horse riders still neglect to use it. In order to reduce injuries as a result of not wearing a helmet during horse riding, it is important to reject misconceptions and beliefs which degrade the importance of wearing a helmet and discourage the use of helmets during equestrian activity [29].

Ball et al. in a retrospective study including 7941 horse related trauma patients emphasize the important protective role of helmet use and they also assert that equestrian related chest trauma
activity has been underappreciated. For this reason they suggest that not only helm but also vest use will be targeted in future injury prevention strategies [2].

Furthermore, the use of gloves and the careful use of the reins can reduce the frequency of amputations and other injuries of the fingers [22], while custom made rider boots can protect the legs from serious injuries [23,30].

4. CONCLUSION

The prevention of accidents and injuries that occur during horse riding in the sensitive group of children and adolescents is of particular importance in order to reduce the possible unbearable consequences in the health and quality of life of young riders. Activities associated with horses by children and adolescents should also be conducted with the best possible equestrian training of the child and always under the supervision of a properly trained adult [13].

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Abu-Zidan FM, Rao S. Factors affecting the severity of horse-related injuries. Injury. 2003;34(12):897-900.
2. Ball CG, Ball JE, Kirkpatrick AW, Mulloy RH. Equestrian injuries: Incidence, injury patterns, and risk factors for 10 years of major traumatic injuries. Am J Surg. 2007;193(5):636-40.
3. Barone GW, Rodgers BM. Pediatric equestrian injuries: A 14-year review. J Trauma. 1989;29(2):245-7.
4. Allgarde J, Redeen S, Hilding N, Drott P. Horse-related trauma in children and adults during a two year period. Scand J Trauma Resusc Emerg Med. 2014;22:40.
5. Sorli JM. Equestrian injuries: A five year review of hospital admissions in British Columbia, Canada. Inj Prev. 2000;6(1):59-61.
6. Barber HM. Horse-play: Survey of accidents with horses. Br Med J. 1973;3:532-4.
7. Laurent R, Uhring J, Bentahar M, Constantinou B, de Billy B, Langlais J. [Epidemiology of equestrian injuries in children]. Arch Peditr. 2012;19(10):1053-7.
8. Ghosh A, Di Scala C, Drew C, Lessin M, Feins N. Horse-related injuries in pediatric patients. J Peditr Surg. 2000;35(12):1766-70.
9. Dekker R, Van Der Sluis CK, Kootstra J, Groothoff JW, Eisma WH, Duis HJ. Long-term outcome of equestrian injuries in children. Disabil Rehabil. 2004;26(2):91-6.
10. Pounder DJ. The grave yawns for the horseman. Equestrian deaths in South Australia 1973-1983. Med J Aust. 1984;141(10):632-5.
11. Kiss K, Swatek P, Lenart I, Mayr J, Schmidt B, Pinter A, Hollwarth ME. Analysis of horse-related injuries in children. Peditr Surg Int. 2008;24(10):1165-9.
12. Moss PS, Wan A, Whitlock MR. A changing pattern of injuries to horse riders. Emerg Med J. 2002;19(5):412-4.
13. Ingemarson H, Grevsten S, Thoren L. Lethal horse-riding injuries. J Trauma. 1989;29(1):25-30.
14. McCrory P, Turner M. Equestrian injuries. In epidemiology of pediatric sports injuries. Individual Sports, D. Caine and N. Maffulli, Editors.Basel, Karger. 2005;8-17.
15. Muniz Fontan M, Moure Gonzalez JD, Miras Veiga A, Rodriguez Nunez A. [Serious accidents caused by horses. Warnings and prevention rules]. An Peditr (Barc). 2009;70(5):434-7.
16. Bixby-Hamett D, Brooks WH. Common injuries in horseback riding. A review. Sports Med. 1990;9(1):36-47.
17. Grossman JA, Kulund DN, Miller CW, Winn HR, Hodge RH, Jr. Equestrian injuries. Results of a prospective study. JAMA. 1978;240(17):1881-2.
18. Chitnavis JP, Gibbons CL, Hirigoyen M, Lloyd Parry J, Simpson AH. Accidents with horses: What has changed in 20 years? Injury. 1996;27(2):103-5.
19. Bond GR, Christoph RA, Rodgers BM. Pediatric equestrian injuries: assessing the impact of helmet use. Pediatrics. 1995;95(4):487-9.
20. Mills NJ, Whitlock MD. Performance of horse-riding helmets in frontal and side impacts. Injury. 1989;20(4):189-92.
21. Cannon P, Darlington J. Riding safely on the Roads. British Horse Society. 1989;19.
22. Regan PJ, Roberts JO, Feldberg L, Roberts AH. Hand injuries from leading horses. Injury. 1991;22(2):124-6.
23. Ceroni D, De Rosa V, De Coulon G, Kaelin A. The importance of proper shoe gear and safety stirrups in the prevention of equestrian foot injuries. J Foot Ankle Surg. 2007;46(1):32-9.
24. Vanneste DR, Janzing HM, Broos PL. The acute atraumatic peroneal compartment syndrome, a rare and therefore sometimes unrecognised entity. Acta Chir Belg. 2003;103:355-7.
25. Stephen DJG, Choy GW, Fam AG. The Ankle and Foot. In: Fam’s musculoskeletal examination and joint injection techniques, Lawry G et al. Editors: Philadelphia, Mosby, Elsevier. 2010:90.
26. Kriss TC, Kriss VM. Equine-related neurosurgical trauma: A prospective series of 30 patients. J Trauma. 1997;43(1):97-9.
27. Nelson DE, Bixby-Hammett D. Equestrian injuries in children and young adults. Am J Dis Child. 1992;146(5):611-4.
28. Eckert V, Lockemann U, Puschel K, Meenen NM, Hessler C. Equestrian injuries caused by horse kicks: First results of a prospective multicenter study. Clin J Sport Med. 2011;21(4):353-5.
29. Haigh L, Thompson K. Helmet use amongst equestrians: Harnessing social and attitudinal factors revealed in online forums. Animals (Basel). 2015;5(3):576-91.
30. Ceroni D, De Rosa V, De Coulon G, Kaelin A. Cuboid nutcracker fracture due to horseback riding in children: Case series and review of the literature. J Pediatr Orthop. 2007;27(5):557-61.

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