The impact of the mandatory rest period in Fédération Equestre Internationale endurance events

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Summary

Background: Endurance riding competitions are increasingly popular, with a corresponding awareness of the frequency of Failure to Qualify (FTQ) due to lameness or metabolic problems. Fédération Equestre Internationale (FEI) rules require a minimum number of days between competitions, known as a mandatory rest period (MRP).

Objectives: To analyse the impact on FTQ outcomes of MRPs which applied between January 2014 and December 2016, and model potential changes to MRPs to establish which rule change could lead to the largest further reduction in the number of FTQ outcomes.

Study design: Retrospective cohort study and predictive model using a subset of data collected by the FEI of every horse start worldwide in Concours de Raid d'Endurance Internationale (CEI) competitions between 2010 and 2017.

Methods: Descriptive statistics followed by predictive/retrospective modelling of potential scenarios. Scenarios involved extended MRP for all horses and/or for only the fastest ridden horses.

Results: There were clear direct benefits demonstrated from the introduction of MRPs. Among directly-affected horses, current MRPs could have prevented 2.3% of FTQ outcomes. Further benefits could be gained by extending MRPs. The ‘best-value’ impact could be found in a one-week extension for all horses plus a one-week extension for the fastest ridden horses – which could result in a reduction of up to 11.5% of FTQ outcomes among directly-affected horses.

Main Limitations: The data set covers all FEI competitions but no National Federation events. The data set is geographically comprehensive, but it does not include every competition started by every individual horse. Training data for each horse was not available.

Conclusions: Mandatory rest periods for horses between endurance competitions have had the intended impact of reducing numbers of FTQ outcomes in CEI events. Further benefits could be gained by extending rest periods for all horses and/or for horses ridden at the highest average speeds.

Introduction

The Fédération Equestre Internationale (FEI) equestrian discipline of endurance consists of long-distance riding – in the most common one-day competition format, over courses of between 80km - 160km in length - and is arguably one of the most challenging disciplines for both horse and rider. According to the FEI description, “although the rides are timed, the emphasis is on finishing in good condition rather than coming in first” [1]. As such the primary aim of the FEI endurance rules is to protect the welfare of the horse [2]. FEI rules govern both FEI-run international-level events, and National Federation-run national-level events. One such rule is that endurance course are split into between three and six stages – called loops – and horses must pass veterinary inspections (also called “vet gates”) at the end of each stage in order to continue on. Furthermore, horses are not deemed to have successfully completed the course until they pass the final veterinary inspection after crossing the finish line. Another rule intended to protect the welfare of the horse is the “mandatory rest period” (MRP) which must be observed by each horse participating in any endurance competition. Since 2014 the length of the MRP has been linked to the distance covered by a horse during the competition and specifies the number of days until that horse is permitted to next compete. The word “rest” is a misnomer, as horses commonly continue to train during this period. The goal of the MRP is to ensure a minimum time between competitions to allow time for the horse to recover from the physical effects of endurance competition. In the rules, first introduced in 2014 and subsequently refined, additional MRP time is added if a horse is deemed to exhibit irregular gait during a veterinary examination. If the horse required immediate invasive treatment, such as intravenous fluid, then a fixed extended rest period applies. Table 1 shows the MRP rules as they applied between 2014-2016. The rules were updated in 2017 and 2018 with minor changes but for the purposes of this study the rules as they applied in 2014 were used.

Equine welfare in endurance competition has been the subject of several epidemiological studies in recent years [2-8] and the risk factor “days over MRP” was recently defined [8] – describing the number of days in addition to the applicable MRP before a horse competed in its next FEI event. The current paper presents an analysis of the impact of the MRP in terms of reducing the incidence of

Failure to Qualify (FTQ) outcomes, and uses predictive models applied retrospectively to historical data to determine the additional benefit that might be expected should longer MRPs be introduced.

Materials and methods

Data from the FEI Global Endurance Database (GED) was used. The GED contains detailed records of every horse start in international-level (Concours de Raid d'Endurance Internationale [CEI]) endurance competitions worldwide. The GED is publicly-accessible on the FEI website in a reduced format [9], and through direct collaboration with the FEI the authors were granted access to the raw data for this study. A total of 113,834 horse starts were recorded in the GED between 1st January 2010 and 31st December 2017. For each horse start the GED records individual information about the horse and rider along with the ride outcome and the riding speed over completed stages. Potential ride outcomes (and codes) are as follows: (1) Result (R): the horse and rider completed the ride safely, including passing the final veterinary inspection; (2) Retired (RET): the rider/trainer elected not to continue after successfully passing any veterinary inspection during the ride; (3) Disqualified (DSQ): the rider was disqualified for a breach of rules; (4) Finished, not Ranked (FNR): the horse and rider completed the ride after the specified time limit for the event; (5) Withdrawn (WD): the horse did not present at the pre-ride veterinary examination or did not show up to the event; (6) Eliminated (EL): the horse was eliminated during a stage of the ride i.e. before a vet gate. EL was commonly accompanied by a reason; (6a) Failure to Qualify (FTQ): technically a subset of EL outcome; the horse was eliminated because it failed to pass a veterinary examination. FTQ was usually accompanied by a subcategory indicating the nature of the FTQ; (6b) FTQ due to lameness (FTQ LA): indicating that the horse was eliminated for displaying signs of irregular gait or other musculoskeletal problems identified during a veterinary inspection; (6c) FTQ due to metabolic problems (FTQ ME): indicating that the horse was eliminated for clinical signs such as high heart rate or dehydration, identified during a veterinary inspection. In this analysis EL outcomes accompanied by a reason (either LA or ME) were treated as the relevant type of FTQ.

The cohort selected for this retrospective study were those individual horses that were recorded as having competed in two or more one-day competitions during the period 1st January 2010 – 31st December 2017 – a total of 82,098 so-called "returning horse starts".

For each horse start in the cohort, the number of days since the horse's previous FEI ride was computed. Separately, the applicable MRP was computed based on the 2014-2016 rules shown in Table 1. The new risk factor "days over MRP" was calculated as the number of days from the end of a horse's MRP until its next endurance competition. For example, if a horse successfully completed a 120km competition, it would have an MRP of 19 days. If it was then ridden again in another FEI ride 21 days after completing its first competition, the horse would have a "days over MRP" of 2 days (21 subtract 19). This calculation was performed for each successive pair of events in which each horse competed.

A bespoke analysis code was written in MATLAB 2017b (MathWorks). The initial analysis (summarised in Supplementary Information) consisted of multivariable logistic regression modelling to identify statistically significant associations between rest periods and FTQ outcomes. The focus of the present paper is on retrospective-predictive modelling using a succession of refined univariable models which assessed the potential effects of alternative extended MRP rules on FTQ outcomes. It was hypothesised that in addition to MRP being determined by distance covered in a horse's previous competition, modelling MRPs accounting for the average riding speed over completed stages would have additional benefit to endurance horse welfare, by reducing the number of expected FTQ outcomes [8].

The predictive model operated as follows: Days over MRP were grouped by week with two exceptions. The category "less than 1 day over MRP" was comprised of horse starts before 2014 i.e. before the 2014 MRP rules were introduced. This meant there were a small number (3,617) of horse starts with a negative "days over MRP" measure. The next category "1-2 days over MRP" included horses that returned to competition immediately after their MRP ended. The reference category "more

than 30 days over MRP" was selected to analyse the effects on FTQ outcomes of horses competing in quick succession.

Consider the hypothetical scenario where all other risk factors were unchanged, but the 2014-2016 MRP rules had applied since 2010. Then none of the horse starts in the category "less than 1 day over MRP" could have taken place when they did. Those horse starts would have instead most likely happened within the next category in the time sequence "1-2 days over MRP". This led to a hypothetical categorisation of horses by days over MRP that was different from the true categorisation. Paired univariable models were constructed to compare the true categorisation (and outcomes) to the hypothetical categorisation (and outcomes). The odds ratios observed in each pair of models was used to predict how many FTQs would have occurred in the hypothetical scenario.

This approach was then extended to examine other potential MRP scenarios based on three model proposals: 1) extend MRPs for all horses through an increase to all existing MRPs; 2) extend MRPs for only horses ridden at average speeds greater than 20km/h over completed stages; and 3) extend MRPs for all horses, plus an additional rest period applicable for horses ridden at average speeds faster than 20km/h over completed stages. Extensions of +7 and +14 days were modelled for each combination of proposals, resulting in a total of nine hypothetical MRP scenarios.

Results

Figure 1 shows the elimination data for the full cohort of horses. The proportion of horse starts resulting in successful completion (R outcomes) increased as rest period increased, and the proportion of starts ending in failure to qualify (FTQ LA or FTQ ME outcomes) decreased as rest periods increased. An example multivariable model is shown in supplementary information – establishing the statistical significance of the risk factor "days over MRP" in the context of 22 other risk factors associated with horses with more than one appearance in the database. The results of this multivariable model, although updated here with additional data and MRP information, have been reported and discussed previously [8].

Table 2 shows an example detailing the stages of calculation in the retrospective-predictive model.

The analysis was repeated for the eight other MRP rules scenarios that were modelled. Table 3 shows the total number of FTQ outcomes that could have been prevented under these scenarios. Table 3 also indicates the proportion of existing FTQ outcomes in each category that could have been prevented, had the rules scenario been introduced in 2010. The 2014-2016 MRP rules represent the smallest reduction in number of FTQs at 58 (2.3% [95% confidence interval -9.7% -12.2%] of all FTQs among horses in both the "<1 days" and "1 – 2 days" categories). An extension of seven days for those horses ridden at average speeds greater than 20 km/h reduced FTQ outcomes by 9.3% [-1.7% - 18.5%] (n=294). An extension of 14 days was associated with a smaller reduction of 8.6% [-3.3% - 18.5%] (n= 32 fewer FTQ outcomes). An increase to MRP of seven days for all horses was predicted to reduce FTQs by 7.3% [-2.1% - 15.1%] (n=309), rising to a reduction of 10.7% [1.2% - 18.8%] (n=512) if implemented along with a seven-day increase in MRP for speed. An increase of 14 days for all horses was predicted to reduce the number of FTQs by 10.4% [-0.2% - 19.4%] (n=614), rising to a reduction of 11.5% [0.6% - 20.7%] (n=726) if implemented in conjunction with a seven-day increase in MRP for speed.

Discussion

Under the assumptions of the predictive models, the MRP rules introduced in 2014 have potentially prevented up to 58 FTQ outcomes – 2.3% of horse starts within the "less than one day over MRP" and "1 – 2 days over MRP" categories. Beyond the headline reduction in number of deleterious outcomes, there is additional benefit provided by ensuring that all horses are ridden at a reduced overall risk of FTQ. The association between shorter rest period and increased odds of FTQ outcome means that any intervention - applied to all horses - designed to extend short rest periods reduces the risk of FTQ for every horse start. The intervention of MRPs in the form introduced in 2014 has been a small victory in improving equine welfare – a clear benefit has been gained from a specific regulatory change. However, the modelling contained in this paper indicates that further potential benefit is achievable with longer and perhaps more targeted MRPs for those horses that genuinely require them.

In endurance, the risk factor “days since horse’s last FEI ride” has been reported to be significantly associated with FTQ outcomes [7]. It was reported that horses that had last competed in an FEI ride more than 90 days ago were at reduced odds of FTQ compared to horses with one or more FEI rides in the last 1-90 days. Note that this risk factor is slightly different to the one focussed on here: in the present study almost every horse with 90+ days since their last FEI ride were included in our reference category of 30+ days over MRP. Risk factors relating to rest time or intensity of riding schedule have been investigated in some studies of Thoroughbred racing. Horses in North America [12] and in Victoria, Australia [10] with one or more race in the previous 31-60 days before the race studied were associated with increased odds of fatality compared to horses with zero races in that time. In California, USA horses with 35 furlongs of accumulated distance at speed within 2-months prior to racing were at increased odds of fatal skeletal injury compared to horses with 25 furlongs of accumulated distance [11]. Thoroughbred studies focus on different outcomes, but the underlying physical effects (with respect to the musculoskeletal system) are likely to be similar for endurance horses. For a review of the bone damage over time that can be accumulated by horses due to riding long distances and/or at high speeds, see [13]. Without an appropriate amount of time between competitions, during which a horse’s musculoskeletal system can recover from the physical stress of riding over long distances, the horse is at increased risk of developing an injury. The damage accumulated to a horse’s bones would be further compounded for those endurance horses ridden at particularly high average speeds.

An aspect that remains elusive in the majority of Thoroughbred epidemiological studies is the ability to accurately account for training regimens and the same is true of studies on endurance competitions. Greater emphasis on including details of training histories could provide valuable insight, leading to predictive models with a high positive predictive value, and greater potential benefit in terms of equine welfare.

For results of the predictive models presented here to be implemented practically, potential drawbacks must be considered.

More than 70% of horses returned to competition after more than 30 days beyond the applicable MRP. However, a small number of competing horses – in this data set, those horses that returned to

competition very soon after their MRP had passed – would be affected by increasing the MRPfor all horses. In the simulated scenarios above, had the 2014 MRP rules been implemented in 2010, 4.4% of horses would have had a longer enforced period between competitions. Even if scenarios with a larger MRP increase were implemented, such as a standard increase of 14 days and an additional increase of seven days for speed, the proportion of horses with an enforced longer MRP would have been 14.4%.

It is important to note that while FTQ outcomes are standard categories, they embody a range of conditions. FTQ due to lameness outcomes can range from minor to severe. FTQ due to metabolic problems can be an outcome due to the horse's heart rate recorded at a veterinary inspection being above the maximum beats per minute specified by the rules, or it could be a consequence of serious dehydration or other metabolic condition requiring invasive treatment. Nevertheless, it has previously been demonstrated that each FTQ outcome recorded by a horse increases their odds of another FTQ in a future competition [8]. Any intervention expected to reduce the number FTQ outcomes (regardless of severity) will therefore ultimately reduce the number of serious FTQ outcomes.

The main limitation of this study is that the GED contains every horse start worldwide in FEI-level competitions but does not include national federation level rides. The MRP rules affect both national and FEI competitions but, an unknown proportion of horses in this study are likely to have taken part in national-level rides in the time between their recorded FEI competitions (while still adhering to the relevant MRP regulation). This is an important missing component of each individual horse's history. However, assuming that the majority of competitors follow the rules, the majority of such cases are likely to be within the reference category of horses with more than 30 days over MRP between competitions. The main results of this study affect horses competing in a second FEI competition 7-14 days after the MRP from their first FEI competition has passed. Even assuming a 12-day MRP for completing 80km, these horses would have returned to competition after at least 19-26 days in absolute terms. According to the rules since 2014 no horse would be able to complete, for example, an 80km FEI ride, subsequently compete in an 80km national ride 12 days later (the MRP for covering 80km), and then return to FEI competition within 24 days of their first FEI ride.

This study was specifically focussed on horses returning to competition within 30 days of their MRP. The reference category of horses with more than 30 days over MRP since their previous FEI ride contained some horses that had periods of several months or even years between starts. There are many other injury or illness-related factors that could affect the future likelihood of FTQ for those horses that would not necessarily be present in horses starting two or more competitions in relatively quick succession. As noted above, horses that spent time competing in national-level competitions between their FEI rides would also be contained in the “more than 30 days over MRP” category. In addition to the national-level ride data, information about veterinary records that could contribute to the risk of FTQ for horses with extended time between competitions, in particular, would be a valuable addition to the scope of data for these types of investigations.

Despite the drawback of incomplete competition history and lack of training data, this study was able to demonstrate actionable results which could be implemented through regulatory change. Extending MRPs could lead to reduced numbers of FTQ outcomes. An increase of seven days to all MRPs would have a positive impact upon equine welfare by reducing the risks to which all horses are exposed. An additional increase for horses ridden faster than 20km/h over completed stages would help to protect those horses from future FTQ outcomes by allowing them extra time to recover from the physical strain of riding long distances at higher speed. When MRP rules were first introduced, some adjustment to competition schedules was required. Should changes such as those suggested here be implemented, further adjustment to schedules might be required. That should be regarded as a small price to pay to protect the welfare of the horse.

Conclusion

These results provide actionable and evidence-based recommendations for the endurance industry stakeholders. An update to the rules about mandatory rest periods based on these results is part of the current considerations of the FEI Endurance Temporary Committee which is due to present wholesale rule changes for the sport at the FEI General Assembly in November 2019. This demonstrates the benefit that can come from forming partnerships between industry/stakeholders and academia. Such studies help to provide the best evidence base on which to formulate new regulations aimed at minimising equine risk and/or maximising welfare.

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Figure 1

Bar chart showing the proportion of horse starts which successfully complete (R outcome), fail to qualify due to lameness (FTQ LA), or fail to qualify due to metabolic problems (FTQ ME), for each category of the horse-level risk factor “days over mandatory rest period (MRP) since previous Concours de Raid d’Endurance Internationale (CEI) ride”.

Table 1

Mandatory rest periods (MRP) as specified by the 2014-2016 FEI rules [1] – the number of days a horse must wait after competing in an endurance competitions before starting another CEI or national-level ride. The MRP depends on distance covered and is extended if the horse failed to qualify due to irregular gait or if it required immediate invasive treatment.

Distance completed in last ride	MRP (days)	MRP if "irregular gait" (first incident)	MRP if "irregular gait" (second successive incident)	MRP if "invasive treatment" (first incident)	MRP if "invasive treatment" (second incident within three months)
Start – 40km	5	19	26	60	90
Over 40 – 80km	12	26	33	60	90
Over 80 – 120km	19	33	40	60	90
Over 120 – 140km	26	40	47	60	90
Over 140km	33	47	54	60	90

Table 2

An example showing the stages of calculation in the retrospective-predictive model. In this case the hypothetical scenario was that the 2014-2016 mandatory rest period (MRP) rules had been introduced in 2010. Outcomes studied were failure to qualify due to lameness (FTQ LA) and failure to qualify due to metabolic problems (FTQ ME). This process was repeated for each of the nine scenarios studied, and the final results calculated in step 6 below are collected in Table 3.

Step 1: Calculate days over MRP distribution for data					Step 2: Univariable logistic regression model for each FTQ outcome			
Days over MRP	Starts	FTQ LA outcomes	FTQ ME outcomes		OR (95% CI) – LA outcomes	P-value	OR (95% CI) – ME outcomes	P-value
<1	3617	1216	327		1.63 (1.52 – 1.76)	<0.001	1.51 (1.34 – 1.70)	<0.001
1-2	2301	751	205		1.56 (1.43 – 1.71)	<0.001	1.49 (1.28 – 1.72)	<0.001
3-9	4543	1377	366		1.40 (1.31 – 1.50)	<0.001	1.33 (1.19 – 1.49)	<0.001
10-16	4579	1351	291		1.35 (1.26 – 1.44)	<0.001	1.03 (0.91 – 1.17)	0.62
17-23	4075	1203	266		1.35 (1.26 – 1.45)	<0.001	1.06 (0.93 – 1.21)	0.36
24-30	3662	1049	252		1.30 (1.20 – 1.40)	<0.001	1.12 (0.98 – 1.28)	0.09
>30	59321	14032	3662		1 (reference)			
Step 3: Calculate new distribution for hypothetical scenario e.g. 2014 MRPS introduced in 2010:					Step 4: Calculate expected number of FTQs for new distribution using Odds Ratios from step 2.			
Days over MRP	Starts	FTQ LA outcomes	FTQ ME outcomes		Expected FTQ LA outcomes (95% CI)		Expected FTQ ME outcomes (95% CI)	
<1	0	0	0		0		0	
1-2	5918	1967	532		1914 (1742 – 2117)		527 (452 – 625)	
Step 5: Calculate difference between recorded (real data) and expected outcomes (hypothetical scenario)					**Step 6: Sum together for final results and calculate percentage of FTQs prevented under scenario**			
FTQ LA outcomes prevented (95% CI)		FTQ ME outcomes prevented (95% CI)			**FTQ outcomes prevented (95% CI)**		**Proportion of FTQs prevented among directly affected starts (95% CI)**	
53 (-150 – 225)		5 (-93 – 80)			**58 (-242 – 305)**		**2.3% (-9.7% - 12.2%)**	

Table 3

Results of the retrospective-predictive models showing the number of failure to qualify (FTQ) outcomes that could be prevented by mandatory rest periods. Nine hypothetical scenarios were investigated, simulating the effect of mandatory rest period (MRP) rules having been introduced in 2010.

Hypothetical scenario of MRP rules since 2010	Number of horse starts directly affected (percentage of cohort)	Number of FTQ outcomes among directly affected starts	FTQ outcomes prevented (95% confidence interval)	Proportion of FTQs prevented among directly affected starts (95% CI)
2014-2016 MRP rules [Table 1]	3617 (4.4%)	2499	58 (-243 – 305)	2.3% (-9.7% - 12.2%)
Increase 7 days for all horses	5918 (7.2%)	4242	309 (-88 – 641)	7.3% (-2.1% - 15.1%)
Increase 14 days for all horses	10461 (12.7%)	5884	614 (-11 – 1142)	10.4% (-0.2% - 19.4%)
Increase 7 days for high average speed[1]	4949 (6.0%)	3157	294 (-55 – 585)	9.3% (-1.7% - 18.5%)
Increase 7 days for all, and 7 days for speed	7459 (9.1%)	4773	512 (57 – 897)	10.7% (1.2% - 18.8%)
Increase 14 days for all, and 7 days for speed	11817 (14.4%)	6313	726 (38 – 1309)	11.5% (0.6% - 20.7%)
Increase 14 days for high average speed	6682 (8.1%)	3769	32 (-124 – 698)	8.6% (-3.3% - 18.5%)

[1] "high average speed" defined as average riding speed over completed stages of greater than 20 kilometres per hour

Increase 7 days for all, and 14 days for speed	9099 (11.1%)	5283	553 (19 – 1006)	10.5% (0.4% - 19.0%)
Increase 14 days for all, and 14 days for speed	13219 (16.1%)	6776	640 (-236 – 1301)	9.4% (-3.5% - 19.2%)

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