UK Rider Reported Falls in a 12-month period: Circumstances & Consequences

Marlin, D.J.[1] and Williams, J.M.[2]

1: AnimalWeb Ltd, Cambridge, UK

2: Hartpury University, Gloucester, UK

Author for correspondence: David Marlin - dm@davidmarlin.co.uk

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Abstract

Anecdotally, horse-riding is a “dangerous sport”, often grouped with activities such as motorcycling, skiing, parachuting, bull-riding, and rugby. This opinion is increasingly supported by evidence from retrospective analysis of trauma centre admissions for equestrian related incidents (ERI’s), albeit from relatively low numbers. The most common approach to reducing severity of ERI’s has focussed on encouraging the wearing of riding helmets and to a lesser extent, air-jackets and or body-protectors. Horse riders in the UK were surveyed to ascertain their experience of falls while riding in the preceding 12 months. A total of 3757 responses were received with a subset of 1977 complete surveys analysed. The majority of respondents were female (97%, n= 1914). Falling off once in the last 12 months was most common (53.4%; n=1055); 24.2% (n=478) had fallen off twice, 11.4% (n=225) three times and 6.5% (n=129) more than 5 times. Respondents were asked to specify the activity they were undertaking when their last fall occurred; hacking/trail riding (25.9%; n=513), schooling on the flat (25.8%; n=511) and showjumping schooling (19.4%; n=384) were the three most common activities where falls took place. Horses changing direction rapidly (40.9%; n = 808) or rearing/bucking (23.8%; n = 470) were the most common reasons for rider falls, with most (73%; n = 1443) riders falling off the side of the horse. Riders were most likely in injure their back (51%; n = 1008), shoulders (39%; n = 771) or pelvis (37%; n = 731) when they fell off, but most injuries were self-rated as minor. Severe injuries as a result of a fall were more common when the riders’ head, back, shoulder or ankle was injured. A variety of factors appear to be involved in rider falls from horses, and many of these may be modifiable and hence preventable.

297 words

Keywords

Equestrian; accident; injury; horse; riding;

Introduction

Anecdotally, horse-riding is considered to be a “dangerous sport”, often grouped with activities such as motorcycling, skiing, parachuting, bull-riding, and rugby. Equestrianism is also engaged in by a relatively large proportion of the population. Statista estimated that in 2021, approximately 259,600 people participated in equestrian sports in England, with likely an even greater number undertaking non-competitive pleasure riding (Department, 2023). In the United States it is estimated that 1.6 million households own horses, with many more engaging in riding (Lord, 2019). According to the US National Electronic Injury Surveillance System (NEISS) in 2017 whilst the number of horse riding accidents was not in the top 10 most common causes of injury, horse riding had the highest percentage of incidents requiring hospitalisation at 14.6%; higher than ATV's, mopeds & minibikes (13.3%), Racquet sports (11.9%), Bicycles (8.8%) and Working out (7.3%) (Commission, 2017). This supports other observations that whilst the rate of overall injury from horse riding is low (2 events/1000 h exposure) compared with track and field (5.7/1000 h), American football (6.1/1000 h and wrestling (10.7/1000h), the risk of severe injury from horse riding is higher than that for American football, motorcycling and car racing (Lee and Steenberg, 2008; Smartt and Chalmers, 2009). It has been suggested that one in five riders will be injured due to a fall from a horse, resulting in severe head or torso injuries, resulting in attempts to reduce injury primarily focusing on low level risk controls, such as helmets to date (Chapman and Thompson, 2016).

In the State of Victoria, Australia, emergency department presentation and hospital admission rates for equestrians were reported to be 31.1 and 6.6 per 100,000 person-years, increasing by 28.8% and 47.6%, in 2002 to 2016, respectively (O'Connor *et al.*, 2018). Female riders and those aged between 10 and 14 years had the highest incidence rates. Fractures and head injuries were reported to be the most common injuries. Given that both hospital admissions and emergency department incidence rates “have increased over the last 14 years” the authors recommended “Refocusing on injury prevention countermeasures” with a “clear plan for implementation and evaluation of their effectiveness in reducing injury” (O'Connor *et al.*, 2018).

Similar results have been reported in other countries. Abdulkarim (2018) reported a total of 149 equestrian related injuries in a retrospective review of an Irish regional trauma centre in 2013; 58% of these occurring to female riders and mostly were associated with falling from a horse. Fractures and concussion were the most common injuries recorded and around 1 in 5 presentations required further treatment via hospital admission or were transferred to tertiary care (Abdulkarim *et al.*, 2018).

Another study focussing on 172 equestrian-related injuries (ERIs) in the State of Victoria, Australia, between 2003 and 2008 reported 3 (2%) deaths and 82 (48%) head injuries of which 39 (31%) occurred with the rider not wearing a riding helmet (Papachristos *et al.*, 2014). Of patients injured for more than 6 months, 38 (35%) still experienced moderate or severe pain or disability, 47 (50%) required longer than 6 months to recover and 40 (42%) returned to work/activity at a reduced capacity. The authors concluded that "The clinical and patient-reported outcomes of ERIs requiring hospital admission are poor. Persistent pain and disability are common, even up to 5 years post-injury in equestrians with many individuals requiring longer than 6 months to return to work and then often returning at a reduced capacity (Papachristos *et al.*, 2014). A further retrospective review of the trauma registry at a level 1 centre in Calgary, Canada (1995-2005) reported that 55% of respondents had "chronic physical difficulties" following their equestrian accident (Ball *et al.*, 2009). While Davies et al. (Davies *et al.*, 2023; Davies *et al.*, 2022) reported stable staff who had been injured often experience long term mental and physical health deficits due to the impact of their original injury.

A retrospective review of 231 equestrian related injury in a single unit trauma in Portland, Oregon, USA between 2001 to 2008, reported that 25% of patients required surgery with a mean length of stay of 5.5 days. The authors found that helmet use only occurred in 1 in 5 of the riders admitted and of the 172 patients not wearing a helmet while mounted, 38% received potentially preventable head injuries if they had been wearing a helmet when their accident occurred (Guyton *et al.*, 2013). Forty per cent of riders reported that poor environmental factors contributed to their accident, whilst 30% reported a poor horse and rider pairing, and 9% reported equipment failure as contributing factors. Overall, fifty-nine per cent reported long-term disabilities as a result of their accident with the authors concluding that "equestrian injury is costly, disabling, and frequently preventable" (Guyton *et al.*, 2013).

Preventing injury from horse falls

Riding hats or helmets and body protectors (hard foam thoracic jackets) and air jackets (jackets that inflate automatically if the rider falls from their horse) are designed to protect the rider's head and thorax, respectively, in the event of injury including falls. There is evidence from several studies that not wearing a suitable riding helmet increases the risk of injury. In a retrospective study in Germany, skull fractures were 6 times more likely if a helmet was not worn (Bilaniuk *et al.*, 2014). In addition, if a helmet was not worn, fractures were also considered more complex and intracranial haemorrhage

was more common. However, there is also conflicting evidence that in certain circumstances helmets may only reduce superficial injury (Carter and Richardson, 2023).

Wearing body protectors or an air jacket has become more common within the past 20 years and riders are required to wear them in certain equestrian activities such as eventing cross-country and racing. However, there is little evidence as to their effectiveness at reducing the risk or severity of injury whilst riding. A retrospective study of 1819 riders who fell whilst wearing an air jacket and 1486 who fell whilst not wearing an air jacket but wearing a body-protector during Fédération Equestre Internationale (FEI) eventing cross-country competition reported that air jacket usage was significantly associated with serious/fatal injuries in falls (Nylund *et al.*, 2019). Riders wearing an air jacket were 1.7 times more likely to sustain a serious or fatal injury in a fall compared to riders who were not wearing an air jacket (Nylund *et al.*, 2019). The reasons for this are not currently clear, but potentially wearing an air jacket may generate a false sense of security and safety during cross-country riding, resulting in increased risk taking amongst eventing riders.

Thus, clear evidence exists that horseback riding is a high-risk activity with the potential for severe or even fatal injury. As stated by others, whilst wearing suitable protective riding helmets may reduce the severity of head injuries, understanding the risk factors leading to falls from horses has received little attention to date, despite having the capacity to significantly reduce serious injury. We surveyed riders with the aim to understand when most falls from horses occurred, what factors riders felt contributed to falls and how the risk of injury and falling could be reduced.

Materials & Methods

Participants

Participants were recruited online via the sharing of a link to the survey onto social media (Facebook®) on selected UK equine-related or discipline-specific groups including but not limited to British Dressage, Endurance UK, Eventing UK, Horsepoo (regional) and via UK media outlets. The survey invitation was targeted as widely as possible to include amateur and professional riders, competing in either affiliated and unaffiliated competitions for or within para-equestrian sport in the UK who had experienced a fall within the past 12 months. Inclusion criteria required participants to be over 18 years of age. The survey was anonymous, and no personal data were collected although respondents could optionally provide an email address for entry into the prize draw. Participants were incentivised to take part through the chance to win one of three prizes.

Survey Design

The study was designed as an online questionnaire (Survey Monkey®, Momentive Europe UC, Shelbourne Rd, Ballsbridge, Dublin 4, Ireland). Questions recorded disciplines participated in, sex and age of participants, as well as frequency and causes of falls in last 12 months, stirrup type and size used, and involvement of stirrups within falls. The survey comprised 19 questions, of which 14 were closed questions, 4 were closed questions with “Other” option included and 1 open question. The draft survey was tested by 48 experienced users and edited to correct any errors before being fully deployed. Data related to stirrups is not included in this manuscript and will be published separately. In order to try to avoid selecting only respondents who had experienced falls, and therefore having this population over-represented, the survey was presented as a survey on stirrup safety. The survey was live for 30 days and 80% of the responses were obtained within the first 7 days.

Data analysis

Data were exported from Survey Monkey™ to Microsoft Excel™ Version 2010 (Redmond, WA, USA). Frequency analysis identified the demographic profile of respondents, the nature of equestrian activities and disciplines respondents engaged with, the number of falls respondents had experienced in the preceding 12 months, and the frequency of factors associated with falls.

Data met non-parametric assumptions therefore a series of Kruskal Wallis analyses identified if differences occurred in fall frequency between the most popular disciplines participated in (dressage, showjumping, eventing, and recreational/pleasure riding, rider age). For factors where significant differences were found, Mann Whitney U post-hoc tests identified how fall frequency differed between the disciplines. Median rankings for individual factors were examined to identify

the direction of differences between disciplines; where median values were the same, mean rank differences obtained from post hoc tests differentiated between disciplines. Significance was set at $p < 0.05$.

Results

Demographics

A total of 3757 responses were received and a subset of 1977 complete surveys where respondents had experienced at least one fall were taken forward to analysis. Most respondents were female (97%, n= 1914). Eighty-seven percent of the sample were aged between 18 and 55 years (Figure 1). The results of the survey are representative of the wider UK riding population with a margin of error of ±2% at the 95% confidence interval.

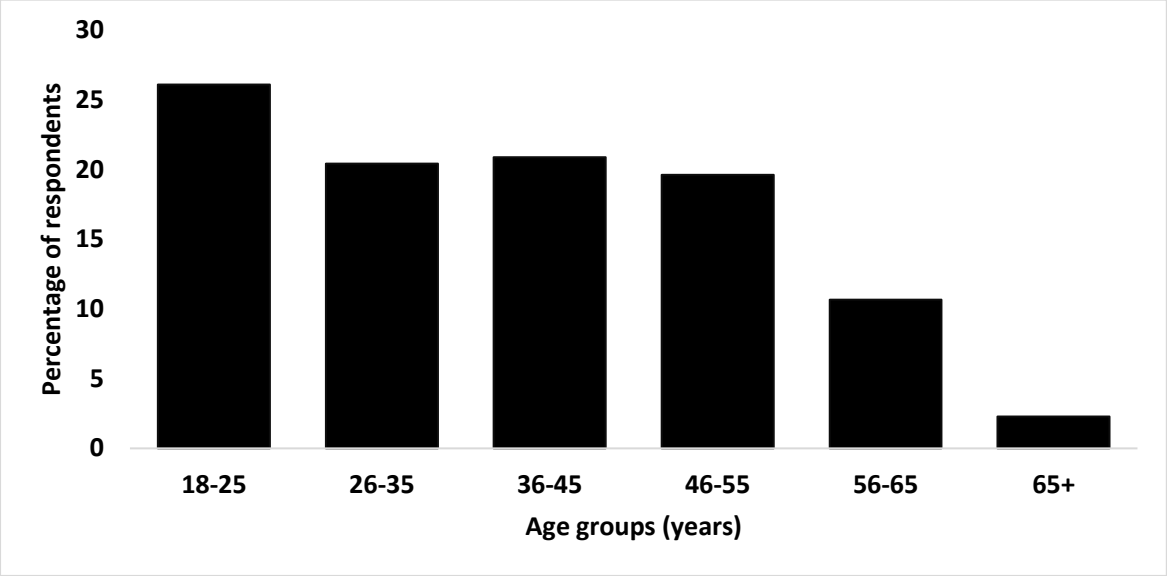


Figure 1: Respondent age range (n=1977)

Respondents were asked which three disciplines/activities they were mainly involved with; across the sample, pleasure riding, dressage and showjumping were the most engaged with (Figure 2). Most of the respondents regularly engaged in three disciplines (45%; n = 886), with 26% (n=522) and 29% (n=569) engaging in a single or two disciplines, respectively.

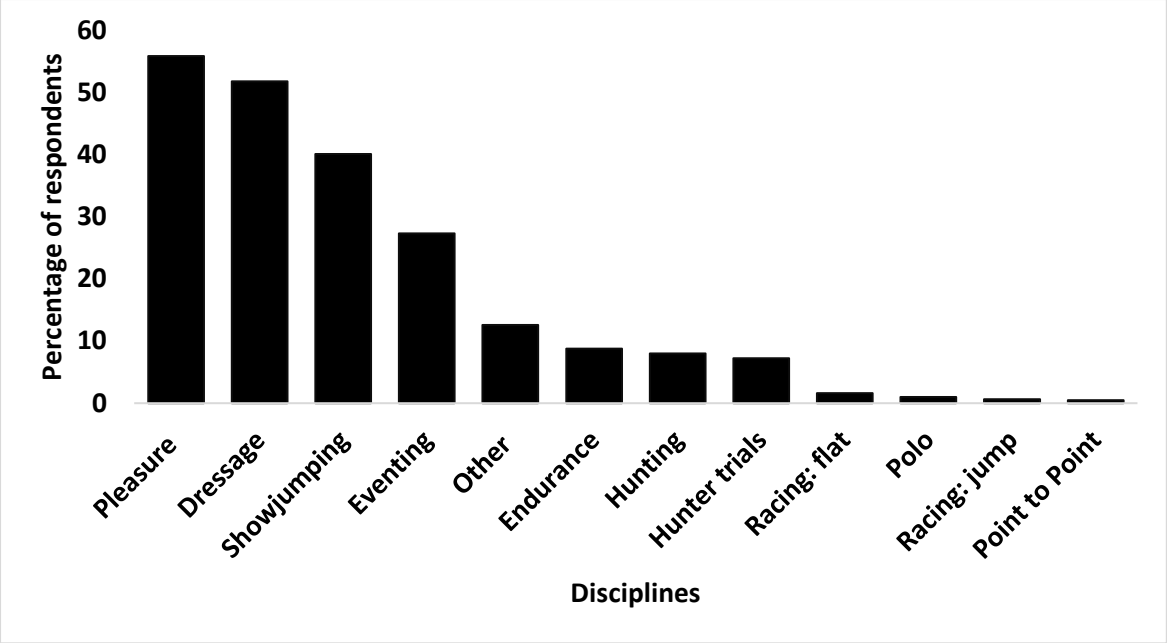


Figure 2: Disciplines respondents were mainly involved with; up to three activities/disciplines could be selected.

Falls

Falling off once in the last 12 months was most common, with just over half of the riders surveyed reporting this (53.4%; n=1055), 24.2% (n=478) had fallen off twice, 11.4% (n=225) three times, and a smaller number had fallen off four (4.6% (n=90)) or more than 5 times (6.5% (n=129)) (Figure 3). Approximately 42% of riders surveyed had fallen off in the last three months (October – December) with 3.6% falling off in the previous week (n=72), 13.7% (n=271) within the previous month and 24.9% (n=493) within the last 3 months. A further 24.8% (n=490) had fallen off between 3 and 6 months ago (July -September) and 32.9% (n=651) between 6 and 12 months ago (January – June). Only around 1 in 10 falls involving the rider resulted in the horse falling as well (11.9%; n=235).

Significant differences in the frequency of falls occurred across the most popular disciplines (Kruskal Wallis: $p = 0.0005$); with pleasure (median± Interquartile range (IQR): 1±1) and dressage (median± IQR: 1±1) riders reporting a significantly lower frequency of falls than showjumping (median± IQR: 2±2) and eventing riders (median± IQR: 2±2) overall ($P < 0.0005$). Showjumping (32.2%; n=255; $P < 0.0005$) and event (29.9%; n=161; $P < 0.0005$) riders were also 3 times more likely to fall off compared to pleasure (18.7%; n=206) and dressage (19.7%; n=202) riders (Figure 3). No significant differences in fall frequency occurred between showjumping and eventing riders.

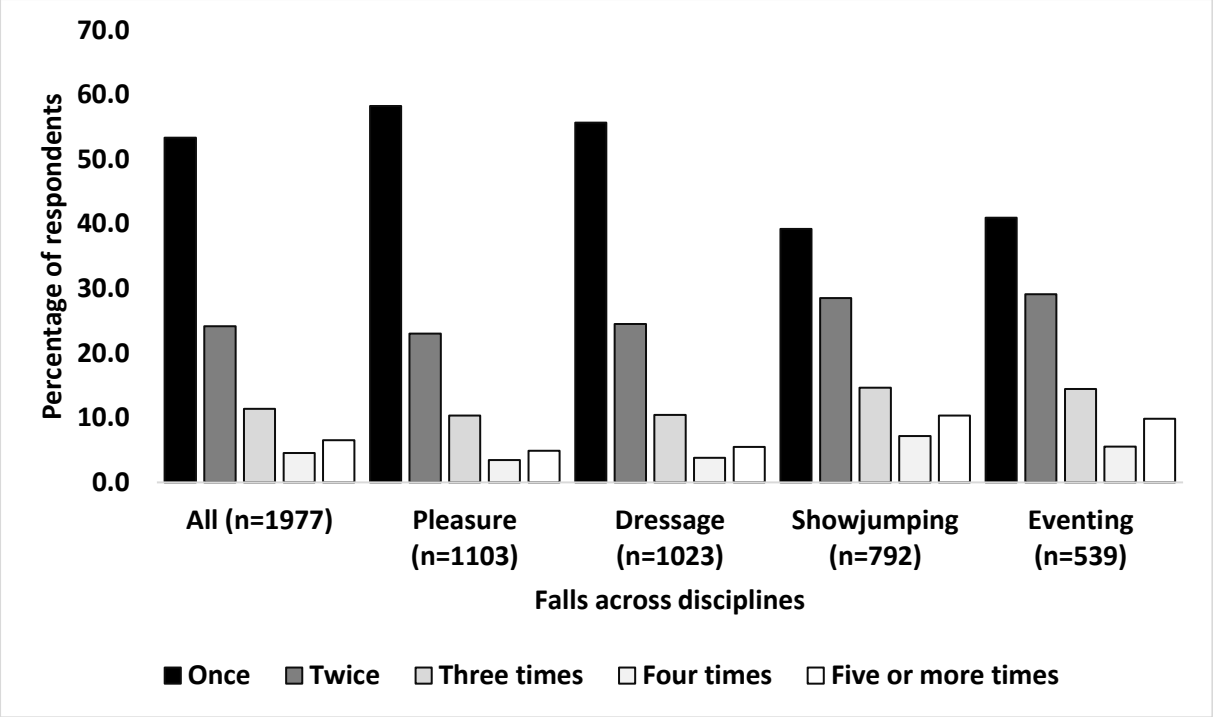


Figure 3: How many times respondents reported they had fallen off in the preceding 12-month period across all disciplines/activities and for the four most popular individual disciplines/activities.

Significant differences in fall frequency also occurred across rider age groups (Kruskal Wallis: $p < 0.001$). *Post hoc* analyses found older riders were less likely to experience multiple falls compared to riders in younger age groups. Riders aged over 65 years reported reduced falls compared to those aged 18- 25 years ($p = 0.003$). Riders aged 56 – 65 years reported reduced falls compared to those 36 to 45 years old ($p = 0.04$), 26 to 35 years old ($p < 0.001$) and 18 – 25 years old ($p < 0.001$). Riders aged 46 – 55 years reported reduced falls compared to those aged 26 to 35 years old ($p = 0.01$) and 18 – 25 years old ($p<0.001$). Riders aged 36-45 years reported reduced falls compared to those aged 25 -36 years ($p = 0.01$) and 18 – 25 years old ($P<0.001$); however, riders aged 25 -36 years experienced increased falls compared to 18 – 25-year-olds ($p < 0.001$).

How did falls occur?

Respondents were asked to specify the activity they were undertaking when their last fall occurred; hacking (25.9%; n=513), schooling on the flat (25.8%; n=511) and showjumping schooling (19.4%; n=384) were the three most common activities where falls reportedly took place (Figure 4). The three most common 'other' activities which resulted in a fall were when "riding/starting a young" horse, when "riding a racehorse" or at the "end of a ride when cooling down".

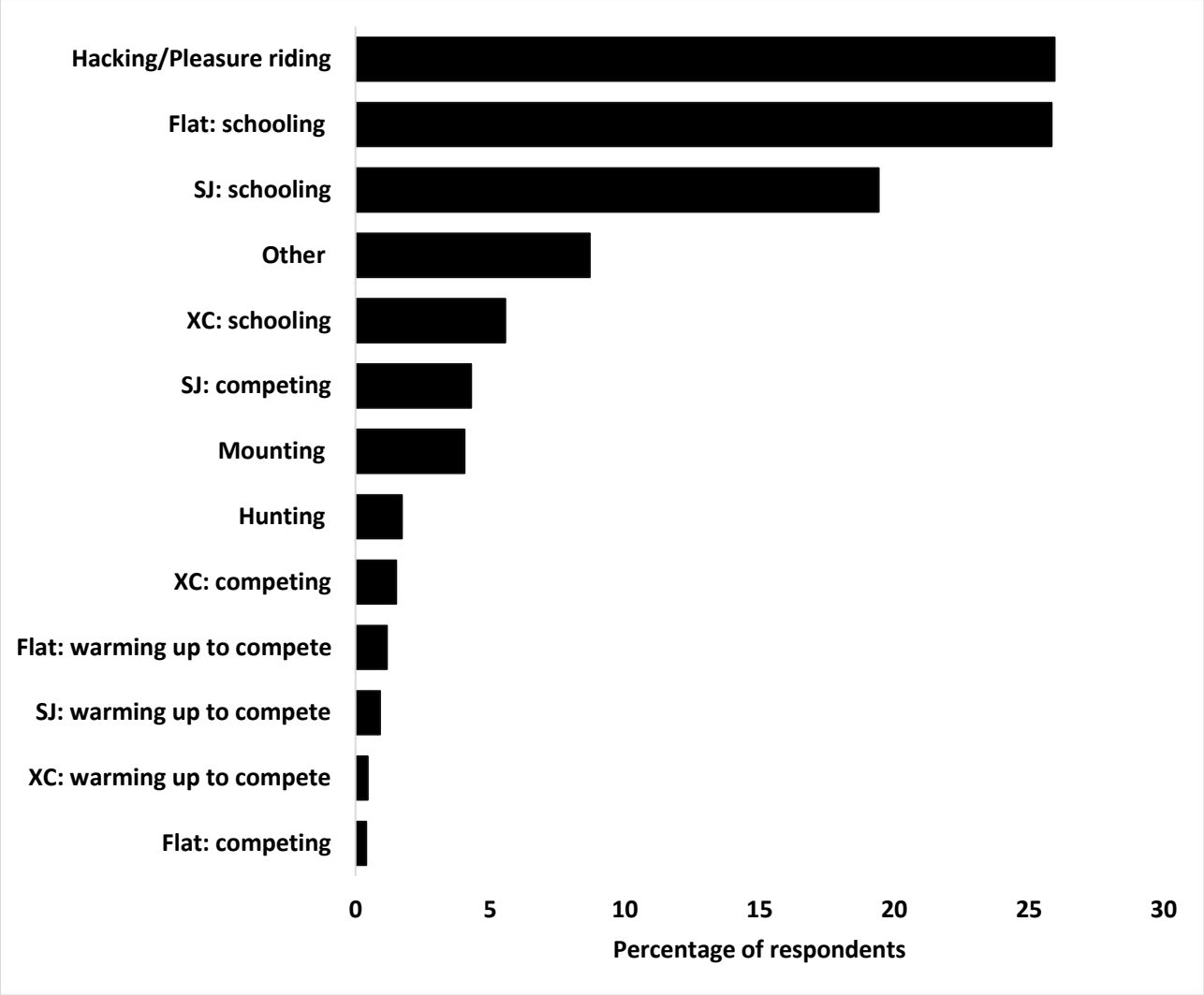
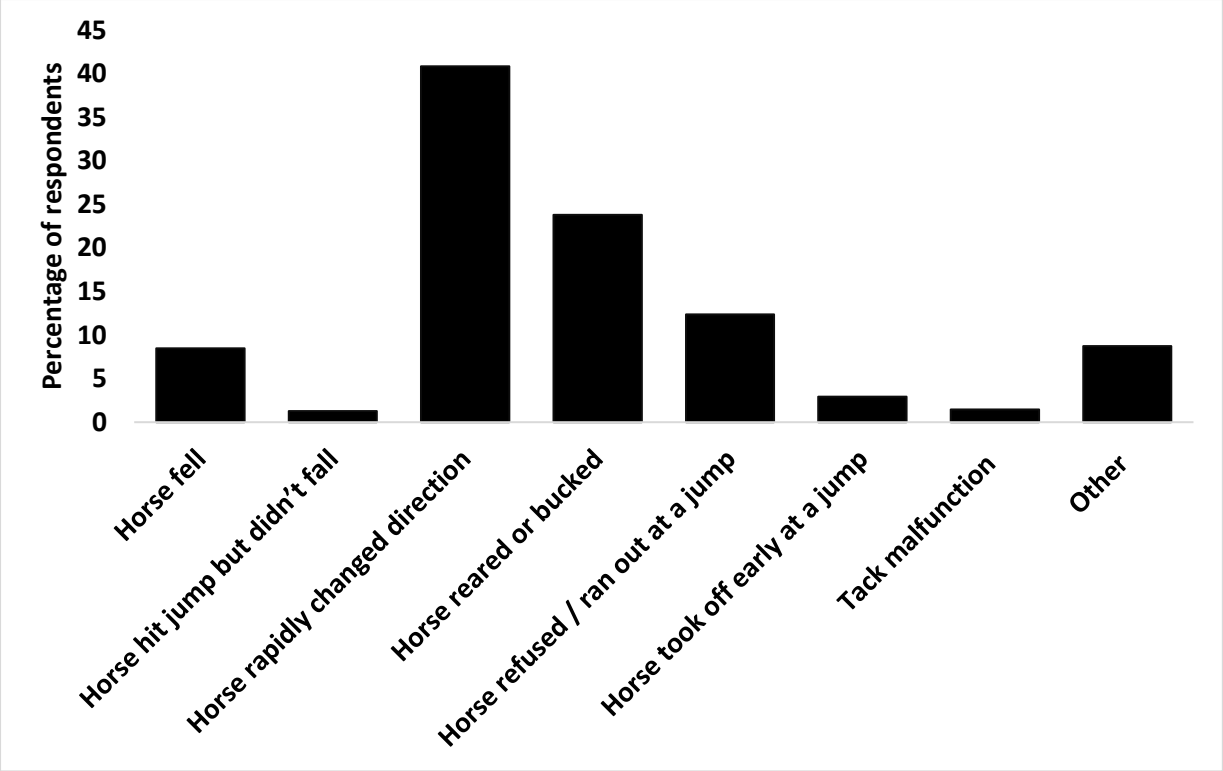


Figure 4: Activity being undertaken when respondents had their last fall (n=1977)

Horses changing direction rapidly or rearing or bucking where the main reasons riders reported which led to their last fall (Figure 5). Other reasons reported why riders fell off including their horse spooking un-expectedly, stumbling or taking a false step, being jumped 'out of the saddle' or the horse over jumping a jump, or falls related to the horse bolting.



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224 Figure 5: Respondent self-reported reasons for why they fell off for their last fall (n=1977)

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226 Most riders (73.0%; n=1443) came off the left or right-hand side of the horse when they fell off
227 (Figure 6), with more reporting falling from the left-hand side (39.6%; n=783) than the right-hand
228 side (33.4%; n=660).

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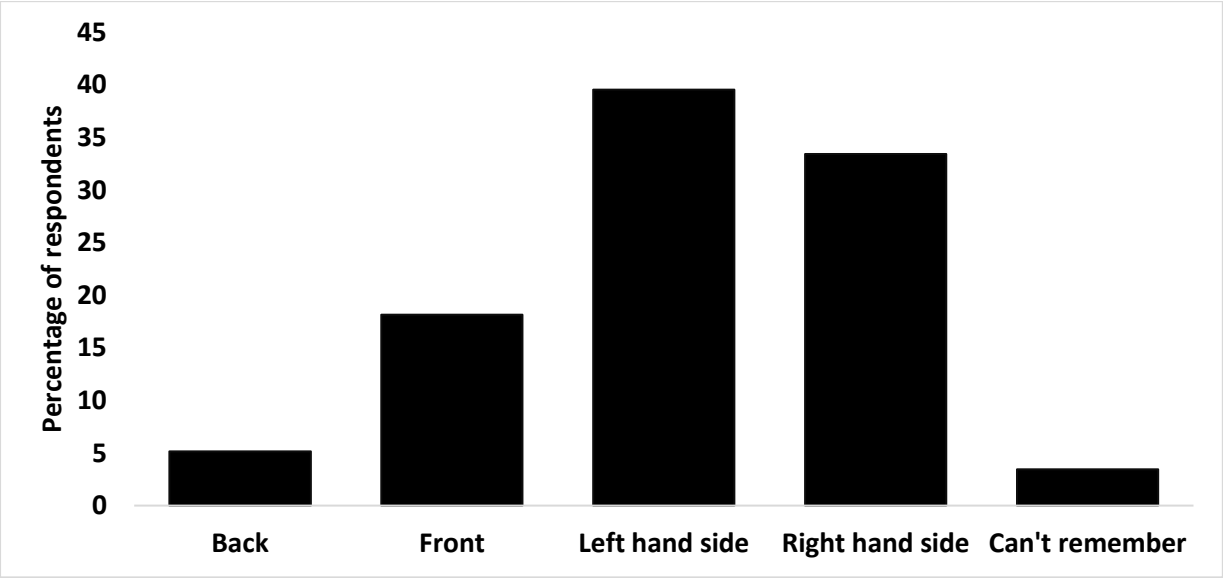

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231 Figure 6: Direction riders recalled falling off during last fall (n=1972)

Rider injuries as a result of last fall:

Injuries from respondents' last fall affected all areas of the body; the three most common areas to be injured were the riders' back (51.1%; n=1010), the shoulders (38.5%; n=761) and the pelvis (37.1%; n=734) (Figure 7). Most injuries were self-rated as "very slight" or "slight" (range: 67.1% - 92.0%), with "moderate" to "moderate-severe" injuries occurring mostly to the back (26.3%), pelvis (18.8%) and neck (18.3%), and "severe" to "very severe" injuries more commonly reported related to the head (6.6%), the back (6.5%), the shoulder (6.2%) and the ankle (6.2%) (Figure 8).

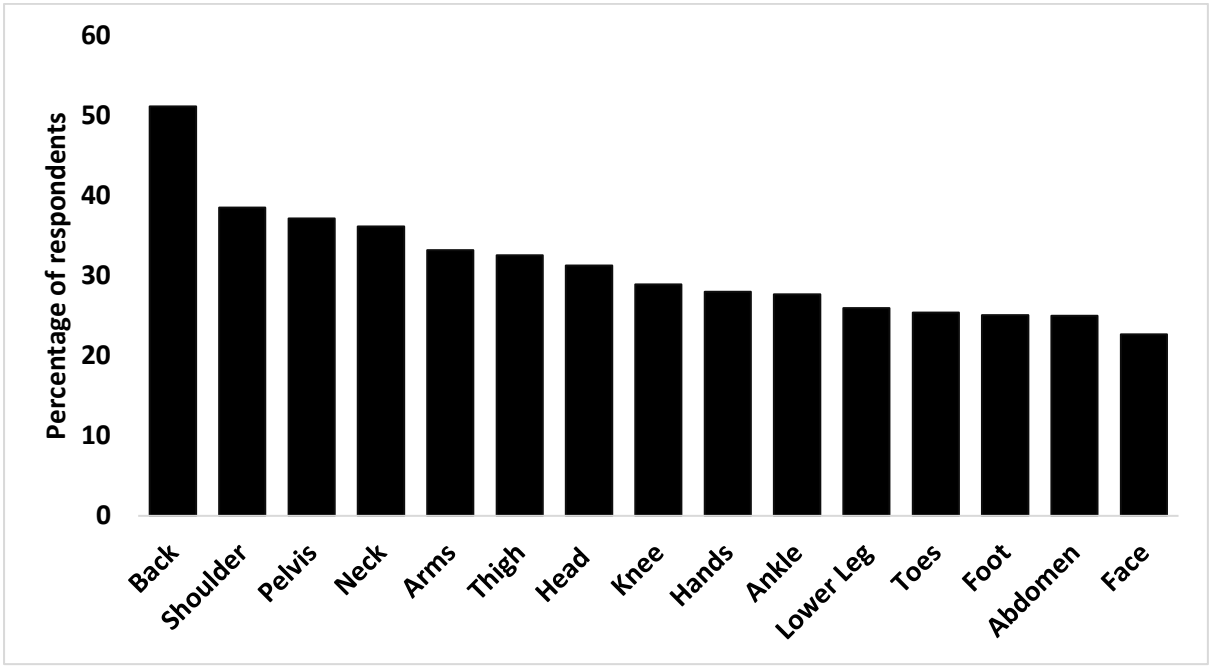

Figure 7: Areas injured across respondents during their last fall; note more than one area could be selected.

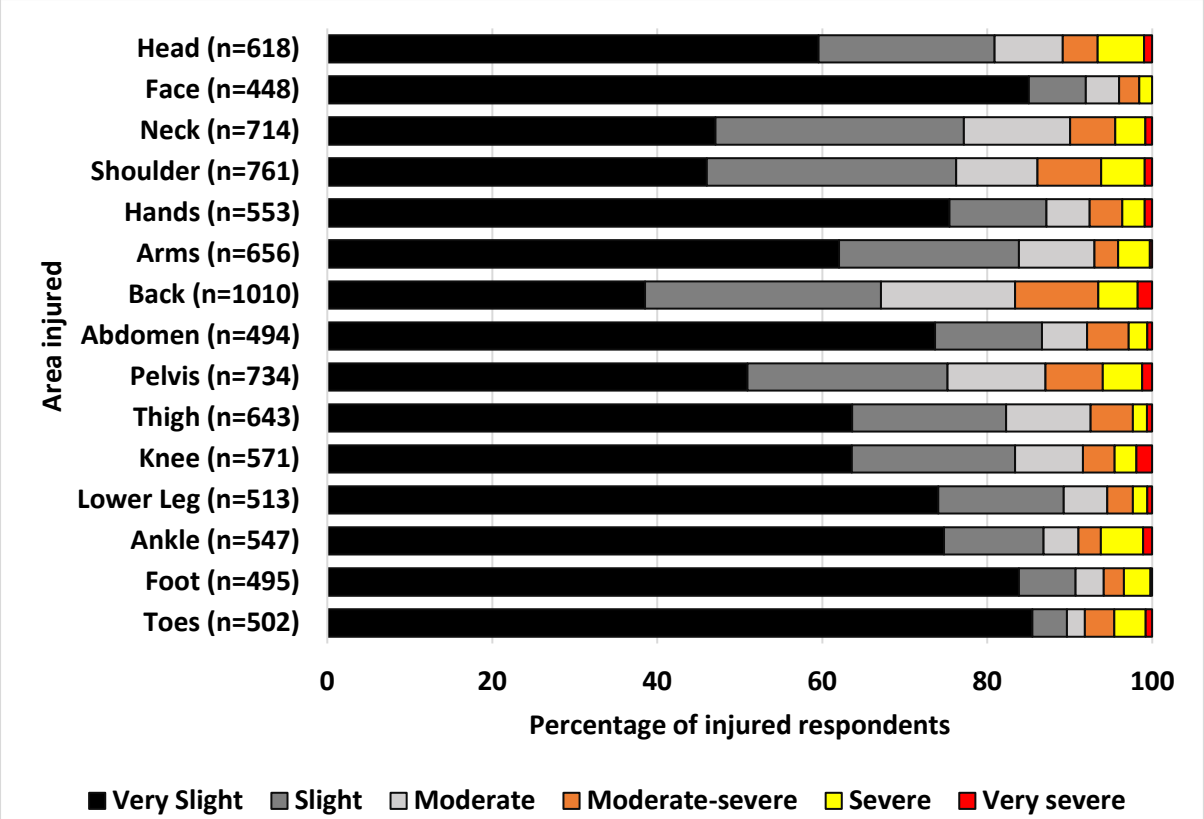

Figure 8: Respondent self-rating of the severity of injuries incurred during their last fall. Definitions: "Very slight": minor pain, no medical treatment, quick recovery; "Slight": minor-moderate pain, self-medicated, recovered in less than a week; "Moderate": moderate pain, recovery took longer than 7 days; "Moderate-Severe": moderate to severe pain, recovery took longer 1-4 weeks; "Severe": hospital A&E admission, recovered after several months; "Very severe": hospital A&E, not recovered.

Discussion

Limitations of the present study include the use of rider self-reported data. In order to attempt to provide as high as possible level of accuracy of recall, we asked respondents to only report events within the past 12 months. In addition, whilst we attempted to avoid biasing the survey towards riders who had fallen, it is conceivable that riders who had experienced falls are over-represented in the respondents.

We believe that this is the first large survey to be able to provide some degree of reliable insight into actual rates of ERI's within the UK equestrian rider population. It is perhaps somewhat alarming that over half the respondents had fallen off at least once within the past 12 months. In order to try to avoid selecting only respondents who had experienced severe falls, and therefore having this population over-represented, the survey was presented as a survey on stirrup safety. The highest frequency of reported falls was in October and December. This pattern may be related to superior recall or incentive to report rather than a time of year effect *per se*. Potential reasons for a true time of year effect could include decreased competitive events, lower fitness level of horses and or riders, decreased riding frequency and increased risk of adverse environmental factors (e.g., wind, storms, rain, soft ground, ice, frost, snow, decreased hours of daylight, etc). Interestingly, environmental factors were also noted as the most common self-reported cause of falls (40%) by Guyton et al. (2013).

Only 11% of falls here resulted in both the horse and the rider falling (i.e., both making contact with the ground), while rider falls were around 10 times more common. This may be due to a number of factors, including poor horse and rider matches, whichaccounted for 30% of falls in Guyton et al's (2013) study.) Rider factors including alack of proper assessment of risk, lack of concentration, lack of rtrength, slower reaction speed or balance, and or failure of riders to anticipate horse behaviour could also explain the increase in rider falls reported. Tack failure is another factor potentially increasing the risk of rider but not horse falls and has been previously been reported to be influential in 11% of falls by Guyton et al. (2013). Further work is needed to understand the aetiology of both horse and rider falls and to quantify how potential interventions could reduce risk.

Pleasure and dressage riders recorded significantly less falls than showjumping and event riders suggesting jumping may be associated with an increased fall risk, however hacking (26%), schooling on the flat (26%) and showjumping schooling (19%) were the three most common activities where falls occurred. Thus, the risk of falls, at least in this sample, appears to be higher in riders when not competing than when competing. This is potentially consistent with longer periods of time spent training at home as opposed to actually competing. Riders may also be inclined to adopt a higher

level of concentration when competing as opposed to when training. We did not ask respondents whether a coach/trainer was present when falls occurred; this could also be a potential influencing factor.

Horses changing direction rapidly (40.9%) or rearing or bucking (23.8%) were the most common reasons why riders felt they fell off, with most (73%) riders falling off the side of the horse, with around 18% more falls to the left then the right. This may partially reflect the fact that the majority of the population are right-handed/right-footed and the right side will therefore be stronger (Larsson, 2023). It could also represent an inherent motor laterality bias in the horse (Bystrom et al., 2020). The expression of conflict behaviours during riding are common and likely contribute to the dangers of horse riding (Luke, 2022). Such behaviours are often associated with a lack of established basic training (McLean, 2017), incorrect application of learning theory through incorrect application or timing of rein or leg aids from the rider resulting in confused signalling to the horse (Williams, 2017), or can be an external expression of pain (McGreevy, 2005) (Dyson, 2018). An increased frequency of conflict behaviours has been associated with reduced rideability in horses (Christensen, 2021) (König von Borstel, 2014); and for riders, horse behaviour is consistently rated an important component in the horse-human relationship (Górecka-Bruzda *et al.*, 2011) (Graf, 2013). The impact of individual riders on horse behaviour has also been noted by Christensen et al. (Christensen, 2021) who found different riders could induce different levels of discomfort in horses, likely due to variation in their experience, application of the aids, balance, handedness and personality; factors which could actively contribute to an increased risk of falls.

Additional extrinsic and intrinsic factors could also affect horse behaviour leading to an increased risk of falls. Shying and rearing behaviour in horses may be a response to environmental stimuli. Horses experience the world differently to humans; they have increased peripheral visual fields, a broader acoustic range hearing sounds of higher frequencies than humans, and an increased sensitivity to movement (Saslow, 2002). Therefore, it is likely that some of the instances reported where falls occurred as a result of sudden changes of direction, shying or rearing behaviour could be associated with environmental cues that the horse has responded to which the rider was not aware of or could not react quickly enough to. The presence of conflict behaviours and poor rideability have also been associated with the presence of musculoskeletal pain in the horse (Dyson, 2018). In instances where horse behaviour has resulted in rider falls, the possibility that the horse has reacted to pain should be investigated to safeguard both equine welfare and human safety.

Riders were most likely to injure their back (51%), shoulders (39%) or pelvis (37%) when they fell off, but most injuries were self-rated as minor. These reports will clearly represent a different population

to those observed at hospitals where the main serious injuries are head, spinal and orthopaedic trauma (Abdulkarim *et al.*, 2018) (Ball *et al.*, 2009) (Bilaniuk *et al.*, 2014) (Gates and Lin, 2020) (Guyton *et al.*, 2013) (O'Connor *et al.*, 2018). However, severe injuries as a result of falls were more common when the riders' head, back, shoulder or ankle were injured, and these are consistent with reports already in the literature.

The results of this large UK based survey suggest that falls occur commonly across all equestrian activities but appear to happen more frequently when hacking and/or schooling i.e., when riding at home as opposed to when competing, and also for horse and rider combinations who engage in showjumping and/or eventing. Future work should aim to understand why this is the case, as jumping was not reported as the most common cause of rider falls; the influence of horse management, training regimens, environment, tack, horse-rider pairing, rider fitness, rider concentration and breed should also be considered. Hacking and schooling at home may also be in circumstances when riders may perceive there is less risk of falling compared with for example competition, and thus, they may be less inclined to wear protective equipment such as helmets or body protectors. An awareness of this and encouraging riders to wear full protective equipment even when hacking/schooling at home may reduce the severity of potential injuries in the case of falls. However, it should be noted, that this survey did not associate individual falls with injuries; therefore, we are unable to identify the frequency or severity of the injuries that resulted from falls that occurred at home where riders anecdotally wear less protective equipment.

Riders tend to fall off due to their horses' changing direction or as a perceived result of conflict behaviours, therefore engaging in activities to enhance rider balance and security would be beneficial. The impact of other factors which could influence rider balance such as stirrup leather length, saddle type/fit and rider experience and rider-horse matching should also be evaluated in future research.

In conclusion, this large survey, which we believe is the first of its kind, provides insight into the frequency of falls, the circumstances, and the consequences in UK equestrians. A positive outcome is that whilst a variety of factors appear to be involved in rider falls from horses, many of these may be modifiable and hence preventable and that encouraging riders to wear protective equipment in activities currently perceived as "low risk" such as hacking or schooling at home may help to reduce injury severity.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Conceptualization, DM, JW; Methodology, DM, JW; Dissemination, DM, JW; Analysis JW, DM; Writing, DM, JW. Both authors have read and agreed to the published version of the manuscript.

REFERENCES

Abdulkarim, A., Juhdi, A., Coffey, P. and Edelson, L., 2018. Equestrian Injury Presentations to a Regional Trauma Centre in Ireland. Emerg Med Int 2018: 7394390. 10.1155/2018/7394390

Ball, J.E., Ball, C.G., Mulloy, R.H., Datta, I. and Kirkpatrick, A.W., 2009. Ten years of major equestrian injury: are we addressing functional outcomes? J Trauma Manag Outcomes 3: 2. 10.1186/1752-2897-3-2

Bilaniuk, J.W., Adams, J.M., DiFazio, L.T., Siegel, B.K., Allegra, J.R., Lujan, J.J., Durling-Grover, R., Pawar, J., Rolandelli, R.H. and Nemeth, Z.H., 2014. Equestrian trauma: injury patterns vary among age groups. Am Surg 80: 396-402.

Byström, A., Clayton, H.M., Hernlund, E., Rhodin, M. and Egenvall, A., 2020. Equestrian and biomechanical perspectives on laterality in the horse. Comparative exercise physiology, 16(1), pp.35-45.

Carter, B.T. and Richardson, M.D., 2023. A retrospective study of helmet use and head injury in severe equestrian trauma. J Neurosci Rural Pract 14: 161-164. 10.25259/JNRP-2022-3-14

Chapman, M. and Thompson, K., 2016. Preventing and Investigating Horse-Related Human Injury and Fatality in Work and Non-Work Equestrian Environments: A Consideration of the Workplace Health and Safety Framework. Animals (Basel) 6. 10.3390/ani6050033

Christensen, J.W., Munk, R., Hawson, L., Palme, R., Larsen, T., Egenvall, A., von Borstel, U.U.K., Rørvang, M.V., 2021. Rider effects on horses' conflict behaviour, rein tension, physiological measures and rideability scores. Applied Animal Behaviour Science 234: 105184.

Commission, U.S.C.P.S., 2017. National Electronic Injury Surveillance System (NEISS). Available at: https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.

Davies, E., Liddiard, S., McConn-Palfreyman, W.J., Parker, J.K., Cameron, L.J. and Williams, J.M., 2023. Anxiety and Depression in British Horseracing Stud and Stable Staff Following Occupational Injury. Animals (Basel) 13. 10.3390/ani13213337

Davies, E., McConn-Palfreyman, W., Parker, J.K., Cameron, L.J. and Williams, J.M., 2022. Is Injury an Occupational Hazard for Horseracing Staff? Int J Environ Res Public Health 19. 10.3390/ijerph19042054

Department, S.R., 2023. Equestrian sports in the United Kingdom (UK) - Statistics & Facts. Available at: https://www.statista.com/topics/3879/equestrian-sports-in-the-united-kingdom-uk.

Dyson, S., Berger, J., Ellis, A.D., Mullard, J., 2018. Development of an ethogram for a pain scoring system in ridden horses and its application to determine the presence of musculoskeletal pain. Journal of Veterinary Behavior 23: 47-57.

Gates, J.K. and Lin, C.Y., 2020. Head and Spinal Injuries in Equestrian Sports: Update on Epidemiology, Clinical Outcomes, and Injury Prevention. Curr Sports Med Rep 19: 17-23. 10.1249/JSR.0000000000000674

391 Górecka-Bruzda, A., Chruszczewski, M.H., Jaworski, Z., Golonka, M., Jezierski, T., Długosz, B. and
392 Pieszka, M., 2011. Looking for an Ideal Horse: Rider Preferences. Anthrozoös 24: 379-392.
393 10.2752/175303711X13159027359827
394 Graf, P., König von Borstel, U., Gauly, M., 2013. Importance of personality traits in horses to
395 breeders and riders. Journal of Veterinary Behavior 8: 316-325.
396 Guyton, K., Houchen-Wise, E., Peck, E. and Mayberry, J., 2013. Equestrian injury is costly, disabling,
397 and frequently preventable: the imperative for improved safety awareness. Am Surg 79: 76-
398 83.
399 König von Borstel, U., Glißman, C., 2014. Alternatives to Conventional Evaluation of Rideability in
400 Horse Performance Tests: Suitability of Rein Tension and Behavioural Parameters. Plos One
401 9: e87285.
402 Larsson, M., Schepman, A., Rodway, P., 2023. Why Are Most Humans Right-Handed? The Modified
403 Fighting Hypothesis. Symmetry 15: 940.
404 Lee, K.H. and Steenberg, L.J., 2008. Equine-related facial fractures. Int J Oral Maxillofac Surg 37: 999-
405 1002. 10.1016/j.ijom.2008.05.009
406 Lord, R., 2019. The Equine Industry: Competing Beliefs, Changes and Conflicts. Available at:
407 https://pubs.mumabusinessreview.org/2019/MBR-2019-03-09-099-120-Lord-
408 EquineIndustry.pdf.
409 Luke, K.L., McAdie, T., Smith, B.P., Warren-Smith, A.K., 2022. New insights into ridden horse
410 behaviour, horse welfare and horse-related safety. Applied Animal Behaviour Science 246:
411 105184.
412 McGreevy, P.D., McLean, A. , 2005. Behavioural problems with the ridden horse. . The domestic
413 horse: The origins, development and management of its behaviour: 196-211.
414 McLean, A.N., Christensen, J.W. , 2017. The application of learning theory in horse training. Applied
415 Animal Behaviour Science 190: 18-27.
416 Nylund, L.E., Sinclair, P.J., Hitchens, P.L. and Cobley, S., 2019. Do riders who wear an air jacket in
417 equestrian eventing have reduced injury risk in falls? A retrospective data analysis. J Sci Med
418 Sport 22: 1010-1013. 10.1016/j.jsams.2019.05.012
419 O'Connor, S., Hitchens, P.L. and Fortington, L.V., 2018. Hospital-treated injuries from horse riding in
420 Victoria, Australia: time to refocus on injury prevention? BMJ Open Sport Exerc Med 4:
421 e000321. 10.1136/bmjsem-2017-000321
422 Papachristos, A., Edwards, E., Dowrick, A. and Gosling, C., 2014. A description of the severity of
423 equestrian-related injuries (ERIs) using clinical parameters and patient-reported outcomes.
424 Injury 45: 1484-1487. 10.1016/j.injury.2014.04.017
425 Saslow, C.A., 2002. Understanding the perceptual world of horses. Applied Animal Behaviour Science
426 78: 209-224.
427 Smartt, P. and Chalmers, D., 2009. A new look at horse-related sport and recreational injury in New
428 Zealand. J Sci Med Sport 12: 376-382. 10.1016/j.jsams.2008.04.001
429 Williams, J., Tabor, G. , 2017. Rider impacts on equitation. Applied Animal Behaviour Science 190:
430 28-42.

431