

Injuries and Illness in Elite Equestrian Athletes: A Two-Season Prospective Study

Verletzungen und Erkrankungen im Elite-Pferdesport: eine prospektive Zwei-Saisonzeiten Studie

Summary

- › **Problem/Intro:** Epidemiological data of injuries and illnesses in equestrian athletes are limited. The objective of this study was to describe the incidence, prevalence, and severity of health problems among a cohort of elite riders.
- › **Methods:** We conducted a prospective cohort study with 38 elite equestrian athletes over a two-year follow-up period. Health problems were recorded weekly with the Oslo Sports Trauma Research Center Questionnaire on health problems and subsequently categorized into illnesses and injuries according to the recently published International Olympic Committee guidelines. Based on the athlete's weekly responses, we calculated health problem prevalence, incidence and severity.
- › **Results:** A total of 93 health problems were reported including 30 illnesses and 63 injuries resulting in a weekly prevalence of 12.1% (95% CI: 10.5-13.7) for all health problems. For acute injuries, the chest, lumbosacral region, and neck were the most commonly reported body locations. The lumbosacral region was the most commonly reported repetitive injury mechanism body region. Illnesses most often affected the upper respiratory and gastrointestinal body systems.
- › **Conclusion:** There was a low prevalence of injuries among this cohort of elite athletes. Future efforts that further improve athlete safety should focus on repetitive mechanism injuries and implementation and scale-up of preventive equipment to the broader equestrian population.

KEY WORDS:

Epidemiology, Acute Injury, Repetitive Injury, Injury Mechanism

Introduction

Equestrian sports are arguably not as widely participated in when compared to other Olympic sports. Nevertheless, it is one of the oldest. When the first Olympic Games were held in ancient Greece, horses and men performed together in chariot races. In the modern games it consists of the three disciplines dressage, show-jumping and eventing. These distinctive events showcase the mastering of a relationship

Zusammenfassung

- › **Epidemiologische** Daten über Verletzungen und Krankheiten bei Pferdesportlern sind begrenzt verfügbar. Das Ziel dieser Studie war es die Inzidenz, Prävalenz und Schwere von Gesundheitsproblemen bei einer Kohorte von Elite-Pferdesportlern zu beschreiben.
- › **Methoden:** Wir führten eine prospektive Kohorten-Studie mit 38 Elite-Pferdesportlern über einen Zeitraum von zwei Jahren durch. Gesundheitsprobleme wurden wöchentlich mit dem „Oslo Sports Trauma Research Center“ Fragebogen erfasst und anschließend in Krankheiten und Verletzungen eingeteilt gemäß den kürzlich veröffentlichten Richtlinien des Internationalen Olympischen Komitees. Wir berechneten die Prävalenz, Inzidenz und Schwere von Gesundheitsproblemen basierend auf den wöchentlichen Antworten der Athleten.
- › **Ergebnisse:** Insgesamt wurden 93 Gesundheitsprobleme gemeldet, darunter 30 Krankheiten und 63 Verletzungen. Das ergab eine wöchentliche Prävalenz von 12,1% (95%CI: 10,5-13,7) für alle Gesundheitsprobleme. Die Brust, lumbosakrale Region und der Hals waren die am häufigsten berichteten Körperteile für akute Verletzungen. Überlastungsverletzungen wurden am häufigsten für die lumbosakrale Region gemeldet. Bei Erkrankungen waren die oberen Atemwege und der Magen-Darmbereich am häufigsten betroffen.
- › **Zusammenfassung:** Es gab eine relativ geringe Prävalenz von Verletzungen in dieser Kohorte von Spitzensportlern. Zukünftige Bemühungen zur weiteren Verbesserung der Gesundheit von Sportlern sollten sich auf Überlastungsverletzungen sowie auf die Implementierung und Erweiterung von verletzungsvorbereitenden Maßnahmen und Ausrüstungen für die breitere Reiterpopulation konzentrieren.

SCHLÜSSELWÖRTER:

Epidemiologie, akute Verletzungen, Überlastungsverletzung, Verletzungsmechanismus

between rider and horse. During dressage, artistic figures and patterns are displayed by the rider and horse. In jumping, different hurdles have to be cleared by rider and horse within a specific time. Eventing is generally considered as triathlon for horses, with a demand of diverse equine attributes (22). All disciplines are held as both individual and team competitions, and men and women compete together (11). ➤

REVIEW

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Table 1

Participant characteristics and average weekly exposure. Data are given as absolute numbers (%), or average (SD).

PARTICIPANT CHARACTERISTICS	
N	38
Female	20 (52.6%)
Male	18 (47.4%)
Age at start of follow-up (years)	36.9 (10.4)
EXPOSURE (AVG. PER ATHLETE PER WEEK)	
Overall (hours)	31.0 (3.3)
Sport specific training (hours)	29.5 (3.2)
Strength & conditioning (hours)	1.5 (0.6)
Competitive events per week (number)	0.6 (0.1)
Horses ridden in competition (number)	3.3 (0.9)

The riders' body is 1.5 to 2 meters above the ground when seated on the horse, which increases the risk for injuries in case of a fall (15). It is therefore no surprise, that acute injuries to the head and extremities are commonly reported in the literature (5, 13, 18-19). These reported rates do not specifically include elite riders and relate mostly to recreational non-competitive athletes. Factors that pertain to elite participation, like the training level of both horse and rider or the increased demands of specific training and competition, however, may affect the injury spectrum.

Nonetheless, season-long epidemiological data of injuries and illnesses in riders remains limited, especially at the elite level. Given this paucity of epidemiological data, the development of measures that intent to protect the riders' health is hampered (20). Consequently, the objective of this two-year prospective study was to describe the incidence, prevalence, and severity of health problems among a cohort of elite riders.

Methods

Study Design

This was a prospective cohort study, spanning two years of follow-up (5 March 2018 to 22 March 2020; a total of 106 weeks). The cohort consisted of all riders (n=38), who were a member of the Dutch Olympic program (TeamNL) during the study period. After de-identification, the data for this study was provided by the medical staff of the Royal Dutch Equestrian Federation (KNHS) from standard weekly health monitoring. To ensure anonymity of athletes, no information on their equestrian discipline was made available. The Medical Ethics Committee of the Amsterdam UMC (location VUmc, Amsterdam, Netherlands) approved the mentioned procedure (registration number 2020.175).

Health Monitoring Procedures

Athletes' health monitoring involved a weekly online survey distributed by e-mail (Briteback, Norrköping, Sweden). Every Monday, athletes were asked to report their training and competition exposure during the past 7 days, as well as any health problems they experienced over that time. If no response was received within 3 days, an automated reminder was sent. If athletes failed to respond for 2 consecutive weeks, they were contacted by the physician of TeamNL (MM).

Training and Competition Exposure

In the weekly survey, athletes reported their training and competition exposure. We divided training exposure into sports specific training (horse riding), strength & condition training, and competition. Exposure was expressed in hours, with the exception of competition exposure which was assessed in the total number of horses ridden at competitive events. Accordingly, we were unable to account for competition exposure in the expression of injury rates.

Health Problem Registration

The Dutch translation of the Oslo Sports Trauma Research Centre (OSTRC) Questionnaire on Health Problems was implemented for illness and injury registration (6, 7, 8, 17). The content and procedure of the OSTRC questionnaire has been described previously (7, 8). In short, the OSTRC questionnaire asks athletes in four questions about any health problems encountered in the previous 7 days, and the problem's consequences on training and competition participation. In case of time-loss, the number of days during which the athlete could not train or compete was registered. Athletes were instructed to report all health problems, regardless of whether or not the athlete already reported the same problem previously or already received treatment. In case a new problem was reported, athletes were asked to specify whether the problem was an injury or an illness. In case of an injury, athletes provided in subsequent questions the injury's anatomical location, cause, and activity during occurrence. Injuries not related to competition nor training (i.e. holidays or home accidents) were excluded from the analysis. In case of illness, athletes reported all symptoms experienced.

Classification and Diagnosis of Reported Health Problems

For the classification, diagnosis and reporting of registered health problems we implemented the recommendations of the recently published IOC guidelines on the recording and reporting of epidemiological data on injury and illness in sports (2, 3, 16). Our health problem registration was, however, implemented before the IOC recommendations were made. As such we could not follow these guidelines to the letter. We explain here only where and why we deviated from the IOC recommendations.

Mode of Onset

Acute mechanism injuries were defined as those injuries with a sudden onset and clearly identifiable injury mechanism. The recent IOC recommendations redefine overuse injuries into repetitive injuries with a sudden or gradual onset. In our data we could only classify injuries with a repetitive mechanism without a further subdivision into a gradual or sudden onset.

Mechanism of Injury

In regard to mechanism of injury, we considered falling with the horse as direct contact with an object, whereas falling from or being launched from the horse as indirect contact through an object.

Recurrences and Exacerbations

Exacerbations were defined as health problems that were reported previously but increased in severity, or problems that re-occurred within four weeks of reported recovery. Recurrences were defined as health problems that were reported previously but occurred more than four weeks ago.

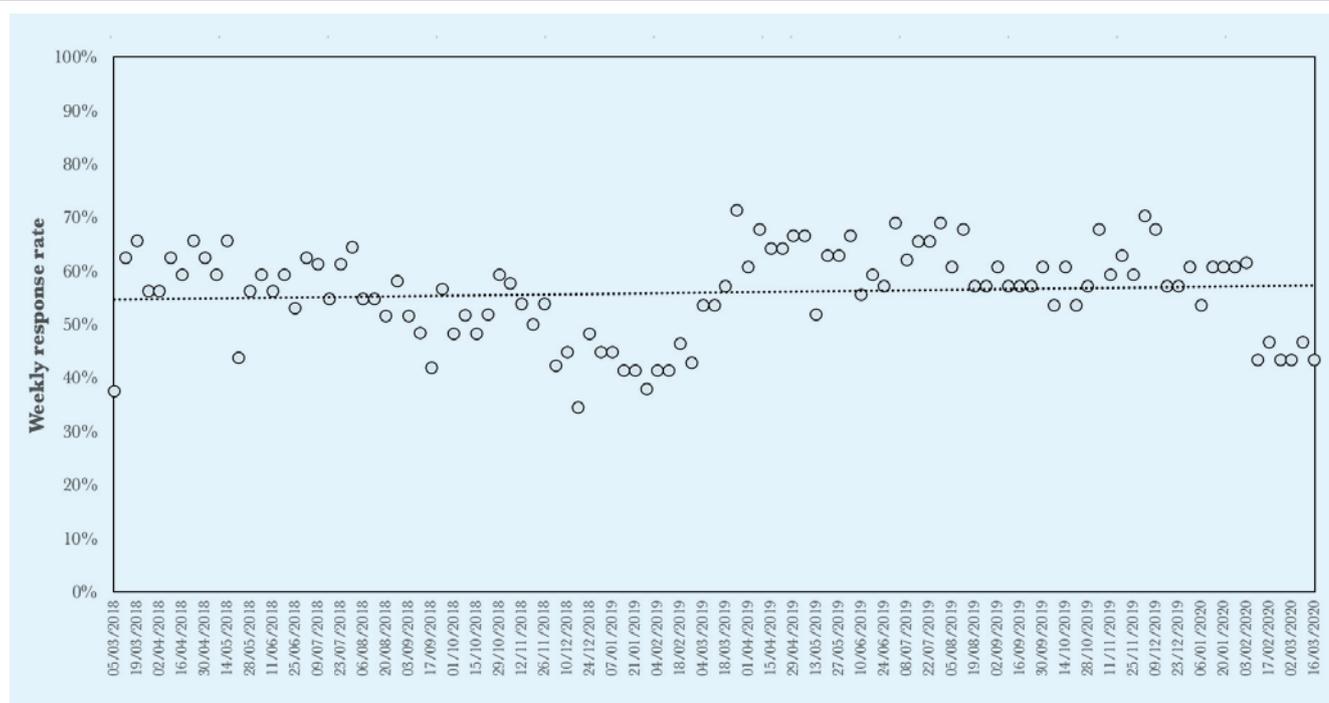


Figure 1

Weekly response rates during the 106-week follow-up.

Statistical Analysis

Means and corresponding standard deviations (SD) were calculated for the baseline demographics. We made prevalence calculations for all and substantial health problems following the methodology outlined by Clarsen et al. (7, 8), which are presented as weekly averages with their respective 95% confidence intervals (CI). For each week, prevalence measures were calculated for reported health problems by dividing the number of athletes reporting a problem by the number of total questionnaire respondents. Substantial health problems were defined as those leading to moderate or severe adaptations in training volume, moderate or severe reductions in performance, or complete inability to participate (7, 8). For acute mechanism injuries, we calculated the injury incidence rate and corresponding 95% CIs as the number of new injuries reported per 1,000 hours of exposure.

As described by Clarsen et al., based on the athletes' responses to the OSTRC questions we calculated a severity score ranging from 0 to 100 each week for each reported health problem (7, 8). The cumulative severity score was calculated for each health problem to value the impact of the problem on the athlete. We also calculated the cumulative time loss in days and burden for each registered health problem as the number of days of time loss per 1,000 hours of exposure.

Results

Population Characteristics

Of the 38 athletes that were included in the study, 17 were part of TeamNL during the entire follow-up period. Table 1 shows the demographics and the average weekly exposure of the athlete population. The average response rate to the weekly surveys was 68.6% (SD 11.7), with the weekly responses ranging from 40.0% (week 42) to 92.3% (week 6, 8, 11) (Figure 1).

Prevalence and Severity of Health Problems

A total of 93 health problems were reported by 33 of the 38 athletes, including 30 illnesses by 16 athletes and 63 injuries by 30 athletes (Table 2). Over the course of the follow-up period, there was no observable trend between the weekly prevalence of health problems and weekly training exposure (Figure 2).

Of all registered health problems, 28 (30.1%) were categorized as substantial, of which 13 were illnesses and 15 were injuries. The average weekly prevalence of all health problems was 12.1% (95% CI: 10.5-13.7) and for substantial problems 4.0% (95% CI: 3.2-4.9). Of all injuries, 43 (68.3%) were new injuries, 14 were recurrences (22.2%) and 6 exacerbations (9.5%). Eight athletes (21.1%) reported no injury during the study, thirteen athletes (34.2%) reported one injury, seven athletes (18.4%) reported two injuries, and ten athletes (26.3%) reported three or more injuries.

Injury and Illness Details

As we have a relatively small population of only 38 athletes and a limited number of reported health problems, we are not able to provide a detailed breakdown of injury and illness patterns with their respective burden. We provide a summary of the results by uniquely reported injuries and illnesses, i.e. excluding exacerbations and recurrences, in Table 3.

Acute Mechanism Injury

A total of 33 unique acute injuries were reported by 21 athletes, corresponding to an average weekly prevalence of 5.2% (95% CI: 4.2-6.2%). The acute injury incidence rate was 0.48 injuries (95% CI: 0.32-0.64) per 1,000 hours of sports exposure. The most commonly reported acute injuries were to the chest, lumbosacral region, and neck, each corresponding to 14.3% of acute injuries (Table 3). Of all acute mechanism injuries 17 (60.7%) occurred via indirect contact through an object (i.e. falling from or being thrown from a horse), followed by 7 (25.0%) injuries through direct contact with an object (i.e. being struck by

Table 2

Absolute numbers, prevalence, severity, and burden of all and substantial health problems. Data are presented as averages (95% CI).

ALL HEALTH PROBLEMS	ALL	ILLNESS	ACUTE MECHANISM INJURY	REPETITIVE MECHANISM INJURY
Number	93	30	33	30
Avg weekly prevalence	12.1% (10.5-13.7)	2.8% (2.0-3.5)	5.2% (4.2-6.2)	4.1% (3.2-5.1)
Avg cumulative severity	102.8 (88.4-117.1)	79.6 (73.1-86.1)	155.8 (144.9-166.8)	63.2 (58.7-67.7)
Avg weekly severity	89.3 (75.0 – 100.0)	22.3 (15.8-28.8)	48.1 (37.1-59.0)	17.7 (13.2-22.2)
Avg time loss (in days)	4.9 (3.9-5.9)	4.8 (4.3-5.2)	8.4 (7.7-9.2)	1.1 (0.8-1.4)
Burden		0.08 (0.01-0.16)	0.15 (0.05-0.25)	0.02 (0.0-0.06)
SUBSTANTIAL HEALTH PROBLEMS	ALL	ILLNESS	ACUTE MECHANISM INJURY	REPETITIVE MECHANISM INJURY
Number	28	13	10	5
Avg weekly prevalence	4.0% (3.2-4.9)	1.4% (0.9-1.9)	2.3% (1.6-2.9)	0.3% (0.1-0.6)
Avg cumulative severity	216.9 (204.3-229.5)	134.0 (128.1-139.9)	393.1 (382.9-403.3)	80.0 (77.0-83.0)
Avg weekly severity	56.8 (44.2-69.3)	16.3 (10.4-22.1)	36.7 (26.5-47.0)	3.7 (0.7-6.8)
Avg time loss (in days)	14.9 (14.0-15.7)	8.6 (8.2-9.1)	26.3 (25.6-27.0)	3.8 (3.6-4.0)
Burden		0.15 (0.05-0.25)	0.46 (0.29-0.64)	0.07 (0.0-0.13)

a horse). Acute injuries in general were the most severe injuries with the highest cumulative severity (155.8; 95%CI: 144.9-166.8), highest time-loss (8.4 days; 95%CI: 7.7-9.2), and highest burden (0.15 days lost per 1,000 hours; 95%CI: 0.05-0.25). The fact that 18 of the 33 acute injuries did not lead to time loss (range 0-22 weeks), signifies that some acute injuries are considerably more impactful than others.

Repetitive Mechanism Injury

A total of 30 unique repetitive mechanism injuries were reported by 16 athletes, resulting in an average weekly prevalence of 4.1% (95% CI: 3.2-5.1%). The most commonly reported repetitive mechanism injuries were to the lumbosacral region (33.3%), followed by the knee (20.0%), and the hip/groin and neck (both 13.3%) (Table 3). Twenty-five of the 30 repetitive injuries did not have any time loss or burden associated with them, suggesting that such injuries have little impact on the ability of the athlete to participate.

Illnesses

The average weekly prevalence of illness was 2.8% (95% CI: 2.0-3.5%). The most commonly registered illnesses based on reported symptom clusters affected the upper respiratory (30.0% of all cases) and gastrointestinal (13.3%) body systems; 14 illnesses (46.7%) were reported without symptoms (Table 3).

Discussion

Our prospective data showed that roughly one in nine athletes in this cohort of elite riders suffers from a health problem at any given time. There were no marked differences between the prevalence of either injury types or illnesses. Acute injuries did have the greatest impact on riders' performance with

the highest average weekly and cumulative severity per injury, as well as the most days lost from participation. The overall injury pattern found in our cohort was similar to the injury patterns established in previous equestrian literature (4, 5, 12, 13, 15, 17, 18). The acute injury rate 0.41 new injuries per 1,000 hours of exposure is, however, very low and not comparable to other studies. In agreement with the findings of Pugh et al. (18), repetitive injuries were most commonly reported for the lumbosacral spine (29.4%) and the knee (17.6%). Illnesses mainly affected the upper respiratory tract, which is in agreement with previous registrations of athlete illnesses (12, 17).

Methodological Strengths & Limitations

There are several methodological limitations that should be considered when interpreting our results. Any injury questionnaire is subject to recall bias, especially if the respondent does not complete the survey within due time. In our data a potential recall effect was minimised by applying the OSTRC questionnaire and following the recommendation to administer the questionnaire weekly (7). Nonetheless, the success of valid data collection is dependent upon the willingness of the participants to complete the weekly OSTRC questionnaire. The fact that we extracted data out of the ongoing health monitoring of the Dutch Olympic program (TeamNL) arguably impacted response rates positively. This approach also improved the accuracy of the registered data as all self-reported health problems were reviewed with the team's sports physician and re-classified if necessary. One important limitation to consider, however, is that in any ongoing health monitoring a clinical intervention is expected once a health problem is reported. This may not have impacted the occurrence of injuries in our report, but likely has reduced the severity of injury and illness.

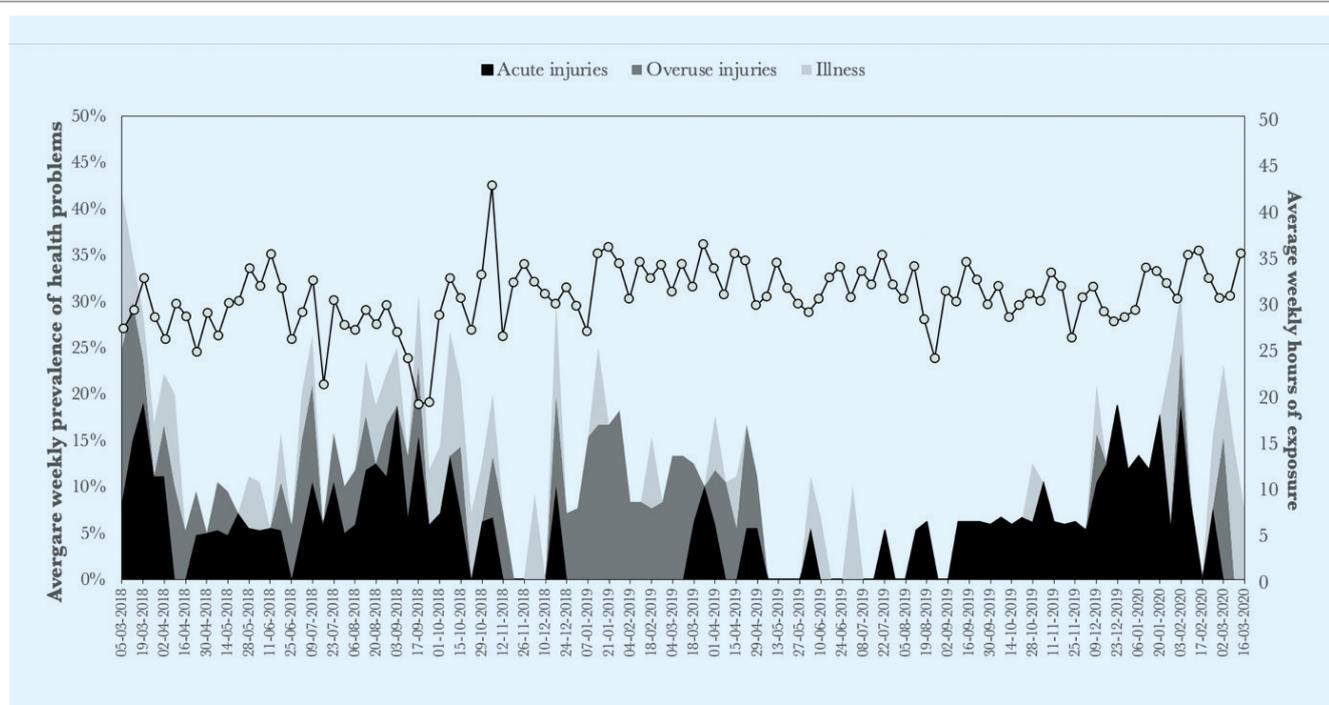


Figure 2

Weekly response rates during the 106-week follow-up.

Conversely, our analysis also had several strengths. As stated, health problems were assessed through the OSTRC questionnaire. This method registers health problems based on injury and illness consequences and is not limited to time-loss injuries alone (6, 7). Our results show a very detailed picture of all injuries and illnesses that are encountered by elite riders. Also, to our knowledge, this is the first epidemiological study that follows the recently published IOC guidelines for injury and illness reporting (2, 3). This provides new insights into the injury patterns, onset mechanisms, and burden of elite riders and may be used as a baseline for further research. Finally, unlike some sports that are able to assemble their athletes for team training, riders often own their own stables and are geographically spread throughout the country. Online health monitoring by means of self-report, provides a feasible valid solution to reach all participants of the national Olympic selection (6, 17).

Clinical Implications

The relatively low incidence and prevalence of injuries among this cohort of elite riders is a positive finding given that equestrianism is considered a high-risk sport. Maybe the professionalism of the sport combined with the availability, and partly mandatory use, of effective preventive measures has positively impacted injury rates. For instance, Andres et al. showed that body protective vests are effective in safeguarding the rider during cross-country events (1). Likewise, the low number of reported head injuries in our study may indicate that the recommendation to wear protective head gear at all times has been effective in reducing trauma to the head (10). With the availability of effective safety equipment, implementation and scale-up of such equipment to the broader equestrian population is critical to have a meaningful impact (21). Such efforts have been described in equestrian sports, but could thrive with a broader push across the sport (9, 10, 14).

Future primary prevention efforts should be directed at repetitive mechanism injuries also. Due to the low number of such injuries in our study we cannot make strong recommendations without further research. Nonetheless, further research could investigate if a strengthening intervention program could reduce the prevalence of injury to the lower back and knee regions since these are known problem areas for repetitive injuries (18).

Conclusions

Our results show that in a cohort of elite equestrian athletes, on average 12% is burdened with a health problem at any given time. We established no differences in the prevalence rates of injuries or illnesses, but we did find that acute injuries have the most severe consequences as shown by average weekly and cumulative severity per injury, as well as the most days lost from participation. We recommend a focus on implementation of measures that prevent or limit the consequences of acute injury, and further research into the onset and prevention of repetitive mechanism injuries. ■

Conflict of Interest

The authors have no conflict of interest.

Table 3

Overview of reported unique health problems by anatomical region (injuries) and classification (illnesses); T=Training; C=Competition; ?=Unreported.

ACUTE MECHANISM INJURY	NUMBER	OCCURRENCE TRAINING VS COMPETITION	AVERAGE CUMULATIVE SEVERITY (RANGE)	AVERAGE DURATION IN WEEKS (RANGE)	BURDEN (95% CI)
Head	2 (7.1%)	T=1; C=1	104.0 (38-170)	1.5 (1-2)	18.8 (7.1-30.4)
Neck	4 (14.3%)	T=3; C=1	74.5 (14-164)	1.3 (1-2)	35.7 (19.6-51.8)
Shoulder	3 (10.7%)	T=1; C=2	149.3 (14-414)	3.7 (1-7)	43.2 (25.6-60.9)
Wrist	1 (3.6%)	T=0; C=1	38.0	2.0	-
Hand	2 (7.1%)	T=1; C=0; ?=1	76.0 (52-100)	1.5 (1-2)	13.2 (3.4-22.9)
Chest	4 (14.3%)	T=3; C=1	98.0 (14-230)	3.3 (1-8)	24.4 (11.1-37.7)
Thoracic Spine	1 (3.6%)	T=1; C=0	135.0	3.0	7.5 (0.2-14.9)
Lumbosacral Spine	4 (14.3%)	T=4; C=0	20.0 (14-32)	1.0 (1-1)	-
Hip/ Groin	2 (7.1%)	T=0; C=0; ?=2	1110.0 (20-2200)	11.5 (1-22)	289.4 (243.7-335.1)
Knee	1 (3.6%)	T=1; C=0	14.0	1.0	-
Ankle	3 (10.7%)	T=0; C=0; ?=3	134.7 (14-300)	2.0 (1-3)	50.7 (31.6-69.9)
Foot	1 (3.6%)	T=0; C=0; ?=1	322.0	17.0	-
REPETITIVE MECHANISM INJURY	NUMBER	OCCURRENCE TRAINING VS COMPETITION	AVERAGE CUMULATIVE SEVERITY (RANGE)	AVERAGE DURATION IN WEEKS (RANGE)	BURDEN (95% CI)
Neck	2 (13.3%)		35.0 (14-56)	2.5 (1-4)	-
Upper Arm	1 (6.7%)		230.0	4.0	0.37 (0.21-0.53)
Wrist	1 (6.7%)		194.0	10.0	-
Lumbosacral Spine	5 (33.3%)		39.2 (14-84)	1.2 (1-2)	-
Hip/ Groin	2 (13.3%)		155.0 (14-296)	5.5 (2-9)	0.07 (0-0.14)
Knee	3 (20.0%)		35.3 (14-72)	1.7 (1-3)	0.02 (0-0.05)
Unspecified	1 (6.7%)		14.0	1.0	-
ILLNESS	NUMBER	OCCURRENCE TRAINING VS COMPETITION	AVERAGE CUMULATIVE SEVERITY (RANGE)	AVERAGE DURATION IN WEEKS (RANGE)	BURDEN (95% CI)
Upper Respiratory	9 (30.0%)		52.9 (14-140)	1.1 (1-2)	0.47 (0.3-0.65)
Gastrointestinal	4 (13.3%)		60.5 (40-100)	1.0 (1-1)	0.26 (0.13-0.4)
Neurological	2 (6.7%)		36.0 (14-58)	2.5 (1-4)	0.04 (0-0.08)
Nonspecific Illness	1 (3.3%)		40.0	1.0	0.02 (0-0.05)
Unspecified	14 (46.7%)		106.4 (14-358)	2.1 (1-9)	1.69 (1.35-2.02)

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