An investigation into equestrian spur use in the United Kingdom

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Abstract

Spurs are traditionally worn by riders to enable more precise stimuli or 'leg aids' to be applied, prompting for changes in locomotion, activity or direction of the horse. Equestrian competitions have seen eliminations and horse welfare concerns raised due to the presence of blood on the horse related to spur use. The aims of this study were to describe spur use across equestrian disciplines and identify reported risk factors that are associated with an increased frequency of skin abrasion. An online survey was administered via social media platforms, industry connections and national online media sources. It included questions on rider demographics, spur design, injury rates and perception of current competition regulations. Inclusion criteria required that participants were aged at least 18 years old, a horse owner/loaner/sharer and resided in the United Kingdom. Eight hundred and fifty-eight participants responded resulting in 628 complete responses for further analysis, 597 from females (95%) and 31 from males (5%). The majority were aged between 18 and 29 years (47%), with 41 participants (7%) reporting their age at 58 years or over. 19 types of equestrian activities were reported and categorised into FEI competitive disciplines, non-FEI competitive disciplines and recreational disciplines. Descriptive statistics, Odds ratios [OR] and Chi-squared tests were utilized (IBM SPSS v24.0) with an alpha value set at $p<0.05$ (confidence interval 95%) unless otherwise stated. 47% of all participants used spurs. Relationships were found between spur use and gender and duration of years riding. Males were 2.88 times more likely to use spurs than females ($p=0.005$). Riders within competitive non-FEI disciplines were 1.53 times more likely to use spurs than recreational riders and 1.48 times more likely to use spurs than those competing in FEI disciplines. Longer spur shanks (>32 mm) significantly increased the risk of skin abrasions or hair loss related to spur use ($p<0.0001$). Rotating spur designs were 1.5 times more likely to be associated with injury compared to fixed shank designs. Future research should consider motivational factors for equipment selection and how it then affects the horse. This information may aid policy makers to formulate ethical guidelines for equestrian sport but also extends to inform riders of all levels how their choice of day-to-day equipment can affect equine welfare.

Keywords: Equestrian; Spurs; Equine welfare

Introduction

The role of the horse within human society has adapted from that of a working animal to its current widespread use in leisure and sporting contexts (Hill et al., 2015; Gorecka-Bruzda et al., 2015). In 2017, high-profile UK equestrian events attracted 7.5 million spectators at paid-attendance sporting events (Deloitte, 2017). Increasing consumerism and participation in equestrian sport remains central to the aims of national and international federations (British Horse Industry Confederation, 2017; FEI, 2018, BEF; 2018). Yet the use of animals for human entertainment attracts differing levels of concern and requests for justification from the general public (Jones and McGreevy, 2010). The longevity of equestrian sport relies on policy makers to minimise welfare risks, imposed on horse and rider, in order to maintain a positive perception from the wider public audience (Jones and McGreevy, 2010; Owers, 2017).

Methods of horse-training and the types of equipment which are used have attracted public attention in recent years over equine welfare concerns (McLean and McGreevy, 2010; Owers, 2017). Previous research in this area has focused on welfare linked to bit use (Tell et al., 2008; Cook, 2011; Björnsdóttir et al., 2014) and nosebands (Randle and McGreevy, 2013; Doherty et al., 2017). To date there has been limited research on spur use. Spurs are a piece of riding equipment used to reinforce the rider’s leg aids prompting locomotion, activity or direction (Arkadiusz, 2010; Hill et al., 2015; Uldahl and Clayton, 2019). Recently spur use in equestrianism has attracted negative public attention over the presence of blood on the horse’s side in competition (Roome, 2015; Jones, 2017; Jones, 2018). The misuse of spurs can result in worn or hairless areas on the horse’s side, which in some cases results in the presence of blood. With increased media and social media attention focusing on social licence to use horses within competitive sport it is essential that the governing bodies are seen to champion equine welfare and where ever possible support evidence based decisions. To date, there is one study that describes the prevalence of equine injuries post-competition in Danish Equestrian Federation competitions in dressage, showjumping, event and endurance (Uldahl and Clayton, 2019). The prevalence of equine injury from spur use in a sub-elite population has not been documented. For this reason, this study sought to examine the prevalence of equine injuries related to spurs across all levels of equestrian disciplines.

Spurs are commercially available in a variety of designs and have become a regular part of horse-riding equipment (Hill et al., 2015; Hockenhull and Creighton, 2012). Regulations exist for the types and dimensions of spurs permitted in competition but there is a lack of literature which describes the demographics of spur users, spur designs and the interaction between equine injuries. Peripheral research has associated spur use with increased tendencies to use stronger bits (Hill et al., 2015) and higher frequencies of equine conflict behaviour (Hockenhall and Creighton, 2012). Understanding how equipment affects equine welfare from an evidence based view-point extends to have direct application to industry and have wider socio-economic implications for the future of equestrian sport (Owers, 2017; FEI, 2018; Dumbell et al., 2019).

The purpose of this study was to record the use and type of spurs across UK equestrian disciplines and relate these findings with the frequency of equine injury associated with their use. The objectives were to provide prevalence of use data describing current equipment trends in UK equestrians and disciplines.

Materials and methods

Participants

Following full institutional ethical approval, an online survey was designed to investigate spur use across UK horse riders with reference to the rider, the discipline and spur designs. The online link circulated via social media platforms, industry connections and national online media sources. Inclusion criteria required that participants met the following conditions: a horse owner/loaner/sharer, reside in the United Kingdom and aged over 18 years old. All responses remained anonymous, as such, participant consent was given by their completion of the survey (as described in the briefing page of the survey). The survey was accessible for a six week period [16 April, 2018 to 28 May, 2018] which is within the standard activity time for online surveys (CASE; 2018) and offered no incentive for participation.

Measure

A three section survey was constructed using the principles put forward by Diem (2002). The survey containing twenty questions was developed containing closed–responses (e.g. Yes/no and Likert scale). Section 1 ascertained participant demographics for both horse and rider including perceived rider level e.g. professional, amateur or leisure riders who do not compete. Within this categorisation riders could further describe their interaction within the discipline from either affiliated, unaffiliated or leisure riding. Section 2 asked questions on the choice of equipment used at home or "in training" and competition environments. The survey design enabled non-spur users to skip questions related to spurs which included type of spur (Table 2), length of spur shank, the prevalence of skin abrasions on the horse and associated practices related to spur abrasions. To clarify the terminology relating to skin abrasions, the question asked whether the participants had experienced 'skin abrasions' or 'hair loss' related to spur use. The decision to omit the word *blood* in this question was purposeful in efforts to reduce the 'participant effect' whereby participants subconsciously alter their behaviour in a way they assume the researcher expects (Nichols and Manner, 2008). The final section was to explore rider perception of "the blood rule" in FEI regulations. Questions included rating scales to whether the participant agreed with elimination of competitors for excessive spur use *and/or* spur abrasions without the presence of blood *and/or* spur abrasions with the presence of blood.

Validity evidence for the instrument was provided by reviewing the questionnaire for: (1) clarity of wording, (2) use of standard English and spelling (3) reliance of items, (4) absence of biased words and phrases, (5) formatting of items, and (6) clarity of instructions (Fowler, 2002). Two faculty senior academics experienced in survey design, were asked to use these guidelines to review the instrument. Based on the reviewers' comments the instrument was revised and as a pilot study the questionnaire was distributed to several test participants before further revisions were made prior to final administration.

Data analysis

A total of 858 initial responses were received. Data validation elucidated a 73% completion rate resulting in 628 complete responses for further analysis. Partial responses (n=230/858) were excluded from analysis as the nature of the study required all three sub-sections to be completed. Additionally during data validation, there was no apparent pattern for survey abandonment and to prevent false-positive assumptions from incomplete responses, partial surveys were not included in analysis. Data were downloaded from Kwik Survey into a Microsoft Excel (2010) spreadsheet (Microsoft Corporation, Redmond, WA). Descriptive statistics were used to report frequencies and percentages within data. Odds ratios [OR] and Chi-squared tests were utilized with an alpha value set at $p<0.05$ (confidence interval 95%) unless otherwise stated. To explore the interactions between multiple variables log-linear analysis, a form of generalized linear regression, was performed. Statistical analysis were performed by IBM SPSS Statistics Software.

Results

Of the 628 participants, 597 were female (95%) and 31 male (5%). The majority were aged between 18 and 29 years (47%), with 41 respondents (7%) reporting their age at 58 years or over. Overall, 19 types of equestrian activities were reported and categorised into FEI competitive disciplines, non-FEI competitive disciplines and recreational disciplines (Figure 1). A small number of respondents reported disciplines which were combined as "*other*" in the recreational category and include: British Trec (n=2), positive reinforcement training (n=2), riding for the disabled (n=1) and no discipline specified (n=1). Participants self-declared their interaction within their disciplines as one of the following levels: professional rider affiliated to their discipline (6%); professional rider unaffiliated to their discipline (4%); amateur rider affiliated (36%); amateur rider unaffiliated (34%) or leisure riders who do not compete (20%). All respondents had at least one-year riding experience and the majority of respondents reported at least 16 years horse-riding experience (74%). The majority of respondents (85%) had received training from an equestrian coach during the previous 12 months (n=531/628) with monthly and fortnightly coaching frequency most commonly reported (n=134, 21% and n=126, 20% respectively).

Spur use

47% (n=294) of participants reported using spurs. There was a significant association between gender and spur use ($X^2_1 = 7.640$; $p=0.006$) in that males were 2.88 times more likely to use spurs than females. The duration of years' riding experience appeared to have no relationship with spur use ($X^2_5 = 4.994$; $p>0.05$). However there was a positive trend found (Figure 2) in that riders with excess of 21 years' riding experience were 3.14 times more likely to use spurs than riders with 3-5 years' riding experience.

The distribution of spur users across individual disciplines varied from 0% of endurance riders to 63% of reining riders using spurs (Table 3). After reining, the highest frequency of spur users within disciplines included polo (62%), showing and hunting (both 54%) and show jumping (50%). Riders within competitive non-FEI disciplines were 1.53 times more likely to use spurs than recreational disciplines and 1.46 times more likely to use spurs than competitive FEI disciplines ($X^2_2 = 5.981$; p=0.050).

There was a highly significant association between rider level and spur use ($X^2_4 = 93.225$; p=0.000). 60% of professional riders used spurs and were 1.5 times more likely to use spurs than to "not use spurs." 54% of amateur riders used spurs and 16% of leisure riders. Furthermore, a highly significant association was found between discipline affiliation and spur use ($X^2_2 = 91.319$; $p<0.0001$). Riders affiliated to their discipline (professional and amateur combined n=265/628) were 1.94 times more likely to ride with spurs than without spurs. Affiliated riders were 2.81 times more likely to ride with spurs than unaffiliated riders and 10.21 times more likely to use spurs than leisure riders.

Skin abrasions – the spur

Overall, 34% of spur users (n=101/294) reported skin abrasions on the horse related to spur use. A significant association was found between spur shank length and skin abrasions ($X^2_3 = 9.228$; p=0.026) in that spur-shanks exceeding 31 mm (1.25 inches) were 3.3 times more likely to be associated with abrasions than shanks less than 25 mm (1 inch) (Table 4). Of those that experienced abrasions, only 28% used methods which are perceived within industry as techniques intended to avoid skin abrasions. The most popular technique was the use of a lubricant (Vaseline) to reduce the friction between spur and the horse (49%) followed by leaving a patch of hair when clipping (33%) and commercial spur guards 'Equine Belly Band' (31%).

Rotating spur designs were 1.5 times more likely to be associated with abrasions compared to fixed designs (Table 4). Although it is important to note this trend failed to achieve conventional thresholds of statistical significance ($X^2_1 = 3.056$; p=0.053). The linear model used as a 3-factor interaction showed no association between spur design, abrasion rate and rider level (log linear analysis; Z= various; $p>0.05$). This suggests that spur design and rider level are independent factors in the prevalence of abrasions.

Skin abrasions- the rider/discipline

There were no significant relationships found between abrasions and individual disciplines ($X^2_{17} = 10.213$; $p>0.05$); or discipline categories ($X^2_2 = 0.041$; $p>0.05$) (Table 5). However, a significant association was found between discipline affiliation and abrasions ($X^2_2 = 21.573$; $p<0.0001$) in that affiliated riders were 3.57 times more likely to have experienced abrasions compared to both unaffiliated and leisure riders. It is important to note that years' riding experience did not equate to a reduced likelihood of abrasions ($X^2_4 = 10.278$; $p=0.036$). For instance, riders with 11-15 years' riding experience were 1.98 times more likely to have experienced abrasions than riders with 21+ years' experience. The level of rider e.g. professional, amateur or leisure did not appear to effect the prevalence of abrasions ($X^2_2 = 4.863$; $p>0.05$). 47% of professional riders experienced abrasions and were 3.63 times more likely to experience abrasions compared to leisure riders.

Perception of competition regulations

From the 628 responses the majority (82%) were in agreement with current FEI regulations which stipulate riders can be eliminated for both (1) excessive use of spurs and (2) for the presence of blood on the horse related to spur use. The remaining participants were equally distributed between disagree (9%) and neutral to the statement (9%). However elimination due to spur abrasions *without* the presence of blood on the horse (e.g. hair loss) was significantly affected by whether the participant used spurs or not ($X^2_1 = 61.743$; $p<0.0001$). Spur users were 3.8 times more likely to disagree with eliminating riders for spur-related abrasions, without the presence of blood, compared to non-spur users.

From the alternative options listed: 60% of participants agreed with the introduction of a phased-sanction approach whereby riders are issued a formal warning on their first incident of spur abrasions *and* subsequent elimination for any repeat offences. 59% of participants agreed with the addition of monetary fines for the presence of spur abrasions involving blood. Increasing sanctions to include formal warnings *and* fines for the presence of spur abrasions was the least popular option with only 50% of riders being in agreement, 28% opposing the idea and 22% remaining neutral on the idea.

Discussion

This study describes spur use across UK equestrian disciplines and the variables which may influence the prevalence of skin abrasion. This information may aid policy makers to formulate ethical guidelines for equestrian sport but also extends to inform riders of all levels how their choice of day-to-day equipment can affect equine welfare.

Sensitive topics and distribution of online surveys using convenience sampling techniques are predisposed to an increased risk of response bias (Saunders, Lewis and Thornhill, 2012; Keiding and Louis, 2016). Related to spurs, controversy surrounding their use has been heightened by recent media coverage of high-profile riders being scrutinized and sanctioned for misconduct. This could have altered the response rate and/or truthfulness of participants who use spurs, if they thought their actions would be scrutinized in the same way. However this study reported a similar ratio of 47:53% spur users to non-spur users which suggests both sub-groups responded equally to the survey. Furthermore, the overall sample population of this study reflects the findings of a national equestrian survey (BETA, 2015) in that the majority of equestrians were female and participated in recreational equestrian disciplines. Typically a representative study population is considered beneficial in increasing the generalizability of results to wider populations, referred to as external validity (Pannucci and Wilkins, 2010). Nevertheless repeating this study with a larger sample population is advised so that the knowledge base advances and results become more reliable.

Despite horse-riding being a predominantly female activity, men compete in all levels of competition and dominate elite level equestrian sport (Cassidy, 2002; Dashper, 2012). This study found a significant relationship between spur use and gender. The history of equestrian sport derives from military riding, landed-gentry and upper-class society (Dashper, 2012; Dumbell and de Haan, 2016). Dated to *circa.* 17th century, spurs were used for military personnel (men) to drive horses into battle (Arkadiusz, 2010) and later adapted as a status symbol within formal knighthood ceremonies. Saunders and Algar (2001) suggest women in the same era seldom rode horses without the company of their husbands and did not use spurs given their long skirts concealed the fashionable undertones attached to their use. Although equestrianism is now more evenly spread across socio-economic demographics (Dashper, 2012) the clothing and equipment required in equestrian sport is firmly associated with formality and the masculine origins of equestrian sport (Dashper and St John, 2016). Yet in sporting contexts it is a rare example of gender equality in that men and women are able to compete against each other at Olympic level, governed by the same rules and equipment restrictions (Dumbell and de Haan, 2016). In spite of this, the current study reports men were 2.88 times more likely to use spurs than females and had higher frequency of spur use overall (in training and competitions) compared to females. Whether gender and class associations apply to equipment and/or spur use due to the socio-historic background of the sport is unknown. There is not enough evidence within this study to examine the motivational factors behind why men and women may use certain types of equestrian equipment but it is an area of research that warrants further investigation.

Factors which influence a rider in their choice of equipment is a current topic of interest (Wolframm et al., 2015). Research has identified personality differences exist between competitive and recreational riders in that competitive riders exhibit higher levels of extroversion and conscientiousness (Wolframm et al., 2015). These personality traits are linked with the skills required for success in sport, such as, disciplined goal-setting, time-management and coping mechanisms to perform under pressure (Wilson and Dishman, 2015; Williams and Tabor, 2017). At present individual personality traits, coaching input and riding manuals are all considered influential but equipment selection is often down to individual rider judgement and the decisions thereafter will affect their horse's welfare (McLean and McGreevy 2010; Hawson et al., 2013).

This study found a lower use of spurs than reported by Uldahl and Clayton (2019) but this is likely to be related to the fact that Uldahl and Clayton (2019) reported data gathered at competition only. In this study, spur use across competitive (FEI and non-FEI) and recreational disciplines was not dissimilar (Table 3). Reasons why spur use was reported in hacking or natural horsemanship could be questioned as the nature of these disciplines are usually for 'enjoyment' or leisure purposes. Recreational riders possess different personality traits including augmented focus on negative events and being more reactive to when something goes wrong during riding (Allen et al., 2011).

The current study found an increased prevalence of spur use amongst riders who reported a longer duration of riding years. However, the current study did not demonstrate an inverse relationship between length of time riding and equine injury rates. To some degree, this concept contradicts theories which imply riders who have spent more time in-the-saddle, may be more experienced (Williams and Tabor, 2017). For instance, elite riders demonstrate increased postural stability and synchronicity with the cyclic movements of the horse (Heleski et al., 2009; Clayton and Hobbs, 2017). By contrast, inexperienced riders are not as equipped to anticipate these movements and demonstrate postural instability of the trunk, arms and legs (Lovett et al., 2005). But in reality it is not only rider experience which can affect rider posture (Williams and Tabor, 2017; Lewis et al., 2018). Research has found greater longitudinal displacement of the rider's toes, in elite level horse-rider combinations, when applying the aids for variations of collected trot (Bystrom et al., 2015). Additionally, sensory and neuro-muscular differences are reported in the wider human population related to motor laterality dominance, e.g. increased muscle mass and grip force on the dominant side of the body compared to the non-dominant side (Steele, 2000; Hammond, 2002). A possible limitation to the current study was that the question relating to spur abrasions did not quantify location of abrasion related to rider laterality dominance. However Clayton et al. (2018) reported no difference in the frequency of abrasions bilaterally.

It is still feasible that greater movement of the rider's legs related to laterality differences, postural stability, gait-variation or otherwise would inevitably result in more friction at the contact point on the moving horse. It is probable that the addition of spurs is likely to exasperate this effect and therefore increase the risks of skin abrasions at the same time. Future studies should explore how rider experience and posture may effect spur use, whilst acknowledging the contraindications of correlating time spent in-the-saddle with rider skill.

It is important to note there is no scientific literature available which has defined optimum spur use or at which point, if any, spurs become beneficial to the rider or equestrian activity. Correct equine learning theory infers horses should be taught to yield to light or minimal pressures from either leg or rein cues (McLean and McGreevy, 2010). On the other hand, contradictory pressures whereby the horse receives a "go" and "stop" cue simultaneously is linked to higher frequencies of conflict behaviours in ridden horses and can lead to dulled behavioural responses (Goodwin et al., 2009). At this point riders may misinterpret the lack of behavioural response and increase the severity of their equipment (Symes and Ellis, 2009; McLean and Christensen, 2017). This trend has been reflected in research showing increased tendencies to use stronger bits in conjunction with spurs across leisure disciplines (Hill et al., 2015). Anecdotally, the same trend is commonly seen in competitive environments with some disciplines stating bit types and spur use is mandatory (British Dressage, 2018). Whilst it was not within the scope of this current study to analyse bit use in relation to spurs, the notion that riders may become involved in a cycle of increasing equipment severity in place of better understanding of horse-training principles, raises concerns for equine welfare. It is recommended that future research examines how variations of equipment are used in practice and their combined effect on horse welfare.

Socio-economic factors can affect individual athletes and organisations within equestrian sport (Downward, 2007; Hemsworth et al., 2015). For example, decision making for professional riders can be influenced by financial incentives, owner opinion, qualification boundaries and ultimately, the need to maintain their reputation in the pursuit of success (Parkin and Rossdale, 2006). This current study supports previous findings in that professional riders were more inclined to use spurs (60%) than leisure riders (18%). Australian leisure riders reported overall spur use of ~32% compared to 77% of Danish riders competing at national level equestrian disciplines (Hill et al. 2015; Uldahl and Clayton, 2019). Professional riders can be idolised by sub-elite riders and perceived as role models (Williams and Tabor, 2017). Role models or “celebrity riders” can generate fashion-trends related to the type of tack or equipment used (Mutter and Pawlowski, 2014). In this current study, riders affiliated to their equestrian discipline were 1.94 times more likely to use spurs, than to ‘not use spurs,’ which could be a reflection of the trend set by professional riders.

Spurs can be used to increase speed or direction (Clayton and Uldhal, 2018) which in a competitive environment has the potential to improve performance. Show jumping for example, is judged by the ability to jump obstacles without knock-downs and the speed of successful completion denotes competitive success. To date there is no study which describes competitive success related to spur use. This study suggests there is a trend emerging which links a high proportion of professional riders use spurs, and most critically, also experience spur abrasions. The methodological protocols varied between this current study and Uldahl and Clayton (2019), survey vs. post competition evaluation, but report similar frequencies of spur-related abrasions in show jumping for example, 50% and 47% respectively. In other sports, athlete transgression for socially undesirable behaviour, contextualised as the misuse of spurs, can result in reputational and financial consequences for individual athletes (Trosby, 2010). There have been similar incidences in equestrian sport related to spur use. Most recently British showjumper Ben Talbot was disqualified from international competition (Jones, 2018) and the consequences resulted in severe backlash on social media, the loss of sponsorship and the horse being removed from his care by the owners. In the absence of knowledge to suggest how spurs relate to performance, riders should be aware of the welfare implications to the horse but also their own reputation which accompanies user misconduct. Future research should examine spur use in relation to competitive success which may then benefit riders in evaluating the costs/benefits of using spurs and ultimately safeguard equine welfare.

One study has previously investigated the effect of spurs on the frequency of equine injury (Uldahl and Clayton, 2019). Similar results were reported in this current study identifying a linear relationship between spur length and frequency of skin abrasions (Table 4). However the frequency of abrasions differed between studies. For instance, Uldahl and Clayton (2019) reported a 20% of riders using spurs of 3cm in length experienced skin abrasions compared to 40% of riders using the same spur length in this current study. Whilst rider skill and postural variation appear to be influential factors in the frequency of skin abrasions, the degree to which horse-related variables may affect the likelihood of abrasions is unknown. For instance, equine coat or 'hair' length will fluctuate with seasonal variations being longer in winter and shedding pre-summer months to aid thermoregulation (Bocian et al., 2016). Coat type can also vary between breeds and due to husbandry management such as dietary influence or clipping the hair in winter months (Dunnet, 2005; Bocian et al., 2016).

An alternative explanation to the higher frequency of abrasions reported in this current study, relative to Uldahl and Clayton, (2019), is that data collection took place in the UK during the months of April to May which coincides with seasonal changes in temperature and daylight hours (Ibbotson et al., 2016). As such there is the potential that repetitive friction caused by the small surface area of the spur *may* increase natural, but more localised hair loss during seasonal changes. At this stage there is no empirical evidence to quantify the mechanism of spur use or how different designs affect the prevalence of skin abrasions. Should pressure-gauge technology be adapted to measure the impact of spur designs and friction to the horse, this could advance how riders select the length and type of spur they use with equine welfare in mind. The practicalities of such studies may be unrealistic given the high costs associated with experimental research and complicated logistics of organising large samples (Pierard et al., 2015). In place of this, further qualitative research could yield more detailed descriptions of the prevalence of skin-abrasions and identify risk factors related to designs *and/or* users.

Inter-discipline regulations are inconsistent relating to whether spurs are optional, mandatory or prohibited entirely (FEI, 2018; British Dressage, 2018). It could be argued that competition guidelines offer a positive influence on a rider's choice of equipment given their core values include protecting equine welfare (FEI, 2018). However, there are discrepancies between industry regulations on spur use; advanced-medium level dressage states spurs are mandatory and riders can be eliminated for non-use (British Dressage, 2018). Other disciplines, for example categories of horse-showing prohibit spur use entirely (VHS, 2018). Inevitably, as this study confirms, competition guidelines do not necessarily extend to restrict the types of equipment that are used in training environments. Horse-racing and mounted games prohibit the use of spurs in competition (BHRA, 2018; MGAGB, 2018) yet participants in these disciplines reported using spurs (Table 5).

Additionally there are varying degrees of restrictions on spur design, length, level of competition, age of rider/horse but how these rules were developed is unknown. Akin to variability in permitted use, the sanctions related to the misuse of spurs range from instant elimination, steward discretion and monetary fines. Although with sufficient motivation competition rules can be adapted to reduce adverse effects on horses (Jones and McGreevy, 2010). For example, societal-pressures have resulted in a phased-ban of hind-boots in show jumping that are intended for any other purpose than protecting the legs, implemented first with ponies, children and amateur competitions from 2019, and then across all FEI competitions by 2021 (Roome, 2015).

Whether the findings of future research recommended throughout this study help to identify risk factors for spur use, a similar phased approach could limit lower level competitions on the type and length of spur permitted. Prior to any rule changes it is recommended that a scientific review of current spur regulations and sanctions is undertaken first. This information may motivate policy makers to improve the consistency of regulations across equestrian disciplines and at the same time clarify the sanctions riders are subject to.

Limitations

The impact of inductive research ideology should be considered before taking the results transcribed in this study as conclusive evidence. The patterns and theories described in this study derive from one researcher's interpretation of data, from a comparatively small sample, relative to the larger UK equestrian population. A recent review of equitation research acknowledges research in this field is often hindered by small sample sizes due to access to participants (Pierard et al., 2015). The findings within this study may have valid claims and be applicable to industry however future research should re-visit these themes with larger sample sizes. This would reduce the risk of false positive assumptions common in small scale studies which lead to inaccurate associations being found or conversely, true associations not being reported (Schlesselman, 1974).

This study used a self-completed questionnaire to investigate a topic that respondents may have believed would reflect on their own riding ability, practices or welfare standards. This may have resulted in responses that were affected by social conformity. If this occurred it is likely that abrasions and impact of spur use would be under-reported within the responses, and this should be considered when interpreting results.

Furthermore, this current study reported the investigated interactions irrespective of statistical significance so to reduce publication bias (Perreault, 1975) but also so that future studies are able to use the findings as a benchmark for further investigation.

Conclusions

Equestrian sport is required to adapt in accordance to societal pressures and minimise risks the risks imposed on horses and riders in sport. This study found that spurs are used by a variety of UK riders across competitive and leisure disciplines. Associations were found between types of spur design and the frequency of equine injury. The results of this study are provided for educational purposes for policy makers and riders alike so that a holistic approach to safeguarding horse welfare is adhered to.

It is recommended that future research should work towards defining quantifiable characteristics for optimum spur use and continue to explore the factors which influence a rider's choice of equipment. Competition regulations should be reviewed on the basis of evidence-based research when it becomes available. Prior to this, a review of current regulations, sanctions and permitted designs across equestrian competitive disciplines is recommended.

Authorship Statement

The idea for the paper was conceived by C. Lemon and V. Lewis, in discussion with H Brown and L Dumbell

The experiments were designed by C. Lemon, H. Brown and V. Lewis.

The experiments were performed by n/a

The data were analyzed by L Dumbell and C Lemon

The paper was written by V Lewis and L Dumbell, with input from C Lemon

References

Allen, M.S., Greenlees, I., Jones, M., 2011. An investigation of the five-factor model of personality and coping behaviour in sport. J. Sp. Sci. 29 (8), 841–850.

BEF (2018) BEF - About the BEF. Available at: http://www.bef.co.uk/Detail.aspx?page=BEF (Accessed: 11 June 2018).

BETA (2018) British Equestrian Trade Association - Market Information. Available at: http://www.beta-uk.org/pages/industry-information/market-information.php (Accessed: 30 January 2018).

Björnsdóttir, S. et al., 2014. Bit-related lesions in Icelandic competition horses. Acta Vet. Scand. 56, 40.

Bocian, K. et al., 2017. Length of winter coat in horses depending on husbandry conditions. Anim. Sci. J. 88 (2), 339–346.

British Horse Industry Confederation, 2018. Equine Sector 2017 Mid-Term Manifesto for the Horse. Available from: http://www.bvec.co.uk/downloads/external-information/mid-term-review-manifesto-for-the-horse-v7-jan-2017.pdf. Accessed December 19, 2017.

British Horse Racing Authority, 2018. Rider Manual (D) - PART 5 - GENERAL DUTIES OF RIDERS - (D)30 to (D)57 - 38. Other requirements as to equipment etc for racing. Available from: http://rules.britishhorseracing.com/Orders-and-rules%26staticID=126094%26depth=3?zoom_highlight=spurs. Accessed July 4, 2018.

Byström, A. et al., 2015. Differences in rider movement pattern between different degrees of collection at the trot in high-level dressage horses ridden on a treadmill. Hum. Movement Sci. 41, 1–8.

CASE, 2018. CASE - FAQ: The CASE Benchmarking Toolkit. Available from: https://www.case.org/Samples_Research_and_Tools/Benchmarking_and_Research/Benchmarking_Resources/CASE_Benchmarking_Toolkit/FAQ_The_CASE_Benchmarking_Toolkit.html. Accessed July 4, 2018.

Clayton, H. M., Hobbs, S.J., 2017. The role of biomechanical analysis of horse and rider in equitation science. J. Vet. Behav. 190, 123–132.

Heleski, C.R., McGreevy, P.D., Kaiser, L.J., Lavagnino, M., Tans, E., Bello, N. and Clayton, H.M., 2009. Effects on behaviour and rein tension on horses ridden with or without martingales and rein inserts. Vet. J. 181 (1), 56–62.

Cook, W. R., 2011. Damage by the bit to the equine interdental space and second lower premolar. Equine Vet. Educ.o 23 (7), 355–360.

Creswell, J., 2014. The Selection of a Research Approach. SAGE Publications Ltd., London.

Dashper, K., 2016. Strong, active women: (Re)doing rural femininity through equestrian sport and leisure. Ethnogr. 17 (3), 350–368.

Dashper, K., 2012. Dressage is full of queens!" Masculinity, sexuality and equestrian sport. Sociol. 46 (6), 1109-1124.

Dashper, K. and St John, M. 2016. Clothes make the rider? Equestrian competition dress and sporting identity. Annals Leis. Res. 19 (2), 235-250.

Deloitte, 2017. Almost 75m tickets sold for UK sports events in 2017 | Deloitte UK. Available from: https://www2.deloitte.com/uk/en/pages/press-releases/articles/almost-75m-tickets-sold-for-uk-sports-events-in-2017.html. Accessed January 4, 2018.

Doherty, O., et al., 2017. An objective measure of noseband tightness and its measurement using a novel digital tightness gauge. PLoS ONE, 12(1).

Downward, P., 2007. Exploring the economic choice to participate in sport: Results from the 2002 general household survey. Int. Rev. Appl. Econ 21(5), 633–653.

Dumbell, L., Lemon, C., Williams, J., 2019. A systematic literature review to evaluate the tools and methods used to measure rein tension. J. Vet. Behav. 29, 77-87.

Dunnett, M., 2005. The diagnostic potential of equine hair: A comparative review of hair analysis for assessing nutritional status, environmental poisoning, and drug use and abuse. In: Pagan, J.D., (Ed), Advances in Equine Nutrition III. Nottingham University Press, Nottingham, pp. 85–106.

Fédération Equestre Internationale, 2018. Dressage rules - FEI. Available from: https://inside.fei.org/sites/default/files/DRE-Rules_2018_Clean_Version_0.pdf. Accessed January 21, 2018.

Fielding, N., Lee, R. M., Blank, G., 2018. The SAGE handbook of online research methods. SAGE Publications, London.

Górecka-Bruzda, A, Kosinska, I., Jaworski, Z., Jezierski, T., Murphy, J., 2015. Conflict behavior in elite show jumping and dressage horses. J. Vet. Behav. 10 (2), 137–146.

De Haan, D., Dumbell, L., 2016. Equestrian Sport at the Olympic Games from 1900 to 1948. Int. J. Hist. Sp. 33 (6–7), 648–665.

Hammond, G., 2002. Correlates of human handedness in primary motor cortex: A review and hypothesis. Neurosci. Biobehav. Rev., 285–292.

Hawson, L. A., McLean, A. N. and McGreevy, P. D., 2013. A retrospective survey of riders' opinions of the use of saddle pads in horses. J. Vet. Behav. 8(2), 74–81.

Heleski, C.R., McGreevy, P.D., Kaiser, L.J., Lavagnino, M., Tans, E., Bello, N., Clayton, H.M., 2009. Effects on behaviour and rein tension on horses ridden with or without martingales and rein inserts. Vet. J. 181 (1), 56–62.

Hemsworth, L. M., Jongman, E. and Coleman, G. J., 2015. Recreational horse welfare: The relationships between recreational horse owner attributes and recreational horse welfare. Appl. Anim. Behav. Sci. 165, 1–16.

Hill, E., McGreevy, P.D., Caspar, G., White, P., McLean, A.N., 2015. Apparatus use in popular equestrian disciplines in Australia. J. Vet. Behav. 10 (2), 147-e152.

Hockenhull, J., Creighton, E., 2012. Equipment and training risk factors associated with ridden behaviour problems in UK leisure horses. Appl. Anim. Behav. Sci. 137 (1–2), 36–42.

Ibbotson, S., Stones, R., Bowling, J., Campbell, S., Kownacki, S., Sivaramakrishnan, M., Valentine, R., Morton, C.A., 2017. A consensus on the use of daylight photodynamic therapy in the UK. J. Dermatol. Treat. 28(4), 360–367.

Jones, B., McGreevy, P. D., 2010. Ethical equitation: Applying a cost-benefit approach. J. Vet. Behav. 5 (4), 196–202.

Jones, E., 2017. 'The blood rule has to change': top British rider disqualified. Available from: http://www.horseandhound.co.uk/news/blood-rule-change-top-british-rider-disqualified-625936. Accessed January 21, 2018.

Jones, E., 2018. Death threats made to rider banned from show for whip use - Horse & Hound, Horse and Hound. Available at: http://www.horseandhound.co.uk/news/showjumper-ben-talbot-banned-whip-use-656893. Accessed July 4, 2018.

Keiding, N., Louis, T. A., 2016. Perils and potentials of self-selected entry to epidemiological studies and surveys. J. R. Stat. Soc. 179 (2), 319–376.

Lewis, V., Dumbell, L., Magnoni, F. 2018. J Phy Fit Treatment & Sports A Preliminary Study to Investigate the Prevalence of Pain in Competitive Showjumping Equestrian Athletes. J Phy Fit Treat. Med. Sp. 4 (3): JPFMTS.MS.ID.555637.

McLean, A. N., Christensen, J. W., 2017. The application of learning theory in horse training. Appl. Anim. Behav. Sci. 190, 18–27.

McLean, A. N., McGreevy, P. D., 2010. Horse-training techniques that may defy the principles of learning theory and compromise welfare. J. Vet. Behav. 5(4), 187–195.

MGAGB, 2018. MGAGB Dress and Saddlery Rules. Available from: http://mgagb.co.uk/rules/mgagb-dress-saddlery-rules/. Accessed July 4, 2018.

Mutter, F., Pawlowski, T., 2014. Role models in sports - Can success in professional sports increase the demand for amateur sport participation? Sp. Manag. Rev. 17 (3), 324–336.

Nichols, A.L., Maner, J.K., 2008. The good-subject effect: Investigating participant demand characteristics. J. Gen. Psych. 135 (2), 151–166.

Pannucci, C. J., Wilkins, E. G., 2010. Identifying and avoiding bias in research. Plastic and reconstructive surgery. NIH Pub. Access, 126 (2), 619–25.

Parkin, T.D., Rossdale, P., 2006. Epidemiology pf equine performance wastage: importance of analysing facts and implementing their message in management. Eq. Vet. J. 38 (2), 98–100.

Perreault, W. D. Jr., 1975. Controlling Order-Effect Bias. Pub. Opin. Q. 39 (4), 544–551.

Pierard, M., Hall, C., Borstel, U.K. von, Averis, A., Hawson, L., McLean, A., Nevison, C., Visser, K. and McGreevy, P., 2015. Evolving protocols for research in equitation science. J. Vet. Behav. 10 (3), 255–266.

Randle, H., McGreevy, P.D., 2013. The effect of noseband tightness on rein tension in the ridden horse. J. Vet. Behav. 8 (2), e18–e19.

Roome, P., 2015. What’s the real question in the Bertram Allen saga? Available from: http://www.horseandhound.co.uk/blog/bertram-allen-disqualified-olympia-blood-521883. Accessed July 4,2018.

Saunders, M., Lewis, P., Thornhill, A., 2012. Research Methods for Business Students, 6th Ed., Pearson, Harlow.

Schlesselman, J.J., 1974. Sample size requirements in cohort and case-control studies of disease. Am. J. Epidemiol. 99 (6), 381-384.

Steele, J., 2000. Handedness in past human populations: skeletal markers. Laterality, 5 (3), 193–220.

Symes, D., Ellis, R., 2009. A preliminary study into rider asymmetry within equitation. Vet. J. 181 (1), 34–37.

Tell, A., Egenvall, A., Lundstrom, T., Wattle, O. 2008. The prevalence of oral ulceration in Swedish horses when ridden with bit and bridle and when unridden. Vet. J. 178(3), 405–410.

Trosby, E., 2010. Public relations, football and the management of player transgressions in Australia. Public Commun. Rev., 1(2).

Uldahl, M., Clayton, H. M., 2019. Lesions associated with the use of bits, nosebands, spurs and whips in Danish competition horses. Eq. Vet. J. 51(2), 154-162.

VHS, 2018. Rulebook - Veteran Horse Society. Available from: http://veteran-horse-society.co.uk/showing-rulebook/. Accessed July 4, 2018.

Williams, J., Tabor, G., 2017. Rider impacts on equitation. Appl. Anim. Behav. Sci. 190, 28–42.

Wilson, K. E., Dishman, R. K., 2015. Personality and physical activity: A systematic review and meta-analysis. Personal. Individ. Differ. 72, 230–242.

Wolframm, I. A., Williams, J., Marlin, D., 2015. The role of personality in equestrian sports: an investigation. Comp. Ex. Physiol. 11 (3), 133-144.

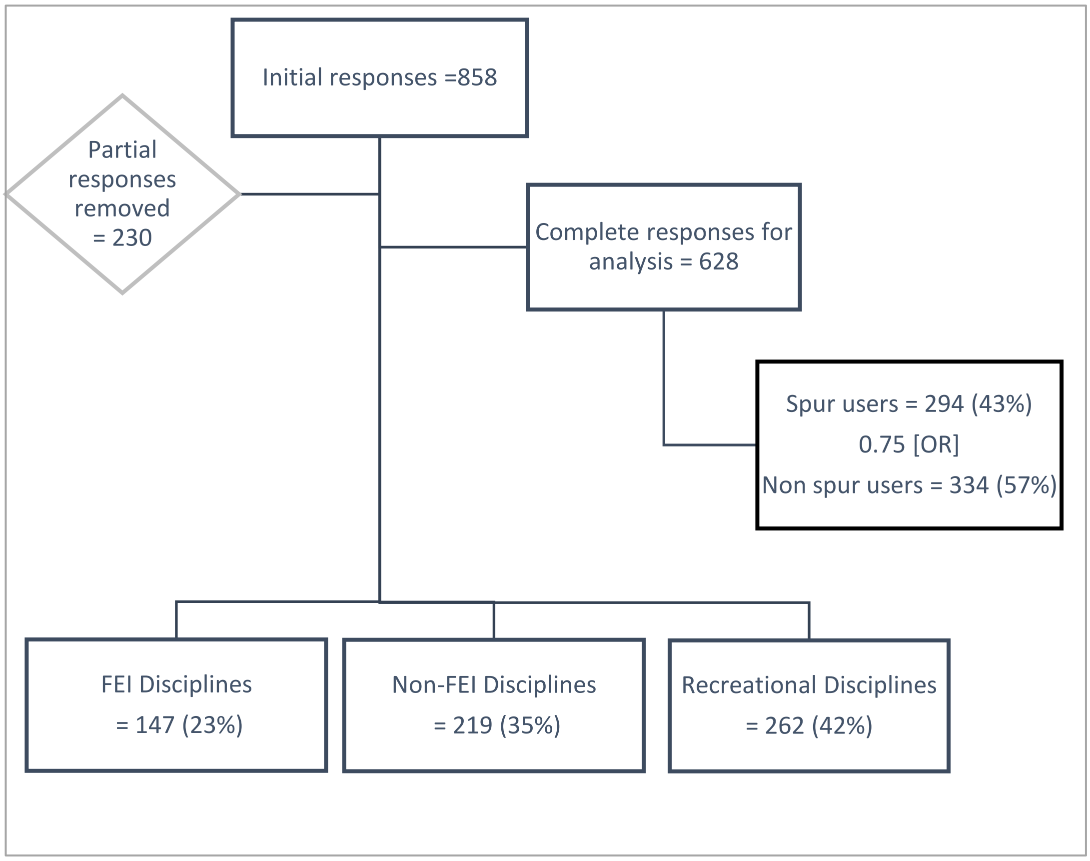

Figure 1: Online survey responses

[Key: FEI Disciplines = Dressage, Show jumping, Eventing, Reining, Endurance; Non-FEI Disciplines = Showing, Polo, Mounted Games, Racing, Horseball; Recreational Disciplines = Riding School, Pony Club, Adult Riding Club, Western, Hacking, Hunting, Natural Horsemanship, British Trec, Positive reinforcement training, Riding for the disabled; [OR]=Odds ratio calculated for spur use].

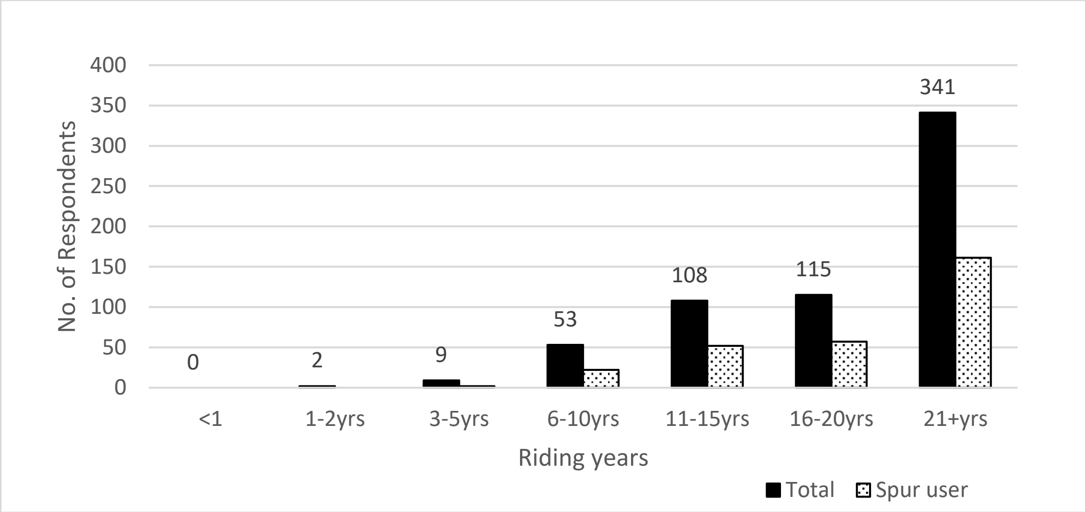

Figure 2 Spur use distribution across years' riding from the 628 respondents.

Table 1 Spur use across equestrian disciplines [Key: OR=Odds Ratio for spur use; Other= see Results]

Category	**Discipline**	**Total *(n)***	**Spur user (% within discipline)**	**Spur users across discipline category [OR]**
RECREATIONAL	Riding School	43	14 (33)	43% **[0.75]**
	Pony Club	35	16 (46)	
	Adult Riding Club	36	14 (39)	
	Western	33	16 (48)	
	Hunting	28	15 (54)	
	Hacking	44	20 (45)	
	Natural Horsemanship	38	16 (42)	
	Other	5	1 (20)	
	-	**262**	**112**	
FEI	Dressage	39	18 (46)	44% **[0.79]**
	Show jumping	32	16 (50)	
	Eventing	33	12 (36)	
	Reining	30	19 (63)	
	Endurance	13	0 (0)	
	-	**147**	**65**	
NON FEI	Polo	37	23 (62)	53% **[1.15]**
	Mounted Games	29	15 (52)	
	NH Racing	37	20 (54)	
	Flat racing	32	15 (47)	
	Horseball	49	25 (51)	
	Showing	35	19 (54)	
	-	**219**	**117**	

Table 4: The effect of spur design and shank length on the prevalence of spur related abrasion [ABR=abrasions].

SPUR DESIGN (p=0.053)					
Spur Type		**Freq. of use**	**% ABR**	**Indiv.[OR]**	**ABR within category [OR]**
Rotating	Vertical Rowel	20	25	0.33	41% [0.69]
	Horizontal Rowel	1	100	1.00	
	Roller plastic	39	44	0.68	
	Roller metal	45	44	0.69	
Fixed	Swan neck	6	17	0.20	31% [0.45]
	Prince of Wales	71	31	0.45	
	Dummy	1	0	-	
	Rounded/blunt end	101	33	0.49	
	Comb	3	0	-	
-	Other*	7	29	0.92	-
	Spursuader	0	0	-	
SPUR SHANK (p=0.026)					
Length		**Freq. of use**	**% ABR**	**Indiv.[OR]**	-
No shank		5	0	-	-
< 25 mm (<1")		183	31	0.45	-
25 – 32 mm (1-1.25")		91	40	0.67	-
>32 mm (>1.25 ")		15	60	1.50	-

Table 5; The effect of discipline and rider level on the prevalence of spur related abrasions in 294 survey responses [Key:ABR=abrasions].

DISCIPLINE (p>0.05)					
Discipline category	**Individual discipline**	**Spur users**	**% ABR**	**Indiv. [OR]**	**ABR within category [OR]**
RECREATIONAL	Riding School	14	36	0.56	43% [0.75]
	Pony Club	16	38	0.60	
	Adult Riding Club	14	14	0.17	
	Western	16	44	0.78	
	Hunting	15	20	0.25	
	Hacking	20	35	0.54	
	Natural horsemanship	16	50	1.00	
	Other	1	0	-	
FEI	Dressage	18	44	0.80	44% [0.79]
	Show jumping	16	25	0.33	
	Eventing	12	25	0.33	
	Reining	19	42	0.73	
	Endurance	0	0	-	
NON FEI	Polo	23	30	0.44	53% [1.15]
	Mounted Games	15	27	0.36	
	NH Racing	20	35	0.54	
	Flat racing	15	33	0.50	
	Horseball	25	40	0.67	
	Showing	19	37	0.58	
RIDER LEVEL (p>0.05) RIDER AFFILIATION (p<0.0001)					
Professional	Affiliated	24	58	1.38	47% [0.87]
	Unaffiliated	12	25	0.33	
Amateur	Affiliated	152	43	0.75	34% [0.52]
	Unaffiliated	85	18	0.22	
Leisure	Leisure Rider	21	19	0.24	19% [0.24]