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Injury History in the Collegiate Equestrian Athlete: Part II; Upper and Lower Extremity Injuries

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Purpose: Equestrian sports are known to have a high risk and rate of injury. While there is injury data available on acute injuries in the equestrian population, it is of a general nature. Within that data appears to be a lack of information on the collegiate equestrian athlete. Thus, the purpose of the current study and this analysis is to describe the incidence of upper and lower extremity injuries and head injuries, sans concussion, in intercollegiate equestrian athlete. **Method:** A survey was developed with input from each author and implemented in Mach forms. It was sent to 43 equestrian coaches in the Eastern United States who passed it on to their athletes. We estimated 753 athletes would have access to the survey and had a total of 73 respondents. Descriptive statistics were calculated for total number of injuries for each injury category. **Results:** Detailed injury information on the upper and lower extremity and head is found in tables 1-10. The upper and lower extremity and head accounted for 15.97, 60.35 and 4.33 percent respectively of the injuries in this group of athletes. **Conclusions and Recommendations:** The current study is amongst the first, if not the first, to report specifically on injury patterns and frequency in US collegiate equestrian athletes. The data indicate that there is an extremely high incidence of injury in the collegiate equestrian population. The lower extremity is particularly susceptible to injury in the equestrian athletes. The lack of data available in a sport, which can be classified as collision and has the potential for significant, long-standing disability from an early age due to interaction with the horse, is troubling. Significantly more sport specific research is needed to improve the health and safety of these athletes. **Key Words:** *Equestrian Injury, Extremity Injury.*

INTRODUCTION

Unlike collegiate equestrian sports, the high risk, rate, and scope of injury in non-collegiate equestrianism is well reported.[1,2,3,4] Silver reported “horse-riders can expect a serious accident once in every 350 hours of participation, which is twenty times more dangerous than motor cycling.”[1] The head was the most commonly injured body part amongst riders 19-49, with upper extremity fractures just ahead of concussion (16.6 vs. 15.2%) in riders’ age 0-18.[5] High incidences of orthopedic injuries have been reported in several populations of riders less than 25 years of age. In a retrospective review of hospital emergency room records for patients age 0-18, 31% of equestrian injuries were coded “orthopedic” and orthopedic injury accounted for the largest number of admissions (34%) and procedures (19/164).[6] In a population of Swiss adolescents age 10-19, 30% of all injuries reported over a 10-year time frame were orthopedic in nature.[7] Case studies found in the literature for equestrian athletes include adductor rupture, bilateral GH dislocation and cervical fracture.[8,9,10]

Much of the above referenced data is reported in the National Electronic Injury Surveillance System (NEISS), which collects information under eight general categories. This data can be requested on a yearly basis from the Consumer Products Safety Commission. The lead author has accumulated data from 1997 to 2015 from which data for comparison is compiled.[11] The NEISS data does not identify specific upper and lower extremity orthopedic injury data (e.g. ACL sprain), however, general information on fractures, strains, sprains, and dislocations is available.

Between 1997 and 2015, 45% of all injuries were from the categories of fracture, dislocation, and strain/sprain.[11] During the same time span, 20.07%, 29.07% and 16.68% of all injuries were to the head, upper, and lower extremity, respectively in the NEISS data.[11] For ages 15-24, 4.7% of injuries were to the head, 5.06% were to the upper extremity (shoulder, elbow, lower arm, wrist, upper arm, hand) and 3.86 % were to the lower extremity (knee, lower leg, ankle, foot, upper leg). [11]

With regard to mechanism of injury (MOI), falling is the most commonly reported mechanism with manual labor related to the upkeep of the animal/facilities also contributing.[12,13] Kicks, head butting and biting have also been reported.[14,15]

While the literature reports general information regarding equestrian injuries, the number and type of injuries experienced by collegiate equestrian athletes in the United States is essentially unknown outside, presumably, the competing institution's medical/athletic training staffs. Thus, the purpose of this portion of our two-part study and analysis is to describe the incidence and types of upper and lower extremity and head injuries (sans concussion) in intercollegiate equestrian athletes.

METHODS

Collegiate Equestrian teams were identified from those listed on the NCAA and IHSA website. Head equestrian coaches from 43 eastern United States colleges were sent a form email letter describing the study. School size ranged from Division I to Division III. All riding disciplines were represented. In the event that the email address for the coach was deemed "undeliverable," individual coaches were contacted in order to ensure that all 43 schools received the study information.

Instrumentation

The primary investigators developed the survey instrument based upon current literature in the field of equestrian. An outside expert in the field of equestrian reviewed the survey instrument for appropriateness of the content, content validity and also provided feedback relative to the format of the questionnaire. An online survey instrument was developed in Mach Forms to gather demographic and injury data from the respondents. The electronic survey was developed and implemented in order to both reduce mailing costs and encourage participation in an uncomplicated manner. For injury history, the survey requested that respondents choose from one of the following categories: 0 injuries, 1 injury, 2 injuries, or more than 2 injuries. For hours of practice/week and years riding the respondents chose from 1-3, 4-6, 7-10, 11-14, 15-18, 22-25, and 25+. For other demographic data, such as style of riding and conditioning activities, respondents selected the appropriate choice(s). Consent was assumed upon voluntary completion and submission of the survey. Anonymity was assured to all participants. This investigation was approved by The College at Brockport's IRB.

The survey was distributed to a total of 43 equestrian teams. A total of 73 athletes completed the survey (women n=71, men=2, age = 20.3 years, weight=62.29kg, height=174.75 cm). It is difficult to arrive at an accurate response rate due to the fact that we did not have an accurate number of athletes on each of the 43 teams and we were unable to determine which coaches actually shared the survey with their team. All participants were identified as being a member of an intercollegiate equestrian team. Due to the small sample size, a residual output analysis was run. It indicated only three outliers, thus verifying sample robustness (f=4.69756E-05).

Data analysis was performed on Excel version 11.6.6 for Mac. Descriptive statistics were calculated for total number of injuries for each injury category.

RESULTS

Due to the volume of data, detailed injury data is presented in the specific charts while the most common responses are presented here. Athletes were asked, to the best of his/her abilities, to report all the injuries they had sustained in their riding career. The total number of injury responses reported was 507. The lower extremity, as a whole, had the most injuries; the upper extremity ranked third. Body areas with the highest number of responses were the ankles (99), knees (108) and hips (49)**.** Body areas with the lowest number of responses were the tibia/fibula (5), forearm (6) and humerus (1). Shoulder/humeral data is presented in **Table 1**. Rotator cuff pain was the most commonly reported shoulder injury and was reported by 23.29% of the respondents. The responses were divided essentially evenly between right and left shoulders. Right glenohumeral dislocations/subluxations were reported by 6.85% of respondents. Detailed elbow data is presented in **Table 2**. Only 10.96% of respondents reported an injury to the elbow. Detailed forearm injury data is presented in **Table 3.** Fractures to the forearm were reported by 8.22% of the respondents. Detailed wrist injury data is presented in **Table 4**. Fractures to the wrist were reported by 15.07% of the respondents, with 10.96% reporting one episode of fracture. Detailed hand injury data is presented in **Table 5**. One episode of hand fracture was reported by 8.22% of respondents.

Table 1: Shoulder/Humeral Injury (number and % of population)

L Shoulder	% Pop	R Shoulder	% Pop
Clavicle Fracture			
1 = 1	1.37	1 = 3	4.11
2 = 1	1.37	2 = 0	
>2 = 1		>2 = 0	
AC Joint Sprain			
1 = 0		1 = 3	4.11
2 = 2	2.74	2 = 0	
>2 = 0		>2 = 1	1.37
1 = 0		1 = 1	1.37
2= 0		2 = 0	
>2 = 0		>2 = 0	
Dislocation/ Subluxation			
1 = 1	1.37	1 = 4	5.48
2 = 0		2 = 1	1.37
>2 = 1	1.37	>2 = 0	
Bursitis			
1 = 1	1.37	1 = 1	1.37
2 = 1	1.37	2 = 0	
>2 = 0		>2 = 0	
Arthritis			
1 = 1	1.37	1 = 1	1.37
2 = 0		2 = 0	
>2 = 2	2.74	>2 = 1	2.74
Rotator Cuff			
1 = 4	5.48	1 = 6	8.22
2 = 3	4.11	2 = 2	2.74
>2 = 1	1.37	>2 = 1	1.37
Surgery			
1 = 1	1.37	1 = 0	
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Humeral Fracture			
1 = 1	1.37	1 = 0	
2 = 0		2 = 0	
>2 = 0		>2= 0	

Fractures and rotator cuff pain are the two most commonly reported injuries in the upper extremity. One fracture in the upper extremity was reported by 19.18% of the respondents, with the most common being wrist fractures (10.96%) and hand fractures (8.22%). Two fractures in the upper extremity were reported by 5.48% of the respondents with these occurring in the left wrist (2.74%) and the right hand (2.74%). The right side (n=20) has 20% more fractures than the left (n=16). Conditions such as bursitis and arthritis were not as commonly reported.

Table 2: Elbow Injury (number and % of population)

L Elbow	%Pop	R Elbow	%Pop
Surgery			
1 = 0		1 = 0	
2 = 1	2.74	2 = 0	
>2 = 0		>2 = 0	
Fracture			
1 = 2	2.74	1 = 1	1.37
2 = 1	1.37	2 = 0	
>2 = 0		>2 = 0	
Sprain			
1 = 1	1.37	1 = 0	
2 = 0		2 = 1	1.37
>2 = 0		>2 = 0	

Table 3: Forearm Injury (number and % of population)

L Forearm	%Pop	R Forearm	%Pop
Surgery			
1 = 0		1 = 0	
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Fracture			
1 = 2	2.74	1 = 3	4.11
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Radial Head FX			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	

Table 4: Wrist Injury (number and % population)

L Wrist	%Pop	R Wrist	%Pop
Surgery			
1 = 0		1 = 2	2.74
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Fracture			
1 = 2	2.74	1 = 6	8.22
2 = 2	2.74	2 = 0	
>2 = 0		>2 = 1	1.37

Table 5: Hand Injury (number and %population)

L Hand	%Pop	R Hand	%Pop
Surgery			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Fracture			
1 = 4	5.48	1 = 2	2.74
2 = 0		2 = 2	2.74
>2 = 0		>2 = 1	1.37

Detailed hip injury data is presented in **Table 6.** Left hip pain/impingement was reported by 20.55% of the respondents while right hip pain/impingement was reported by 21.92%. For both the left and right hip 9.59% reported one episode. For the left hip, 6.85% reported greater than two episodes of pain/impingement. For the right hip, 10.96% reported greater than two episodes of pain/impingement. Bilateral hip pain was reported by 13.69% of respondents.

Table 6: Hip Injury (number and % of population)

L Hip	%Pop	R Hip	%Pop
Pain/Impingement			
1 = 7	9.59	1 = 7	9.59
2 = 3	4.11	2=1	1.37
>2 = 5	6.85	>2=8	10.96
Surgery			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 1	1.37
Fracture			
1 = 1	1.37	1 = 0	
2 = 0		2 = 0	
>2 = 0		>2 = 1	1.37
Arthritis		**Arthritis**	
1 = 2	2.74	1 = 2	2.74
2 = 1	1.37	2 = 0	
>2 = 0		>2 = 1	1.37
Bursitis		**Bursitis**	
1 = 3	4.11	1 = 2	2.74
2 = 1	1.37	2 = 0	
>2 = 0		>2 = 2	2.74

Detailed knee injury data is presented in **Table 7**. In the knee, 9.59% and 8.22% reported one episode of left and right knee pain respectively; while, 26.03% and 24.66% of respondents reported greater than two episodes of knee pain in the left and right knee respectively. At least one incidence of bilateral knee pain was reported by 32.87% of respondents.

Table 7: Knee Injury (number and % of population)

L Knee	%Pop	R Knee	%Pop
Patella Fracture			
1 = 0		1 = 1	1.37
2 = 0		2 = 1	1.37
>2 = 0		>2=0	
Pain			
1 = 7	9.59	1 = 6	8.22
2 = 3	4.11	2 = 3	4.11
>2 = 19	26.03	>2 = 18	24.66
Bursitis			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Ligament Sprain (No ACL)			
1 = 3	4.11	1 = 6	8.22
2 = 0		2 = 3	4.11
>2 = 0		>2 = 1	1.37
ACL Sprain			
1 = 1	1.37	1 = 2	2.74
2 = 0		2 = 0	
>2 = 0		>2 = 0	
ACL Surgery			
1 = 1	1.37	1 = 2	2.74
2 = 0		2 = 0	
>2 = 0		>2 = 0	
PCL Sprain			
1 = 1	1.37	1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	
PCL Surgery			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Patella Dislocation/Sub.			
1 = 2	2.74	1 = 3	4.11
2 = 1	1.37	2 = 2	2.74
>2 = 1	1.37	>2 = 1	1.37

TABLE 7: CONTINUED

Arthritis			
1 = 1	1.37	1 = 2	2.74
2 = 1	1.37	2 = 1	1.37
>2 = 1	1.37	>2 = 1	1.37
Cartilage		**Cartilage**	
1 = 1	1.37	1 = 2	2.74
2 = 1	1.37	2 = 0	
>2 = 2	2.74	>2 = 1	1.37

Detailed ankle injury data is presented in **Table 8**. Right ankle sprains were reported by 28.77% of the respondents: one episode (17.81%), two episodes (4.11%), and greater than two episodes (6.85%). Left ankle sprains were reported by 17.81% of the respondents: one episode (6.85%), two episodes (4.11%), and greater than two episodes (6.85%). Right ankle pain was reported by 36.99% of the respondents: one episode (10.96%), two episodes (2.74%); greater than two episodes (23.29%). Left ankle pain was reported by 28.77% of the respondents: one episode (8.22%), two episodes (1.37%); greater than two episodes (19.18%). One episode of left ankle fracture was reported by 4.11% of the respondents. In the right ankle, 6.85%, 2.74% and 1.37% reported one, two and greater than two ankle fractures respectively.

Table 8: Ankle Injury (number and % of population)

L Ankle	%Pop	R Ankle	%Pop
Tib. /Fib. Fracture			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2= 1	1.37
Tib. /Fib. Surgery			
1 = 1	1.37	1 = 1	1.37
2 = 0		2 = 1	1.37
>2 = 0		>2 = 0	
Fracture		**Fracture**	
1 = 3	4.11	1 = 5	6.85
2 = 0		2 = 2	2.74
>2 = 0		>2 = 1	1.37

TABLE 8: CONTINUED

Sprain			
1 = 5	6.85	1 = 13	17.81
2 = 3	4.11	2 = 3	4.11
>2 = 5	6.85	>2 = 5	6.85
Pain			
1 = 6	8.22	1 = 8	10.96
2 = 1	1.37	2 = 2	2.74
>2 = 14	19.18	>2 = 17	23.29
Dislocation			
1 = 0		1 = 0	
2 = 0		2 = 1	1.37
>2 = 1	1.37	>2 = 0	
Surgery		**Surgery**	
1 = 0		1 = 2	2.74
2 = 0		2 = 0	
>2 = 1	1.37	>2 = 1	1.37

Detailed foot injury data is presented in **Table 9**. One fracture in the right was reported by 10.96% of respondents while 2.74% in the left foot. One episode of right and left foot pain was reported by 6.85% and 5.48% respectively. Greater than two episodes of foot pain was reported by 9.59% and 4.11% of respondents respectively.

Table 9: Foot Injury (number and % of population)

L Foot	%Pop	R Foot	%Pop
Pain			
1 = 4	5.48	1 = 5	6.85
2 = 1	1.37	2 = 2	2.74
>2 = 3	4.11	>2= 7	9.59
Surgery			
1 = 0		1 = 1	1.37
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Fracture			
1 = 2	2.74	1 = 8	10.96
2 = 0		2 = 0	
>2 = 0		>2 = 0	
Sprain			
1 = 4	5.48	1 = 4	5.48
2 = 0		2 = 1	1.37
>2 = 1	1.37	>2 = 1	1.37

Injury to the head (other than concussion) is reported in **Table 10**. Contusions to the head were reported by 16.44% of the respondents. Injury to the teeth was reported by 9.59% of the respondents. Jaw fracture was reported by 2.74% of the respondents.

Table 10: Head Injury (number and % of population)

Head	% Pop
Contusion	
1 = 5	5.48
2 = 3	4.11
>2 = 4	6.85
Skull Fracture	
1 = 0	
2 = 0	
>2 = 1	1.37
Jaw Fracture	
1 = 2	2.74
2 = 0	
>2 = 0	
Tooth/Teeth Injury	
1 = 5	6.85
2 = 2	2.74
>2 = 0	

DISCUSSION

Upper Extremity

Our data revealed a surprisingly low percentage of injuries to the upper extremity (15.97% of total injuries). It was hypothesized that a much larger percentage of overall injuries would be to the upper extremity due to the nature of falling from the horse. Our finding is in contrast to many other published reports examining upper vs lower extremity injuries including NEISS data showing that the percentage of upper extremity injuries almost doubles that of lower extremity injuries (30% vs 16%).[3] A review of studies in PubMed, EMBASE and Scopus databases found combined fracture rates for the upper extremity of 50.7% of total fractures vs. a 22.9% lower extremity fracture rate. Only two of the six studies reported greater lower than upper extremity fracture rates, excluding cranium, ear, nose and throat.[16] A review of Medline/Cochrane databases found one study reporting more lower vs. upper extremity injury and 3 greater UE vs. LE injuries. [17] Our almost 4:1 lower to upper body ratio is drastically different.

Injuries to the upper extremity can occur from several mechanisms associated with falling. The most common mechanism is when the hands strike the ground with the load transmitted up the forearm. It is interesting to note that while we separated out forearm from wrist fracture, the greater number of fractures was reported for the wrist vs. forearm. Only two athletes reported both wrist and forearm fractures. It appears that the equestrian athletes differentiated between a true wrist fracture and forearm fracture. The greater number of injuries occurring on the right side is not surprising and may be attributed to the fact that right-handedness dominates the population.

The extremely high number of athletes reporting shoulder pain is interesting and may have several explanations. Part of controlling the horse occurs via collection (control of the horse's head via the rein) with a posture where the shoulders are back, down and level with the elbows "loose" enough to minimize rein tension that would irritate the horse's mouth and lead to poor behavior. Should the rider become "stiff," the instructor often times instructs the rider to relax the shoulders, elbows and/or low back. This often results in a slouched/protracted posture, which is known to contribute to shoulder pathology.[18] Off horse, the work required to take care of the horse and barn is often high volume and repetitive in nature, with much of it spent in slouched and or bent and twisted postures.[12,13] The barn environment can also be hazardous due to the unpredictability of the horse, potential slip hazards, and tools that may cause injury.

Lower Extremity

Interestingly, 60.35% of all injuries reported were to the lower extremity. This figure is significantly higher than analysis of NEISS data from 2002-2004 noting 16% of all injuries occurred to the lower extremity.[3] Also interesting was our finding of essentially equally divided injuries reported between the right and left sides of the body.

In a review of primarily foot and ankle injuries, the most common traumatic mechanism of injuries cited in the literature were to the lower extremity where the foot hangs up in the stirrup causing a twist, the horse stepping on, falling on or kicking the athlete, and being thrown from (fall) or self-ejecting from the horse.[19]

Other research examines possible atraumatic contributions to lower extremity injury. It is generally perceived that a more stable rider is better able to maintain position and stay on the horse, thus minimizing the risk of injury due to falling. Yet, limited work investigating the complex interaction of the rider's lower extremity with the horse and riding technique exists. Work on jockey position demonstrated how the modern jockey position increased the dampening effect of forces transmitted to the rider, stabilizing the rider's center of mass.[20]

A novel study examining segment accelerations demonstrated that experienced show jumping athletes have smaller leg accelerations than novice athletes during a jumping task. They concluded that novice riders had a poor ability to maintain balance when absorbing the forces created during landing. In a practical sense, this could increase the risk of falling and hence injury.[21]

One of the most problematic teachings of riding is the concept of "heels down" or more accurately, persistent dorsi-flexion. This is accomplished through either active dorsi-flexion or passive stretching of the Gatroc/Soleus complex by "putting more weight in the heel". Only one study was found mentioning this posture, measuring only 7 degrees of dorsiflexion in his subjects.[22] Unfortunately, no comment was made if this was a heel below the horizontal (what the instructor is asking for) or tibia forward over a flat foot (traditional cavalry teaching). The only paper found discussing why this posture creates more potential for injury, through its effect on stability is by Pilato.[23]

Several factors can influence lower extremity atraumatic MOI. Barn boots are typically constructed with lighter materials with no reinforced toe piece, which afford less protection than a typical safety boot. Competition boots are made from stiffer materials, which provide support not unlike a lace up ankle brace. Work performed to care for the horse and indoor/outdoor practice surfaces must also be considered. Indoor practice arenas are often made of soft sand to minimize impact on the horse. While comfortable for the horse, the irregularities can make it difficult to find stable footing when walking or should the rider need to quickly dismount. Riders are taught to hold onto the reins to maintain some control of the horse when routinely dismounting. In an emergency or quick dismount, holding the reins vs. letting the horse go influences how the rider lands.

The width of the horse's barrel is an important consideration. When mounted, the rider is taught to maintain a foot position between 12-2, with 12 o'clock being "ideal". Maintaining the 12 o'clock position can require a multitude of compensations, which can influence injury. Getting the foot to the suggested 12 o'clock position can require supination and/or isolated tibial internal rotation. At the knee joint, internal tibial rotation increases contact forces on the medial side of the tibia. The high incidence of knee pathology and pain may also be attributed to factors such as a varus preload created by the roundness of the horse's barrel, a knee angle in the approximate area of maximal patella-femoral contact force, the necessary practice of several skills requiring full knee extension and/or the large vertical forces previously mentioned.[24,25]

The average healthy hip joint has adequate range of motion to accommodate for the influence of the horse. However, the critical factor in hip motion is the athlete's gender. While the male hip joint allows for more abduction/external rotation as the joint is flexed, the opposite is true for the female hip joint.[26] When the athlete comes out of the saddle to perform a skill such as in the posting trot, gallop or when the horse gets ready to jump, he/she ideally wants firm foot contact with the stirrup. The complex interaction between the shape of the horse's barrel and teaching of traditional use of the leg aid biases the hip into adduction and internal rotation. The female athlete then must abduct and externally rotate the hip to maximize the down pressure at the stirrup/foot interface. This would bias potential hip impingement toward the female athlete.

Of special note should be commentary by Andrew[27] who reports that, "In our study, multivariate analysis identified age and pattern of injury as significant predictors of a poor physical outcome at 12 months. When compared to isolated extremity fractures, multiple lower-extremity fractures had the greatest risk of a poor physical outcome. The poorer physical health outcomes for participants in equestrian sports are most likely related to participants being older than those participating in other sports. Although age was a significant predictor of outcome, the median age of those with a poor outcome was only 38.8 years." While our population is younger and of a very different sample, the number of bilateral symptoms and, in some, joint fractures at an early age can certainly precipitate the need for early surgical intervention to address pathology, leading to similar poor physical outcomes.

Head

Our finding of 4.33% of the responses involving the head (jaw/face/skull) is drastically lower than the NEISS historical average from 1997-2015 of 19.94%. We suspect the most likely causes of this difference are population size and the categories used for data collection; head contusion, skull/jaw fx, tooth/teeth injury vs. NEISS head; face, globe of the eye, mouth and ear.[11]

Although many head injuries are associated with falling, they may also be the result of other mechanisms.[14,28] When un-mounted, the head may make contact with some part of the barn structure or the horse can swing it's head or kick, making contact with some part of the athlete's head.

Isolated facial injuries, especially fractures, tend to occur when the athlete is un-mounted.[14,28] Orbital floor, jaw and zygomatic arch injuries occur in both mounted and un-mounted situations[14,29] Most of the facial injuries reported in another study were soft tissue (56%) with the others being bony. Of those, 58% resulted in fracture.[28]

Depending on the instructor's education and philosophy, riders are taught one or more situation specific types of dismounting and or landing techniques. However, to the best of our knowledge, the efficacy of each has not been studied. Also, during a fall, a foot can unexpectedly become stuck in the stirrup, increasing the risk of being stepped on or dragged should the rider fall.

Helmet use is constantly cited as a way to reduce injuries to the head. Injury to the skull is mitigated during competition through mandatory helmet use when the athlete is mounted. However, when un-mounted, helmet use is based on preference. Meredith reported only 35% of students wore a helmet when un-mounted.[29] This is perplexing as an un-mounted rider performing tasks around the horse increases the risk of being injured by the horse's head or hoof. Face shields or masks have proven effective in reducing facial injuries in bull riding and have been discussed as a way to reduce the risk of injuries to the front of the skull in traditional equestrian competitions.[30] However, this type of helmet has yet to find its way into traditional equestrian competitions, much less off-horse situations.

LIMITATIONS

As with part one of this analysis, the most significant consideration for this study is the fact that the injury data is self-reported by the athlete. It is possible that this methodology may lead to the potential for under-reporting of information and the possibility that not all of the injuries reported were actually diagnosed by a health care professional. Age specific information to compare with our population is limited, and what is available/reported is general in nature, making comparison to more popular, mainstream sports difficult.

CONCLUSIONS

To our knowledge, we are the first to report specific injuries to U.S. intercollegiate equestrian athletes. More importantly, this study begins to highlight the high incidence of injury experienced by collegiate equestrian athletes, particularly to the lower extremity.

In situations where athletes don't have access to athletic training services, the high injury profile can be used to justify athletic training support and/or break down barriers between coaches, athletes and athletic training staff. It appears that equestrian has the potential to produce significant, long-standing disability from an early age. The injury patterns identified here may be used as a starting point to begin the focus on conditioning and rehabilitation efforts for equestrian athletes. Significantly more sport specific research regarding injury patterns/frequency, athletic requirements and riding technique on stability is needed to improve the health and safety of these athletes. In addition, further research utilizing injury data that is diagnosed by a health care professional is encouraged.

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