

Risk factors and elimination rates due to lameness in New Zealand endurance races

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Abstract

Recently there have been a number of publications examining risk factors and elimination rates from endurance competitions. Several risk factors have been identified for elimination due to lameness. Although research has been done in many countries all over the world, there is little known about endurance competitions in New Zealand. Specific information about risk factors and elimination rates for lameness in New Zealand has never been researched before. Therefore, the aim of this study was to identify and quantify the risk factors and elimination rates due to lameness during Endurance rides in New Zealand. This data should provide a reference point for comparison with data from other FEI endurance countries.

Data from every endurance competition organised in New Zealand from September 2010 to March 2013 were downloaded from the Equestrian Sports of New Zealand website

(www.nzequestrian.org.nz). When available, the following information was classified as variables within the database; ride location, date of the ride, ride level, ride distance, horse gender and horse age. The distribution of the number of horses that were eliminated due to lameness and the non-lame group of horses were assessed using a Chi-square test. Single table analysis was performed to calculate the association between the variables and the outcome of elimination due to lameness. Variables with values of $P < 0.21$ were used for multivariable logistic regression.

In total 4,168 horse entries were included. Of these, 3460 entries qualified for the ride (83%) and 542 entries got eliminated by veterinarians (13%), of which 412 were eliminated due to lameness. Major risk factors appear to be the variables ride distance and ride level. Rides during the National Championships are associated with increased risk as well. The overall elimination rate due to lameness was 10%, which is low in comparison with the rest of the World.

The following physical parameters are checked: general condition, respiratory system, heart rate, heart sounds, colour of mucous membranes, capillary refill time, skin recoil, gastrointestinal sounds, gait evaluation, soreness, lacerations and wounds. According to the FEI, a horse should be eliminated for lameness when there is a consistent lameness visible while trotting in a straight line on a loose rein. [1, 4] A horse may also be eliminated if there is another cause which could compromise the welfare of the horse. [1]

Recently there have been a number of publications examining risk factors and elimination rates from endurance competitions [2-5] with elimination rates due to metabolic reasons and lameness in endurance rides ranging from 10% to 60%. [4] A contributing factor to the variation in elimination rates reported is that every ride is held in a different geographical location which leads to large variation in weather and terrain. The percentage of lame horses eliminated can vary from 9% [4] to 32% [6] depending on the circumstances during the rides. In a study with purebred and crossbred Arabians in a 120 km endurance ride, the elimination rate due to lameness was 17%. [5] Another study with different length rides (40, 80 and 120 kms) reported a similar elimination rate due to lameness of 18%. [3] In the USA during 2007 a much lower elimination rate of 9% was reported. [4] There may be some regional or country based differences in elimination rates. With data pooled from FEI rides of more than 100 km in nine different countries (Australia, France, Italy, South Africa, Spain, United Arab Emirates, UK, Uruguay and USA), 32% of the horses were eliminated due to lameness. [6] In a recent study examining risk factors for eliminations in FEI endurance rides from all participating countries an elimination rate of up to 50% was reported, of which 30% were due to lameness [2]

Several risk factors have been identified for elimination due to lameness. Horses aged 11-15 years were more often eliminated (OR=13,44) than horses aged 6-10 years. Reasons proposed for this greater risk were the possibility of older horses having greater wear and tear and the difficulty in managing the training load in relation to the horse age. [5] Additionally, a more cautious and moderate racing strategy for younger horses may lead to a lower number of eliminations. [4]

The distance of the ride has also been identified as a risk factor with an increased risk of OR=1,04 per mile identified with a higher elimination rate. [4] Horses competing in rides over 130 km were at higher risk getting eliminated due to lameness (OR=1,18) than horses competing in 100-130 km rides and the completion rate in 80-100 km was higher than in distances of 120-160 km. [2, 7] The country where the endurance ride was organised has also been identified as a risk factor [2, 6] with endurance horses participating in competitions held in the UK (OR=1,69) and Uruguay (OR=2,11) at higher risk to getting eliminated due to lameness than horses participating in endurance competitions held in South Africa. [6] Terrain, climate, training methods and riding style were identified as factors contributing to this significant difference. [2] In a subsequent paper Nagy et al. reported that hard or deep going were not significant risk factors for getting eliminated due to lameness. Though, it must be noted that these measurements were subjective. [7] In an attempt to quantify the welfare of the horse the following physical parameters are checked by the veterinarian during the examination: heart rate, skin recoil, colour of mucous membranes, intestinal motility, capillary refill time and soreness. Exhausted horses show clinical signs like increased heart rate. [4] According to Fielding et al., special attention should be paid to the heart rate and its recovery at the veterinary examinations.

They also found that examination of the physical parameters is important both prior to the start of the ride as during the ride. Although abnormalities in gait during the ride are a risk factor to get eliminated due to lameness, abnormalities prior to the ride are no significant risk factor. Of course it has to be noted that lame horses shouldn't compete anyway. Lastly, soreness of the back was also associated with elimination due to lameness [4].

Despite the above mentioned research in many countries all over the world, there is little known about endurance competitions in New Zealand. New Zealand has been included in a study only once before; this study was about describing risk factors for elimination during FEI endurance rides all over the world. [2] Specific information about risk factors and elimination rates for lameness in New Zealand has never been researched before. Therefore, the aim of this study was to identify and quantify the risk factors and elimination rates due to lameness during Endurance rides in New Zealand. This data should provide a reference point for comparison with data from other FEI endurance countries.

Material and methods

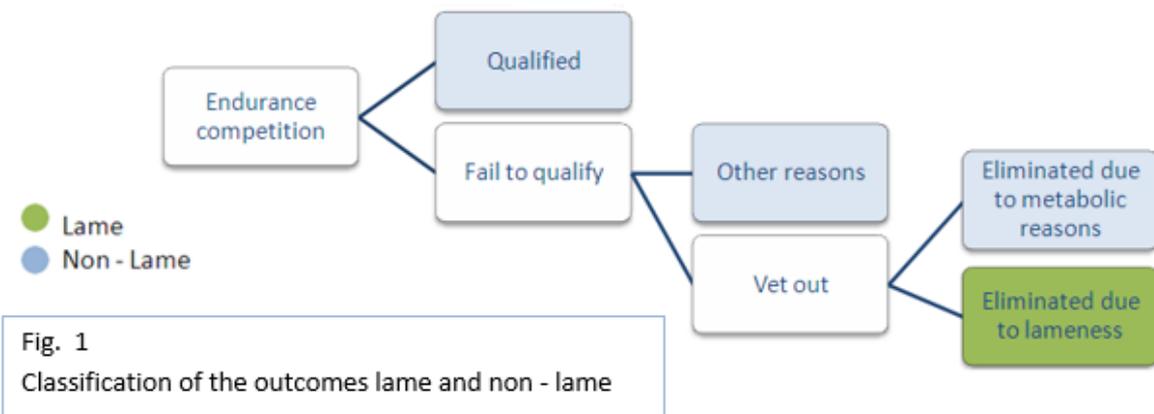
Data

Data from every endurance competition organised in New Zealand from September 2010 to March 2013 were downloaded from the Equestrian Sports of New Zealand website (www.nzequestrian.org.nz). The information obtained was entered into a customised Access database, each rider/horse

combination on every ride was assigned an unique identification number. A rider/horse combination was treated as a unique entry. In total, 4168 entries were used. Entries either qualified the race or didn't. Reasons for failing to qualify were retirement, disqualification or not found fit to continue by the veterinarian. Horses not fit to continue were eliminated due to lameness, for metabolic reasons or other reasons. In total 412 entries were eliminated due to lameness and therefore classified as lame. All other entries were classified as non-lame. This can be seen in figure 1.

When available, the following information was classified as variables within the database. Ride clubs which are located on both the North and the South Island, forming two groups in a variable called location. A third group was added, called the National Championships. The date of the ride was also included and classified into two variables: month and year.

Rides were categorized in different levels; CEN Novice, CEN Open, CEI 1*, CEI 2* and CEI 3*. These groups formed the variable called level. Rides covered different distances as well, ranging from 40 – 160 km. In total, eight groups were used in the variable distance. Horse gender and age information were also included as variable. Horse gender was grouped in male and female horses. Horse age groups were classified as: 5 years and under, 6-10 years, 11-15 years, 16-20 years, 21 years and over. Both horse gender and age count were based on the number of entries which means that some horses might be included several times.



Statistics

Data were imported from Access into an Excel spreadsheet and then analyzed using the statistical programme CDC Epi Info™. Within variables groups with the largest number of entries were used as the reference.

The distribution of the number of horses that were eliminated due to lameness and the non-lame group of horses were assessed using a Chi-square test. Single table analysis was performed to calculate the association between the variables and the outcome of elimination due to lameness. Variables with values of $P < 0.21$ were used for multivariable logistic regression. This was performed using the statistical software STATA. Variables with values of $P < 0.05$ were considered as significant. The categories and outcomes are summarized in tables 2 and 3.

Results

General

The season of endurance riding starts in August and ends around May or June. During the three seasons investigated, 540 rides were held. On the North Island 320 rides were organised and 220 rides were organised on the South Island. There was a variation from 1 to 37 rides organised per month. In total, there were 4,168 entries. On the North Island, there were 2,924 entries and there were 1,245 entries on the South Island. During the season, the number of entries varies between 11 and 301 per month. Endurance competitions in New Zealand in the years 2010-2013 were organised by 17 ride clubs. Eleven of these ride clubs are located on the North Island and six are located on the South Island. The total number of entries during these years varied between 19 and 671 per ride club. The average of starts during the National Championships was 95 entries.

As seen in figure 1, most entries were either 40 or 80 kilometres distance. There were respectively 1,651 and 1,480 entries compared to a small group of 693 entries that started in the 100, 120 and 160 km class. The distribution of entries reflects the number of riders offered each distance with most rides

being 40 km distances followed by 80 km distances.

As seen in figure 2, most entries were at the CEN Novice and CEN Open level. A small group of top riders are in the highest CEI levels. Most rides (245) were organised for the CEN Open level, followed by 237 CEN Novice rides. The average of CEI rides organised per level was 20.

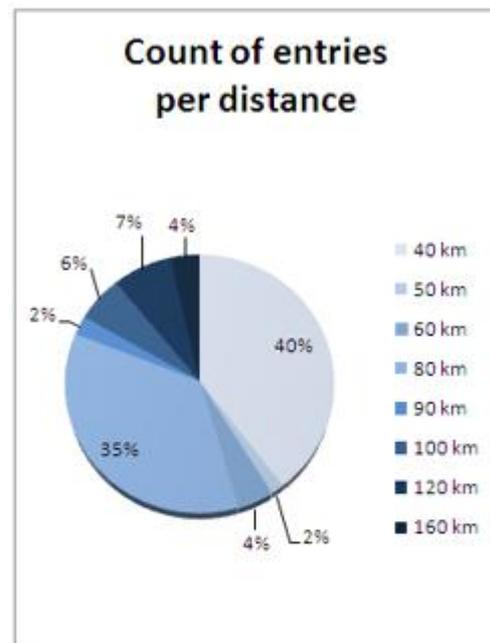


Fig. 1
Count of entries per distance

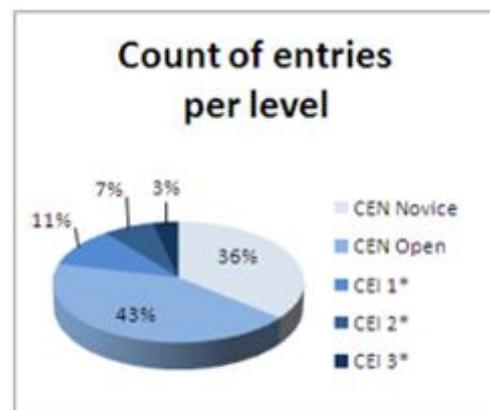


Fig. 2
Count of entries per level

During these years, a total of 540 different riders participated on 648 different horses in New Zealand endurance competitions. Gender information was available for 449 horses. Of these, 188 horses were female and 261 horses were male.

As seen in figure 3, most of the horses were aged between 6 and 10 years. Horses aged 6 – 10 years had the greatest representation across all all distances. There were no entries of horses younger than 6 years in distances over 80 km and no entries of horses older than 20 years in distances over 60 km.

A count of horses per level throughout the season is shown in figure 4. In the beginning of the season, riders only participated in the lower levels. A total of 93 entries participated in August. As the season progresses, riders begin to participate in higher levels. The highest numbers of competing entries are half way through the season: 470 horses in January. There are relatively more participants in the higher levels in April.

Then in the end of the season, riders only take part in the lower levels. In May and June, the season ends with a total of 60 respectively 25 entries competing.

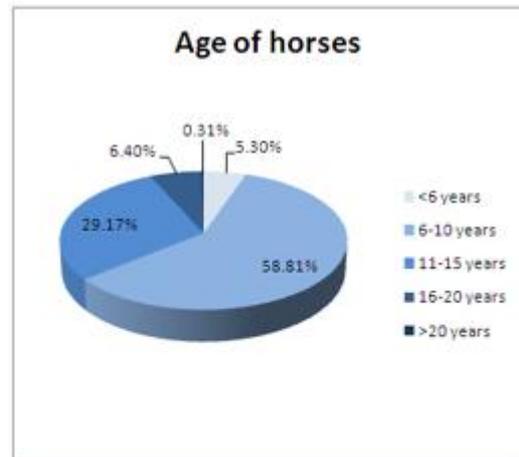


Fig. 3
Age of horses

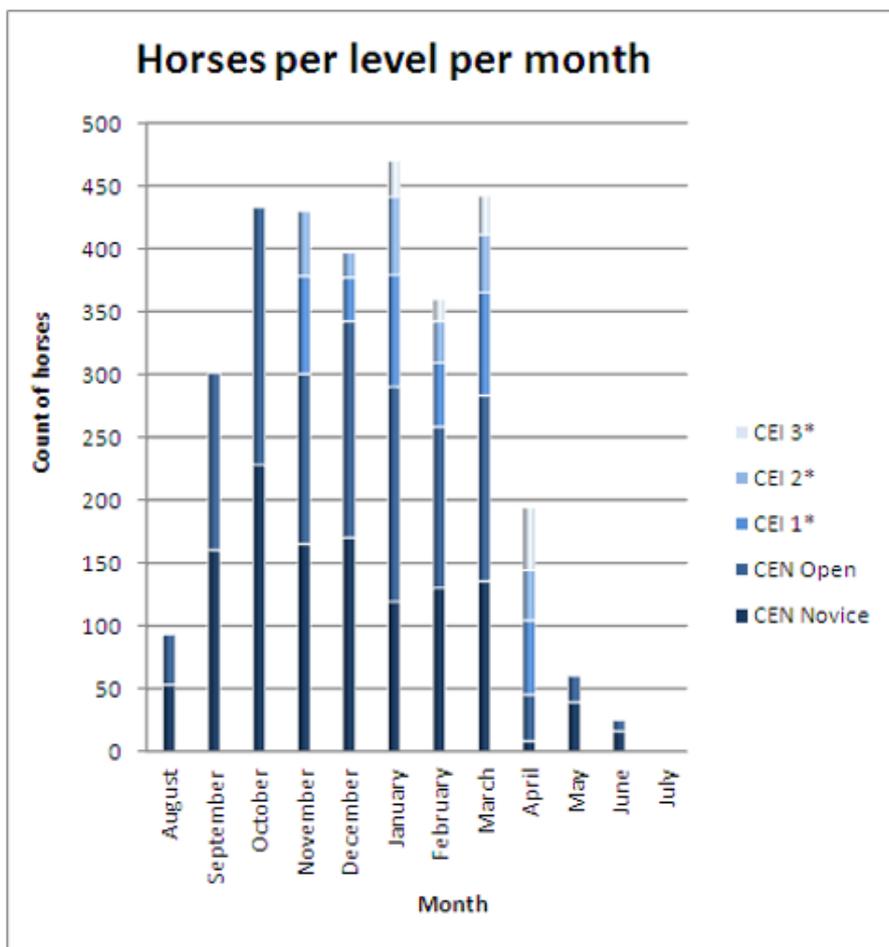


Fig. 4
count of horses per level per month

Lameness

In total 4,168 horse entries were included. Of these, 3460 entries qualified for the ride (83%) and 542 entries got eliminated by veterinarians (13%), of which 412 were eliminated due to lameness. This leads to an overall elimination rate as a result of lameness of 9.9%.

The elimination rate due to lameness is shown per level in Figure 5.

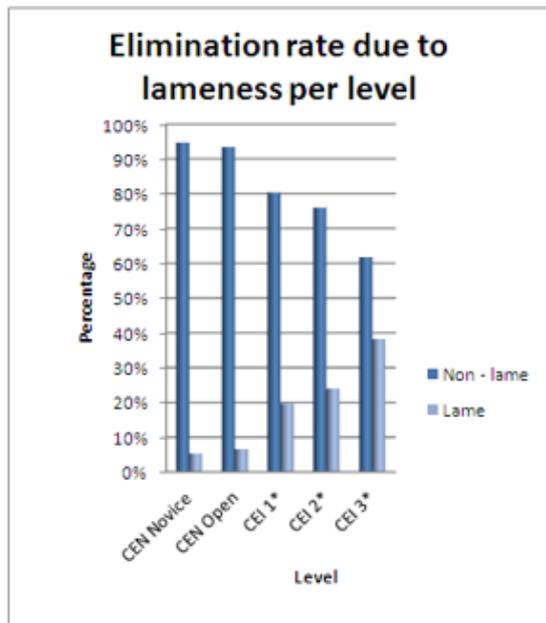


Fig. 5
Elimination rates due to lameness per level

In the lowest CEN Novice level the elimination rate due to lameness is 5%, whilst this was 38% in the highest CEI 3* level. Compared to the reference CEN Open level, all CEI levels were associated with increased odds to get eliminated due to lameness ($P < 0,001$) in univariable analysis (shown in table 2). In multivariable analysis, shown in table 3, only the CEI 1* and CEI 3* levels remained at a significantly higher risk. Horses competing in CEI 3* level were at the highest risk (OR = 12.50, 95% CI = 7.37-21.20).

As shown in Table 2, elimination rates due to lameness vary between the different ride distances. The elimination rate due to lameness increased when the distance ridden increased. For 40 km distance rides there was an elimination rate due to lameness of 3%;

this increased to 24% on 100 and 120 km rides and up to 38% on 160 km rides. Rides with a distance of 60 km and longer were associated with an increased risk of elimination due to lameness compared to rides of 40 km ($P < 0,001$) in multivariable analysis (shown in table 3). It is notable that the odds ratio for rides of 160 km in univariable analysis was 18.32 (95% CI 11.95-28.09).

There was no significant association between horse gender and getting eliminated due to lameness. Female horses had an elimination rate due to lameness of 10% and male horses of 9%.

Another variable investigated was horse age. Information was available for 4019 horse entries. The lowest elimination rate due to lameness was found for entries of horses younger than 6 years old (5%) and the highest elimination rate was found for entries of horses older than 20 years (33%). In multivariable analysis, horses older than 10 years are associated with an increased risk getting eliminated compared to horses aged between 6 and 10 years.

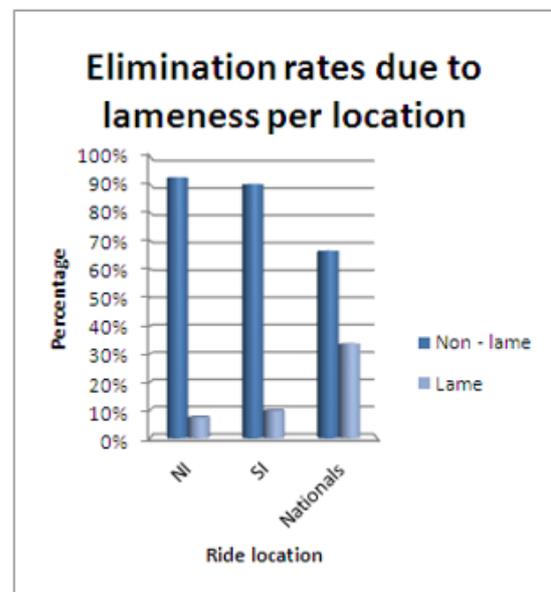


Fig. 6
Elimination rates due to lameness per location

The elimination rates due to lameness between different ride clubs varied from 2% to 33% with an average of 10% on the North

Island and 7% on the South Island. This can be seen in Figure 6. Compared to the North Island, rides organised by clubs on the South Island were associated with an increased risk of getting eliminated due to lameness (OR = 1.29). Rides organised by clubs on both the South and the North Island were associated with a significantly lower risk getting eliminated due to lameness than rides on the National Championships (OR = 0.15 and 0.21) in univariable analysis. The National Championships was associated with significantly higher odds for elimination compared to the North island rides in multivariable analysis as well (OR = 2.04). During the competition season, elimination rates varied widely. In the beginning of the season the elimination rate due to lameness didn't exceed 6%. From December till March the elimination rate due to lameness varied between 10% and 14%. In April, the elimination rate was 30% after which the elimination rate didn't exceed 8% anymore in the last months of the season. The months in the middle of the season (December till April) were associated with an increased risk of getting eliminated due to lameness in univariable analysis, but none of the months were significant in multivariable analysis.

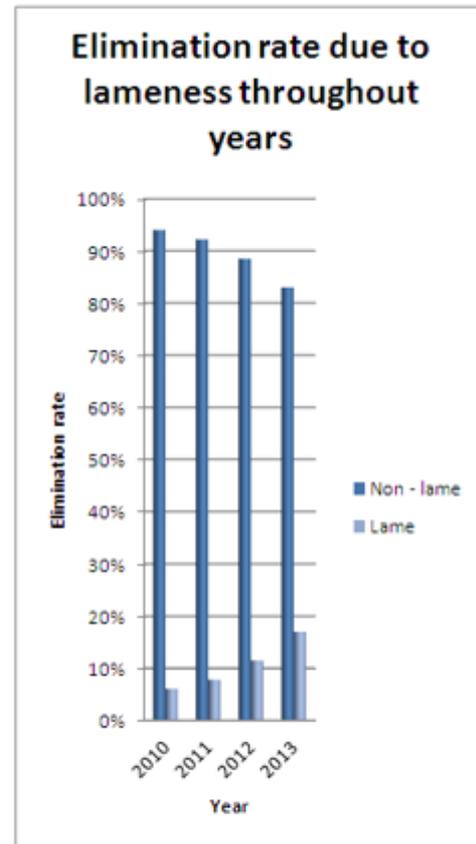


Fig. 7
Elimination rates due to lameness throughout years

The increasing elimination rate due to lameness over time is shown in Figure 7. Where the elimination rate in 2010 was only 6%, the elimination rate in 2013 increased to 17%. The years 2012 (OR = 1.57) and 2013 (OR = 1.60) are associated with increased odds of getting eliminated due to lameness in multivariable analysis.

Next page: Table 2
Univariable analysis

A total of 302 horse entries had speed information available. The average speed of all these entries was 13.97 km per hour. The average speed of horses that didn't get vetted out lame was 13.98 km per hour. Horses that were eliminated due to lameness had an average speed of 13.96 km per hour. The average speed was the highest on 60 km distance; 15.38 km per hour.

	Total	Non lame	Lame	Non lame %	Lame%	OR	95% CI	P value	OR	95% CI	P value
Level											
<i>CEN Novice</i>	1500	1420	80	94.60%	5.40%	0.80	0.60 - 1.07	0.13			
<i>CEN Open</i>	1778	1661	117	93.42%	6.58%	1.00 (referent)		NA			
<i>CEI1*</i>	449	361	88	80.40%	19.60%	3.46	2.57 - 4.67	<0.001			
<i>CEI2*</i>	292	222	70	76.03%	23.97%	4.47	2.23 - 6.21	<0.001			
<i>CEI3*</i>	149	92	57	61.74%	38.26%	8.80	6.02 - 12.86	<0.001			
Distance											
<i>40 km</i>	1651	1597	54	96.73%	3.27%	1.00 (referent)		NA			
<i>50 km</i>	64	61	3	95.31%	4.69%	1.45	0.44 - 4.78	0.54			
<i>60 km</i>	181	169	12	93.37%	6.63%	2.10	1.10 - 4.00	0.021			
<i>80 km</i>	1493	1337	143	90.34%	9.66%	3.16	2.29 - 4.36	<0.001			
<i>90 km</i>	86	88	11	88.89%	11.11%	3.70	1.87 - 7.32	6.157E-05			
<i>100 km</i>	239	181	58	75.73%	24.27%	9.48	6.35 - 14.15	<0.001			
<i>120 km</i>	305	231	74	75.74%	24.26%	9.47	6.50 - 13.81	<0.001			
<i>160 km</i>	149	92	57	61.74%	38.26%	18.32	11.95 - 28.09	<0.001			
Horse gender (entries)											
<i>Female</i>	1186	1067	119	89.97%	10.03%	1.10	0.85 - 1.42	0.47			
<i>Male</i>	1541	1399	142	90.79%	9.21%	1.00 (referent)		NA			
Horse age (entries)											
<i><6 years</i>	74	71	3	95.95%	4.05%	0.42	0.13 - 1.35	0.1342	1.00 (referent)		NA
<i>6-10 years</i>	2782	2529	253	90.91%	9.09%	1.00 (referent)		NA	2.368	0.74 - 7.57	0.1342
<i>11-15 years</i>	961	838	123	87.20%	12.80%	1.47	1.17 - 1.85	0.0009878	3.474	1.08 - 11.2	0.02663
<i>16-20 years</i>	197	173	24	87.82%	12.18%	1.39	0.89 - 2.17	0.1493			
<i>> 20 years</i>	7	5	2	71.43%	28.57%	4	0.77 - 20.71	0.07416			
Location											
<i>North Island</i>	2718	2515	202	92.53%	7.47%	1.00 (referent)		NA	0.15	0.12 - 0.20	<0.001
<i>South Island</i>	1167	1052	115	90.15%	9.85%	1.36	1.07 - 1.73	0.01156	0.21	0.15 - 0.29	<0.001
Nationals											
<i>August</i>	284	189	95	66.55%	33.45%	6.26	4.71 - 8.32	<0.001	1.00 (referent)		NA
<i>September</i>	128	124	4	96.88%	3.13%	0.61	0.21 - 1.76	0.36			
<i>October</i>	416	404	12	97.12%	2.88%	0.57	0.29 - 1.11	0.09			
<i>November</i>	661	628	33	95.01%	4.99%	1.00 (referent)		NA			
<i>December</i>	498	468	30	93.98%	6.02%	1.22	0.73 - 2.03	0.44			
<i>January</i>	575	517	58	89.91%	10.09%	2.14	1.37 - 3.33	0.0006244			
<i>February</i>	599	516	83	86.14%	13.86%	3.06	2.01 - 4.66	<0.001			
<i>March</i>	451	403	48	89.36%	10.64%	2.27	1.43 - 3.59	0.0003707			
<i>April</i>	539	462	76	85.71%	14.29%	3.13	2.05 - 4.79	<0.001			
<i>May</i>	211	147	64	69.67%	30.33%	8.29	5.25 - 13.08	<0.001			
<i>June</i>	66	64	2	96.97%	3.03%	0.59	0.14 - 2.54	0.48			
<i>July</i>	25	23	2	92.00%	8.00%	1.66	0.37 - 7.32	0.50			
<i>Year</i>											
<i>2010</i>	0	0	0	0.00%	0.00%	-	-	-			
<i>2011</i>	612	575	37	93.95%	6.05%	0.76	0.52 - 1.11	0.16			
<i>2012</i>	1668	1538	130	92.21%	7.79%	1.00 (referent)		NA			
<i>2013</i>	1383	1224	159	88.50%	11.50%	1.54	1.2 - 1.961	0.0005068			
	506	419	86	82.81%	17.19%	2.43	1.8 - 3.26	<0.001			

		OR	95% CI	P value
Level	<i>CEN Novice</i>	1.17	0.85 - 1.62	0.327
	<i>CEN Open</i>	1.00	(referent)	NA
	<i>CEI 1*</i>	1.84	1.26 - 2.69	0.002
	<i>CEI 2*</i>	0.91	0.26 - 3.17	0.885
	<i>CEI 3*</i>	12.50	7.37 - 21.20	0.000
Distance	<i>40 km</i>	1.00	(referent)	NA
	<i>50 km</i>	1.59	0.48 - 5.31	0.449
	<i>60 km</i>	2.04	1.04 - 4.02	0.038
	<i>80 km</i>	3.03	2.12 - 4.33	0.000
	<i>90 km</i>	3.52	1.63 - 7.57	0.001
	<i>100 km</i>	5.13	3.03 - 8.68	0.000
	<i>120 km</i>	10.43	2.93 - 37.06	0.000
	<i>160 km</i>	-	-	-
Horse age	<i><6 years</i>	1.11	0.34 - 3.65	0.865
	<i>6-10 years</i>	1.00	(referent)	NA
	<i>11-15 years</i>	1.53	1.19 - 1.95	0.001
	<i>16-20 years</i>	1.65	1.01 - 2.72	0.046
	<i>> 20 years</i>	11.62	2.14 - 62.96	0.004
Location	<i>North Island</i>	1.00	(referent)	NA
	<i>South Island</i>	1.29	1.00 - 1.67	0.049
	<i>Nationals</i>	2.04	1.44 - 2.90	0.000
Year	<i>2010</i>	0.98	0.62 - 1.46	0.905
	<i>2011</i>	1.00	(referent)	NA
	<i>2012</i>	1.57	1.20 - 2.04	0.001
	<i>2013</i>	1.60	1.16 - 2.20	0.004

Table 3
Multivariable analysis

Discussion

This study describes the first multivariable analysis of risk factors for elimination due to lameness during competitive endurance rides in New Zealand. It includes all the competitions organised between September 2010 and March 2013 on all levels and distances from 40 to 160 km. All horses with information about being qualified were used. In the present study, 83% of the horses qualified for the ride which is higher than the 46% and 51% reported by Nagy et al [6] [2]. It is thought that lower completion rates in the rest of the world are due to the fact that Dubai as a location has been included in the calculation. Races in the Middle East are being ridden at much higher speeds compared to the rest of the world and might have lower completion rates because of that. [2] Although not much research has been done yet, it is clear that the qualification rates are extremely high in New Zealand even when compared with countries outside of the Middle East.

The elimination rate due to lameness was 10% in the present study. Previous studies report elimination rates varying from 9 to 32%. Data were collected recently (between 2007 and 2012), but it must be noted that only one study included rides below 80 km [3]. An elimination rate due to lameness of 18% was reported. Adamu et al and Nagy et al. investigated rides of >100 km [2, 5, 6] and reported an elimination rate due to lameness of respectively 17%, 32% and 30%. The elimination rate for rides of >100 km in the present study was 29%. In New Zealand it is not uncommon that riders take their horses out of the race before they get eliminated. When they don't think the horse is fit enough they won't ride in order to prevent any damage to the health of the horse. The welfare of the horse appears to be more important than winning the competition. This might be because most endurance riders in New Zealand have only a few horses. They want to get the best out of their horses by giving them the chance to develop themselves.

A question that can be asked is whether a horse is really lame based on one person's

view. According to FEI rules, a suspected lame horse has to be checked again by three other veterinarians, who vote anonymously whether the horse is lame or not. The same happens at the final veterinary check. In this way, consistency and objectivity is maintained. [1] The rules for New Zealand Endurance are the same as for FEI Endurance for all parameters. However, although there are always three veterinarians for CEI rides, usually only two veterinarians are present at CEN rides.

Different variables were investigated to find out whether they were risk factors for getting eliminated due to lameness or not. First, the elimination rate for distance increased as the distance was increasing compared to 40 km rides. Rides of 60 km and longer were associated with significantly higher odds to be eliminated due to lameness. The 60 km ride has anecdotally been named as the 'race-distance'. Although there were only 302 horse entries with speed information available, the average speed did in fact appear to be the highest on 60 km rides. However, it could not be concluded that the higher speed was an explanation for the significantly higher odds of getting eliminated due to lameness. Previous studies also reported ride distance being associated with increased risk getting eliminated due to lameness [2, 4] It is logical to assume that a greater amount of exercise leads to increased load on the horses legs and increased muscle tiredness, which could lead to increased odds of elimination due to lameness.[2]

Because of earlier explained association between distance and level, it makes sense that the highest elimination rates due to lameness are noted for the highest CEI levels in comparison to the CEN Open level. Several facts can contribute to this. First, CEI level rides are long races with a great workload for the horse. Also, horses have to be trained several years before they are ready to compete on this level, which makes the average age of horses on this level higher than on CEN levels. And lastly, most CEI level competitions are ridden during championships. This might increase

competitiveness of riders, which may make them take bigger risks during the ride.

Horses older than 10 years were associated with increased risk to be eliminated due to lameness. Most horses were aged between 6 and 10 years old, which is why this was the referent group. Previous articles also found age as a significant risk factor. Adamu et al. also found a higher elimination rate of horses aged 11-15 years old compared with horses aged 6-10 years old. Two possible reasons were named, namely either the possibility of older horses having more difficulties to perform, or riders not being able to train the horse correctly in relation to its age.

Despite the fact there was a gender bias for horse gender (58% of the horses was male), there was no significant risk for female horses found compared to male horses.

Endurance rides organised on the North Island were compared to rides organised on the South Island and the National Championships. Both were associated with increased odds to be eliminated due to lameness. The increased risk during rides held on the South Island might be due to the terrain, since flat landscape is much more common on the North Island. Steep pathways may lead to increased workload and horses getting tired quicker than when riding in a flat environment.

The significantly higher elimination rate during National Championships might be due to riders riding more competitively and taking greater risks. The National Championships are the most important rides of the year organised in New Zealand. It can be discussed whether this higher elimination rate is due to the fact that more entries are participating in higher levels whilst in some competitions the highest CEI levels aren't even provided. Therefore, multivariable regression analysis was performed. National championships still appeared to be associated with higher risk getting eliminated due to lameness, independent of all other variables.

The elimination rate due to lameness increased throughout the years. This increase was found to be significant for the years 2012 and 2013. This could be due to the fact that veterinarians have become more critical in judging a horse lame or not. Horse welfare has become a more and more important subject within the FEI and it is possible that veterinarians are eliminating lame horses more often or earlier than they used to do. The information obtained from this study could be used in the often debated welfare issue [8] since the elimination rate due to lameness did not appear to be extraordinary high.

In conclusion major risk factors appear to be ride distance and ride level. Rides during the National Championships are associated with increased risk as well. The overall elimination rate due to lameness was 10%, which is low in comparison with the rest of the world.

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