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Mapping equestrian injuries and injury incidence in Sweden using insurance registry data

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Abstract

A nationwide insurance database including all members of the Swedish Equestrian Federation and acute injuries reported to Folksam Insurance Group during 2017 was used to investigate horse-related injuries and calculate injury incidence nationally. Of the 152 069 insured members during 2017, 907 were injured, an average of 1.2 injuries per injured person. Females represented 96.9% of all those injured and had a higher risk of injury than males (RR = 3.18). The average age of injured equestrians was 30 years, and the highest injury incidence was for riders aged 21–40 years (RR = 8.83) and 41+ year-olds (RR = 7.33). The most common diagnoses included soft-tissue injuries (39%), fractures (36.7%), and concussions (17.3%). The most frequently injured body regions were the head and neck (36.4%) and the upper limbs (22.3%). Horse-related injuries occurred most frequently while riding a horse (86.2%), and the most frequent incident type was a fall (77.4%). The type of incident and activity was not independent from injury type. Injuries to equestrians represent a sizable public health concern. Injury prevention methods should be directed toward females, and protection against injury should be targeted for different incidents. Focus should be on preventing fall injuries, with appropriate matching of horse and rider and horsemanship skills.

KEYWORDS

epidemiology, equestrian, injury, injury incidence, prevention

1 | INTRODUCTION

Horse riding has long been regarded as a dangerous sport and globally, presents a major public health issue. A recent investigation found that every year in Sweden, there is on average 1756 acute injuries and three deaths resulting from horse-related incidents, giving a mortality rate of 0.03 per 100 000 population when all types of riding and horse-related activities were examined.¹ The mortality rate was found to be even higher in Australia, with a mean annual rate of 0.13 deaths per 100 000 population, and the injury rate was found to be 16.2 injuries per 100 000 population.² In New Zealand, an overall death rate of 0.17 per 100 000 population and an

injury rate of 23.7 hospitalizations per 100 000 population was observed.³

The unique nature of the equestrian sport, which consists of a relationship between the rider and a potentially unpredictable horse, results in an increased and unique set of risks not present in many other sports and activities.⁴ When compared to other sports and adventure activities, horse riding has been found to be associated with a significantly higher injury incidence rate. For example, horse racing was found to even have a higher injury incidence than that of motorcycle racing despite having similar biomechanical and physiological demands as well as similar personal protective equipment requirements.^{5–7} Bentley et al⁸ investigated insurance claims

rates of adventure sports in New Zealand and found that the horse-riding injury claim incidence rate was almost two times greater than the rate for mountain biking and four times that for tramping/hiking.

In Sweden, national sports-related injuries for 35 different sports were examined using insurance data from 2008 to 2011.⁹ The highest injury incidences were found to be in motorcycle racing, handball, skating, and ice hockey. However, this study did not examine equestrian activities.

Some recent investigations into injuries to equestrians have been conducted in Sweden.^{1,9} While these studies have provided an overview of the different injury types and demographics of injured equestrians in both county and national levels, there was no exposure data available to allow calculation of injury incidence.

The Swedish insurance company, Folksam Insurance Group (Folksam), has been the insurer for all members of the Swedish Equestrian Federation since 2017. The aim of this study was therefore to analyze horse-riding insurance claims to identify the most common injuries and injury incidence rate among all members associated with the Swedish Equestrian Federation.

While this database is limited to those equestrians who make an insurance claim, the insurance dataset allows for a national, in-depth investigation of horse-related injuries in Sweden. We were able to obtain information on all insured equestrians and as such, have exposure data for this subset of riders. Additionally, we can compare the injury risk of horse riding to previous reports of the injury risk of other sports in Sweden for which the Folksam database was used; however, this was only based on competition licensed athletes.⁹ This dataset also allowed for differences in competition riders to other members of the Swedish Riding Association to be investigated.

2 | METHODS

2.1 | Sample

The Swedish insurance company, Folksam, has been the insurer for the Swedish Equestrian Federation since 2017. As such, all members of the Swedish Equestrian Federation, including beginner to competition riders, were insured by Folksam, with the total number of registered horse riders being 152 069 and 22 000 (14.5%) of these riders had a license for competition. The insurance covers every member during training, Swedish Equestrian Federation activities as well as competitive riding.

This cross-sectional study involved a one-year investigation of all horse-related injuries among all members of the Swedish Equestrian Federation which were reported to Folksam. Both individual-level exposure and injury data were used. An eligible injury was defined as acute physical damage to the rider

resulting from a specific identifiable event which was reported to and recorded in the Folksam Sports Database. This dataset only included injuries that had occurred while participating in an activity with or related to horses. This included horse-riding and horse care activities in conjunction with either training or competition and was inclusive of the year 2017. Injuries were reported by the athlete, or a parent if the athlete is a minor, via telephone, email, or online. Diagnoses were provided by either a medical doctor, physiotherapist, or other medical professional. This database has previously been evaluated for reporting quality and established as a valid surveillance system.¹⁰ Data included information on age (0-6, 7-12, 13-20, 21-40, 41 years or older), which had been predefined by the Swedish Sports Association, gender, date of injury, nature of injury, injured body region and if the rider had a license for competitive riding. Additionally, claimants were required to provide a description of the injury event, which was then categorized into the type of activity (horse-riding, horse-handling, or other horse care activities) and the incident type (fall, kick, bite, trampled, crushed or knocked by horse, caught in equipment, and other).

2.2 | Analysis

Descriptive statistics, including frequencies and percentages, were conducted on all available variables using SPSS statistics 24.¹¹ Injury incidence was then calculated separately for males and females as well as the different age-groups by dividing the number of insurance claims by the number of registered athletes and multiplying by 1000. This was expressed as “the number of injuries per 1000 registered athletes per year.” Risk, expressed as risk ratio (RR), was then calculated between sexes by dividing the incidence of injury in females by the incidence in males. Pearson's chi-squared tests of independence were used to explore associations between injured riders with age and gender. Additionally, the association was explored between injury type and location of injury with age, gender, incident type, and type of activity.

3 | RESULTS

During 2017, there were 152 069 registered equestrians. Of these, 907 (0.6%) made a claim to Folksam following an acute injury while participating in a horse-related activity. 31 of these were riders with two claims.

3.1 | Equestrian demographics

The average age of injured equestrians was 30.0 years, with a range of 3 to 74 years (Table 1). While females had a mean age of 29.6 years (range 3-70 years), males had a mean age of 41.7 years (12-74 years). Females predominated, with 96.9% of injured equestrians being female. Of the riders who

Category	Number injured n(%)	Number insured n(%)	Injury incidence	RR (F/M)
Females	879 (96.9)	138 511 (91.1)	6.35	3.18
Males	28 (3.1)	13 525 (8.9)	2.07	
Unknown	0 (0)	33 (0.02)		
0-6 y	5 (0.6)	3618 (2.4)	1.38	
7-12 y	120 (13.2)	39 752 (26.1)	3.02	
13-20 y	238 (26.2)	40 632 (26.7)	5.83	
21-40 y	264 (29.1)	29 889 (19.7)	8.83	
41 + y	280 (30.9)	38 178 (25.1)	7.33	
Total	907	152 069	5.97	

TABLE 1 Frequency and percent of injured equestrians by age and gender

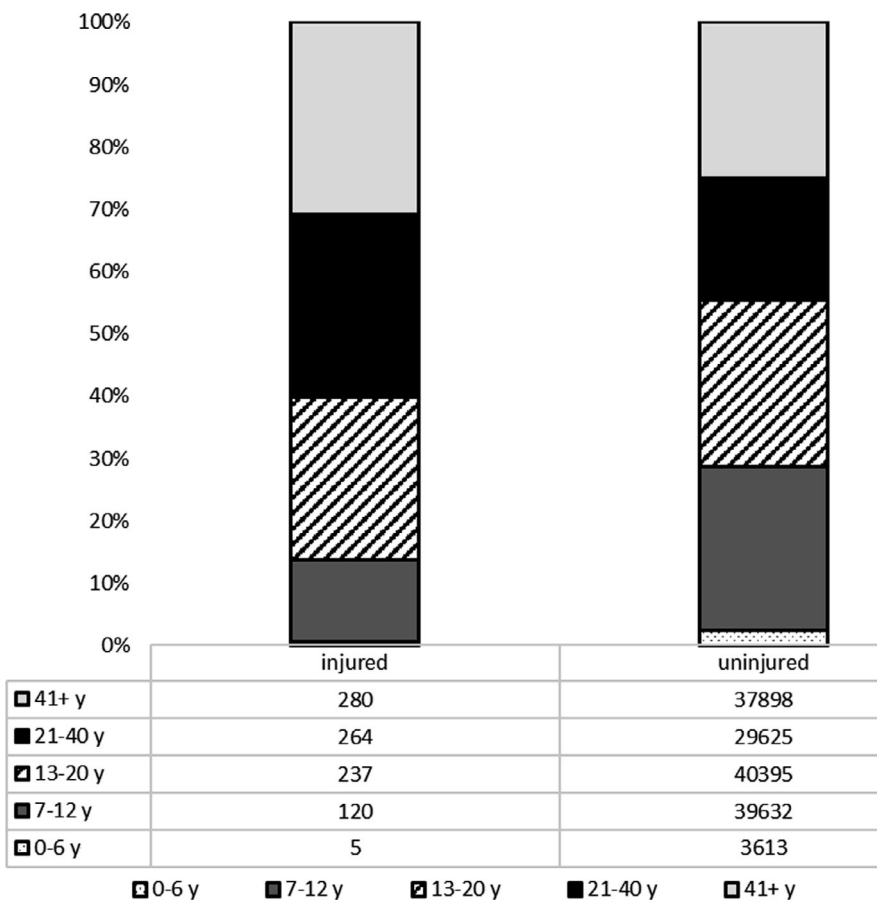


FIGURE 1 Age of those incident and not incident involved equestrians

had two claims, the average age was 26.8 years. There were 22 000 (14.5%) riders who were licensed with a competition license, and only five (0.6%) of the licensed riders were injured. These were all female and younger than 40 years.

The overall injury incidence rate was 5.97 injuries per 1000 registered athletes per year. Females were associated with more than triple the risk of injury than males ($RR = 3.18$), having an injury incidence of 6.35 compared with 2.07 for males. The percentage of riders injured in the different age-groups compared with all registered members can be seen in Figure 1. Those aged 21-40 years were associated with the highest injury incidence

(8.83), while 0-6-year-olds had the lowest (1.38). Additionally, age ($P < .0005$) and gender ($P < .0005$) were not independent from being involved in an incident.

3.2 | Injuries

For the 907 equestrians involved in incidents, there were 1132 recorded injuries, equating to an average of 1.2 injuries per person. One equestrian was fatally injured.

As can be seen in Figure 2, injuries to the head/neck were the most common (36.4%), while the most frequently seen

injury types were soft-tissue injuries (39%) and fractures/dislocations (36.7%) (Figure 3). Concussion was also commonly occurring, accounting for 17.3% of all injuries.

Incidents occurred most frequently when the equestrian was riding the horse (86.2%), followed by horse handling (6.7%). The most frequently observed incident types were falls from horseback (77.4%) and kicks (4.5%). The largest number of injuries that occurred while the rider was riding the horse resulted from falls, while kicks typically occurred during horse-handling and mounting/dismounting activities (Figure 4). Of those riders with multiple claims, incidents occurred while riding the horse in 91.9% of cases.

The result of the analysis of independence shows that age, incident type, and activity were associated with injury type and injured body region. However, gender was found to be independent from both injury type and injured body region (Table 2).

Younger riders tended to have higher proportion of injuries to the head/neck and upper limbs, whereas older riders displayed higher proportions of trunk/back and lower limb injuries. Head injuries occurred most commonly in fall, kick, and crush/knock incidents and when the rider was riding the horse. In trample incidents, lower limb injuries were more common and in injuries occurring due to the rider being caught in the equipment, such as when the hands are twisted in the reins, upper limb injuries were more frequent. However, upper limb injuries were still frequent in fall and kick injuries. Upper limb injuries were also the most common type of injury when handling the horse. Injuries to the trunk/back were most common in incidents occurring during mounting and dismounting.

Older riders suffered a higher percentage of fractures than the younger riders, whereas younger riders displayed concussions more frequently than the older riders (Table 3). Soft-tissue injuries were the most common type of injury

occurring in all incident types except for kicks and when the rider was caught in the equipment. In incidents where the rider was caught in equipment or kicked, fractures were more frequent. Fractures were also the most frequently occurring injury type when the rider was participating in horse handling and mounting/dismounting. In falls, concussion also occurred frequently (18.6%). A high rate of concussion was also observed when the incident occurred during the rider riding the horse.

Fractures were present in almost 40% of the injured riders and mostly affected the upper limbs (47%) and the lower limbs (26.1%). However, these mostly occurred in falls (48.4%) and incidents when the rider was caught in the equipment (57.1%). Lower limb injuries were more common when the rider was kicked (53.8%) or trampled (50%), and the head was the most frequently injured during incidents where the rider was crushed or knocked by the horse (50%).

4 | DISCUSSION

This study confirms previous findings that females are more frequently involved in equestrian injuries than males.^{8,12} Additionally, all those who were injured and were licensed with a competition license were female; however, the numbers were small. This study also investigated the injury incidence and risk ratio between males and females. The results suggest that not only do females represent 96.9% of all those injured, they have a higher risk of injury than males (RR = 3.18), indicating that the predominance of women is not just linked to increased exposure of females. There is no clear explanation available in the data as to why this may be the case; however, it could be interpreted as either biological or behavioral differences between the genders. It has been

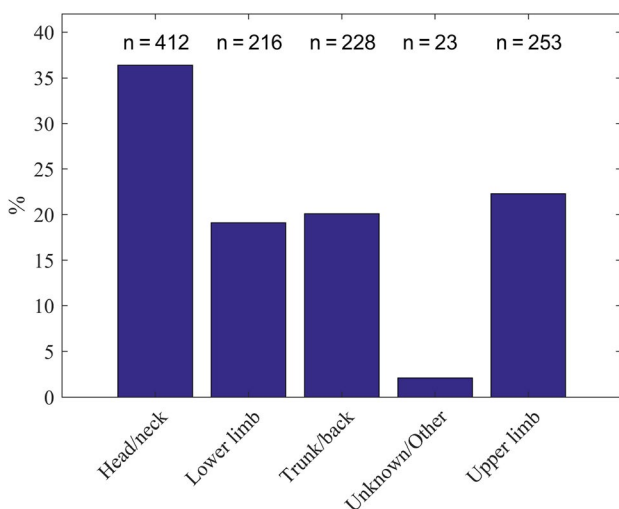


FIGURE 2 Frequency and percent of the body region injured

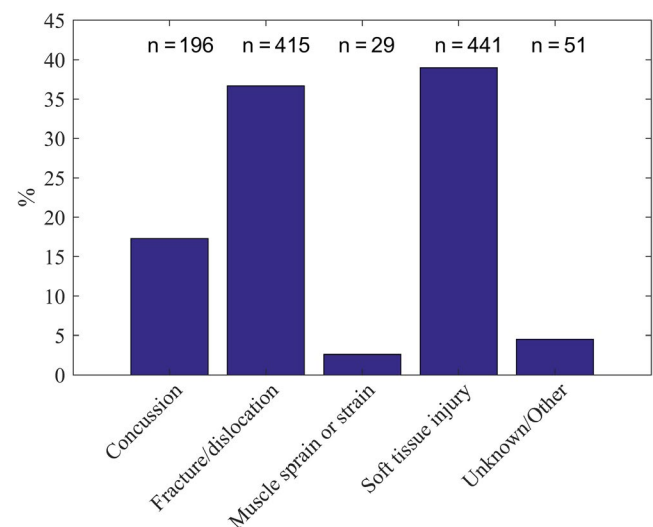


FIGURE 3 Frequency and percentage of the different types of injuries

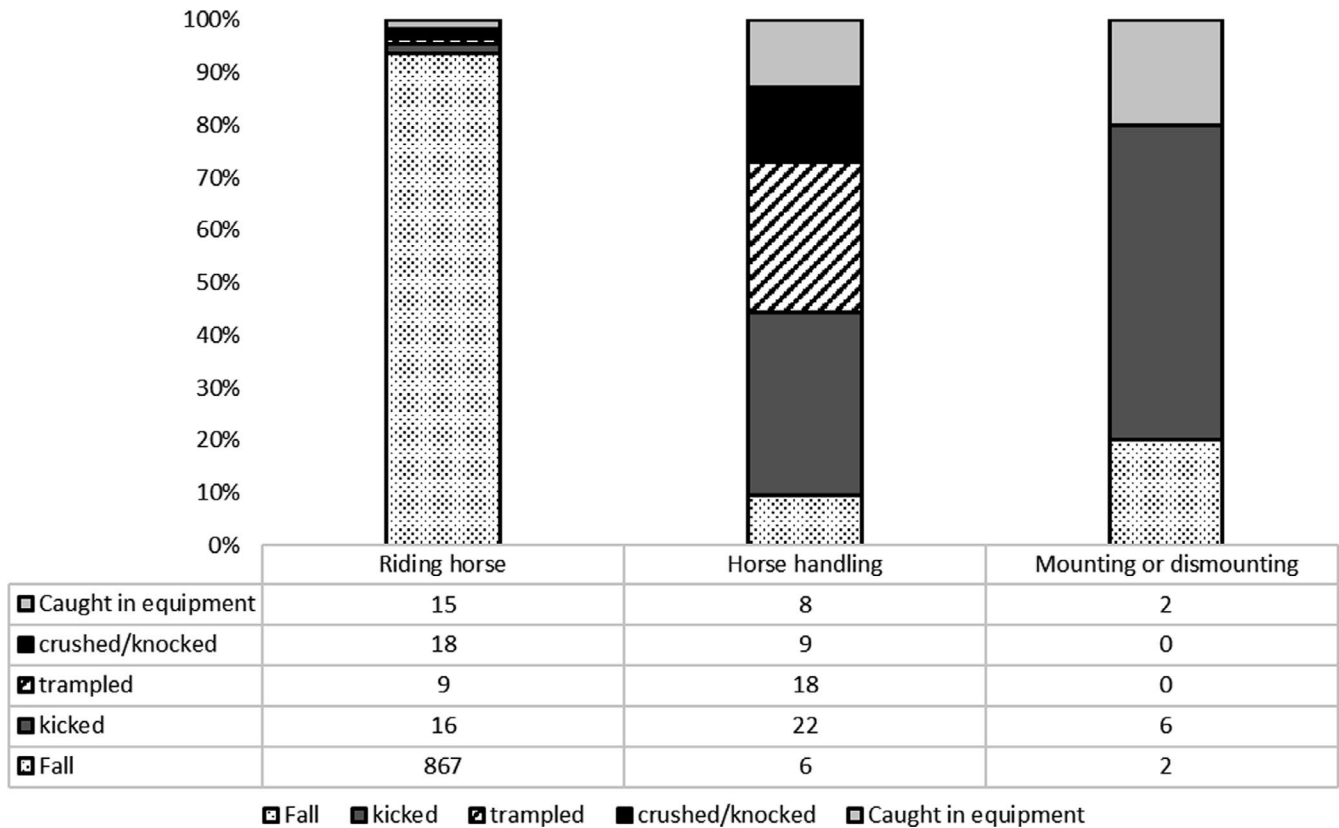


FIGURE 4 Proportion of incident types leading to injury by activity

found previously, however, that males are more likely to suffer hospitalized, higher severity injuries than females,¹³ so it could be concluded that the higher risk of females to be injured is more likely due to longer riding times for females or different activities performed by males and females, leading to different risk and severity of injury. Additionally, it is worth noting that the male riders were older than the females. As age may be linked to more experience and more experience is linked to lower odds of injury, this may partially explain the lower risk of injury for males. This finding needs to be further explored for proper interpretation.

This study also confirmed that younger age-groups were more frequently involved in equestrian incidents than older age-groups, and the highest injury incidence was not only found in riders aged 21-40 years (RR = 8.83) but also 41+ year-olds (RR = 7.33). Similarly, a study by Smartt and Chalmers¹⁴ found that the oldest age-groups displayed a high injury incidence, indicating that while most injured riders are younger, older riders also have a high risk of injury. The increased risk of injury seen in the higher age-group is likely related to increased fragility with increased age¹⁵ and is consistent with previous findings that increased age is associated with higher likelihood of injury,¹⁶ serious injury,¹³ and fatality.¹

Differences in the type of injuries suffered by younger and older riders were also observed. Younger riders tended

to have higher proportion of injuries to the head/neck and upper limbs, whereas older riders displayed higher proportions of trunk/back and lower limb injuries. Older riders suffered a higher percentage of fractures than the younger riders, whereas younger riders displayed concussions more frequently than the older riders. Increased likelihood of fractures in older age-groups has been seen in previous studies and that older have a tendency of getting a fracture could probably be a consequence of osteoporosis.¹⁷ Similarly, it has been previously found that younger participants of sports more frequently suffer concussions.¹⁸ Unfortunately, the age-group categorization was predefined and the size of the age-ranges was different for the different age-groups. Therefore, the data may be skewed to older riders and should be noted in interpretation of the results. An interesting follow-up study could utilize binary logistic regression to examine associations with injured riders. Further information would need to be obtained on the members; however, as currently only age and gender are available.

Of the 152 069 registered equestrians, there was total of 907 equestrians who reported to Folksam following an injury, with one fatality. This resulted in an overall injury incidence of 5.97 injuries per 1000 registered athletes. This injury incidence was considerably smaller than the reported injury incidence claims rate in New Zealand of 28.6 claims per 1000 participants.⁸ However, the claims rate from New Zealand

TABLE 2 Body region injured by age, gender, incident type and activity

Category	Body region n(%)					Total	Pearson's chi-square
	Head/neck	Upper limb	Trunk/back	Lower limb	Unknown/other		
Age							
7-12	65 (46.4)	52 (37.1)	12 (8.6)	10 (7.1)	1 (0.7)	140	<0.0005*
13-20	138 (4.62)	68 (22.7)	42 (14)	39 (12.7)	13 (4.3)	299	
21-40	112 (34.1)	64 (19.5)	68 (20.7)	80 (24.4)	4 (1.2)	328	
41+	97 (26.6)	69 (19)	106 (29.1)	87 (23.9)	5 (1.4)	364	
Gender							
Male	10 (27)	6 (16.2)	12 (32.4)	9 (24.3)	0 (0)	37	0.181
Female	402 (36.7)	247 (22.6)	216 (19.7)	207 (18.9)	23 (2.1)	1095	
Incident type							
Fall	340 (38.5)	192 (21.8)	191 (21.7)	141 (16)	18 (2)	882	<0.0005*
Kick	19 (36.5)	5 (9.6)	11 (21.2)	16 (30.8)	1 (1.9)	52	
Trample	5 (15.2)	6 (18.2)	2 (6.1)	20 (60.6)	0 (0)	33	
Crushed/knocked	14 (50)	7 (25)	3 (10.7)	4 (14.3)	0 (0)	28	
Caught in equipment	4 (16)	11 (44)	2 (8)	8 (32)	0 (0)	25	
Unknown/other	30 (26.8)	32 (28.6)	19 (17)	27 (24.1)	4 (3.6)	112	
Activity							
Riding horse	370 (37.9)	209 (21.4)	202 (20.7)	175 (17.9)	19 (1.9)	975	0.011*
Horse handling	22 (29.3)	25 (33.3)	10 (13.3)	17 (22.7)	1 (1.3)	75	
Mounting/dismounting	0 (0)	3 (27.3)	5 (45.5)	2 (18.2)	1 (9.1)	11	
Unknown/other	20 (28.2)	16 (22.5)	11 (15.5)	22 (31)	2 (2.8)	71	

* $P < .05$.

was reported in the context of insurance claims in adventure tourism and hence involves likely a large sample of inexperienced riders.

When compared to previous investigations of other sports injuries in the Folksam database, the injury incidence for equestrians was 17th out of 35 sports, just higher than power-boating (5.6 per 1000 athletes) and basketball (5.5 per 1000 athletes) but lower than triathlon (6.2 per 1000 athletes) and water-skiing (8.5 per 1000 athletes), placing equestrian injuries in the top 50% of insurance claim rates. Other sports with a lower injury incidence were Taekwondo (4.9 per 1000 athletes), automobile sports (4.5 per 1000 athletes) and weight lifting (3.1 per 1000 athletes). However, the previous study was based on only competition licensed athletes and several years of injury data were included. In the present study all members, including beginner to competition riders were included with only one year of data available. In our study, out of the 22 000 riders who held a competition license, only five (0.6%) of were injured, all of which were female and younger than 40, so it did not allow us to perform thorough analysis and determine injury incidence for competition licensed riders. To establish a comparable injury incidence, a number of

further studies need to be conducted. It does appear, however, that competition riders were less frequently involved in injurious horse-related incidents, and this could be connected to an increased level of riding proficiency or experience in horse handling. This reflects previous investigations which have found increased involvement in horse-related injury events¹⁶ and injurious falls¹⁹ for less-experienced riders.

A recent study using national hospital discharge data, the Patient Accident Register (PAR), and the cause of death register (DOR) administrated by the National Board of Health and Welfare found that nationally in Sweden, there was on average three fatalities and 1756 injuries per year which was greater than the figures reported in the current investigation; however, this study included all equestrian activities not just licensed riders.¹ The insurance database was limited to only those who were members of the Swedish Equestrian Federation and therefore represented a limited sample of equestrian incidents which comprises only 43% of the total number of horses, reported in 2016 to be 355 500.²⁰ This is not a direct comparison to the number of individuals who are in contact with horses every year, but it is likely that the number of registered horse riders is small compared with

TABLE 3 Type of injury by age, gender, incident type and activity

Category	Injury type n(%)						Total	Pearson's chi-square
	Muscle sprain/strain	Fracture/dislocation	Soft-tissue injury	Concussion	Other/unknown			
Age								
7-12	2 (1.4)	51 (36.4)	47 (33.6)	36 (25.7)	4 (2.9)	140	<0.0005*	
13-20	13 (4.4)	82 (27.4)	126 (42.1)	62 (20.7)	16 (5.4)	299		
21-40	7 (2.1)	107 (52.6)	145 (44.2)	57 (17.4)	12 (3.7)	328		
41+	7 (1.3)	174 (47.7)	123 (33.7)	41 (11.2)	20 (5.5)	365		
Gender								
Male	1 (2.7)	14 (37.8)	15 (40.5)	6 (16.2)	1 (2.7)	37	0.997	
Female	28 (2.6)	401 (36.6)	426 (38.6)	190 (17.4)	50 (4.6)	1095		
Incident type								
Fall	27 (3.1)	315 (35.7)	343 (38.9)	164 (18.6)	33 (3.7)	882	0.035*	
Kick	0 (0)	22 (42.3)	21 (40.4)	6 (11.5)	3 (5.8)	52		
Trample	0 (0)	14 (42.4)	16 (48.5)	3 (9.1)	0 (0)	33		
Crushed/knocked	0 (0)	10 (35.7)	14 (50)	2 (7.1)	2 (7.1)	28		
Caught in equipment	0 (0)	16 (64)	5 (20)	1 (4)	3 (12)	25		
Unknown	5 (5)	30 (30.9)	36 (37.1)	18 (18.6)	8 (8.2)	97		
Other	0 (0)	8 (53.3)	3 (20)	2 (13.3)	2 (13.3)	15		
Activity								
Riding horse	27 (2.8)	347 (35.6)	384 (39.4)	180 (18.5)	37 (3.8)	975	0.010*	
Horse handling	1 (1.3)	36 (48)	29 (38.7)	4 (5.3)	5 (6.7)	75		
Mounting/dismounting	0 (0)	7 (63.6)	2 (18.2)	0 (0)	2 (18.2)	11		
Unknown/other	1 (1.4)	25 (35.2)	26 (36.6)	12 (16.9)	7 (9.9)	71		

* $P < .05$.

the total number of individuals in some contact with a horse every year. Despite this, the injured rider populations found in both investigations were similar, with the PAR data showing 89.6% females and an average age of 26.8 years, compared with the current investigations 96.9% females and average age of 30 years. Additionally, in both datasets, the head was the most frequently injured region, followed by the upper limbs. This indicates that the Folksam dataset is representative of national injury statistics. However, in the present study the most commonly occurring injuries were soft-tissue (39%), closely followed by fractures (36.7%). In the national data, there was a higher number of fractures (40.5%) compared with soft-tissue injuries (24.4%). In this case, the Folksam injury data more closely match with an investigation of equestrian injuries in Skaraborg, Sweden, where not only hospital data but also medical center and dentist visits were included.²¹ This is indicative of the lower severity injuries included in these datasets, which are perhaps more representative of the entire pattern of equestrian injuries than when a hospital dataset is examined alone.

Falls were the most commonly occurring incident type and incidents most frequently occurred while riding the horse, and hence, it is an important focus area for injury prevention, particularly as those with multiple claims were even more commonly engaged in these activities. Matching the horse and rider and ensuring adequate horsemanship skills for different riding types is necessary to help prevent these incidents.

Tests of independence revealed that injury type and location is independent to the type of incident and activity, indicating that different protective measures may be necessary during different tasks. For example, fractures to the upper limbs were common in horse-handling incidents, when the equestrian got caught in the equipment. Some fracture protection to the hands can be designed for use during horse-handling activities and established procedures for appropriately handling the horse should be educated and enforced. Foot protection can be provided as a countermeasure to lower limb injuries resulting from being trampled by the horse. While it is true that protective clothing and appropriate horse-handling procedures have been developed and are enforced at riding establishments such as the Swedish Equestrian Federation events, the result of this study suggests that even when riding and following the rules of a riding establishment, injuries are still frequently observed. This indicates that improvements to existing measures are needed and should be designed specifically to countermeasure frequently observed incident scenarios. For example, footwear can be designed with added protection along the top of the foot to counter the weight of the horse if it were to step on the rider's foot. A high percentage of kick injuries were seen while the rider was mounting and dismounting, and the exact type of injury and cause of these injuries needs to be

further investigated to understand what prevention measures are required.

Additionally, fractures to the head were common as a result from being kicked while performing horse-handling activities, indicating that head protection should be provided during these activities, which was similarly found in Meredith et al.²¹ During Swedish Equestrian Federation events, riders are required to wear a helmet during riding activities, and an increasing number of places recommend wearing a helmet while on the ground. This should be further encouraged and enforced. The protective effects of equestrian helmets for head and facial injuries have been confirmed.¹⁶ However, in the present study, head and neck injuries stand for 36.4% of all injuries and it could therefore be argued that the helmets are not efficient enough. Several studies have stated that helmets protective effect has to be improved and should be designed specifically for the softer ground and impact surfaces typically seen in falls from horseback.²¹⁻²³ Additionally, one most important preventive measure is that all riders in practice follow established procedures and that it is ensured that riders have the experience and skill required for horses and activities of different types.

5 | PERSPECTIVE

This is the first manuscript of its kind, using Swedish insurance data to look at the national picture of injuries to equestrians. This work was also unique as exposure data were available for examining the risk and the injury incidence for different age-groups and genders nationally in Sweden. This information can be used to help inform developments of safety equipment within Sweden and as such, reduce the toll of equestrian injuries. The findings suggest that both young and old riders deserve attention and that different safety should be provided for different activities.

6 | CONCLUSIONS

Each sport carries its own individual risk of injury and differing patterns of injury. However, based on the findings of these investigations, it appears that equestrian incidents are among those which should be priority areas for future developments and regulation of protective measures. This study found that age and gender are not independent from occurrence of injury event, injured body region, and injury type. The most commonly occurring types of injuries were soft-tissue injuries (39%), closely followed by fractures (36.7%) and concussions (17.3%). The most common injured body region was the head/neck (36.4%). Injury prevention methods should be directed toward females, and protection of different body regions should be targeted for different incident scenarios.

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