The Open Agriculture Journal

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RESEARCH ARTICLE

Prevalence of Hoof Disorders in Horses in South Korea

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Abstract:

Background:

Few studies have investigated hoof disorders, which are closely associated with musculoskeletal diseases in horses in South Korea. Therefore, this study was undertaken to investigate hoof disorders during regular hoof trimming in Korea to gather basic data for the management of racehorse and riding horse hooves.

Objective:

The purpose of the present study was to investigate hoof disorders to gather basic data for the management of racehorse and riding horse hooves in South Korea.

Methods:

This study investigated hoof diseases in 2,241 racehorses and 650 riding horses in South Korea. Hoof disorders were observed during regular hoof trimming in the winter (from December 2017 to January 2018) by 30 experienced farriers. The hoof disorders that were scored and recorded were: Thrush (T), White Line Disease (WLD), Superficial Hoof Wall Cracks (SHWC), Hoof Wall Separation (HWS), Defects of the Hoof Wall (DHW), Wounds (W), Inflammation of the Bulb (IB), Quittor (Q), and Laminitis (L). Each lesion was scored as absence (normal) or presence (mild, moderate, or severe) upon inspection and was determined as mild, moderate, or severe with regard to the pain test. The severity and pain of each lesion were determined according to the criteria of the KFA. A positive diagnosis of having a hoof disorder was when abnormalities were found in one or more of the hooves of each horse.

Results:

The mean age of these racehorses and riding horses was 5.5 years (from 2 to 9 years old) and 14.5 years (from 3 to 26 years old), respectively. More than half of the horses were male (38% stallions and 23% geldings). According to the survey of hoof diseases in domestic horses, the most prevalent hoof disorder was thrush (4.2%). Other identified disorders were superficial hoof wall crack (SHWC, 1.2%), white line disease (WLD, 1.0%), hoof wall separation (HWS, 0.6%), defect of the hoof wall (DHW, 0.5%), laminitis (0.3%), wounds (0.2%), quittor (0.1%), and inflammation of the bulb (IB, 0.0%). The lesions based on a pain and inspection test were classified as severe (SHWC, HWS, laminitis), moderate (thrush, HWS, DHW), and mild (wounds, quittor).

Conclusion:

This study describes a variety of hoof disorders and their prevalence in horses in South Korea, which has not been reported previously. It is expected that the basic data will be used to prevent hoof disorders in horses and to develop plans for the welfare of horses in South Korea.

Keywords: Farrier, Hoof disorder, Prevalence, Racehorse and riding horse, South Korea, Musculoskeletal diseases.

Article History	Received: September 16, 2019	Revised: December 13, 2019	Accepted: December 31, 2019

1. INTRODUCTION

Horses are considered highly valuable in various industries and are associated with many aspects of society, including horseback riding, tourism, and horse−human companionship. In addition, the horseracing industry comprises a major proportion of horse owners. In Korea, there are an estimated 27,000 domesticated horses [1], which encompass approximately 12,000 light horse breeds, such as Thoroughbreds, and two pony branches, which include the Jeju horse and the crossbred horse (a cross between the Jeju horse and Thoroughbred horse, known as the Halla horse).

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There are three racetracks (Seoul, Busan, and Jeju) in Korea. While the Seoul and Busan racetracks include races with Thoroughbred breeds, the Jeju racetrack has been running races using traditional Korean horses (Jeju horse and Halla horse). Korean racetracks run flat on the sandy tracks. In South Korea, there are about 500 horse riding courses, including those in the public sector, and most use Thoroughbred breeds and Halla horses. Horses raised in Korea receive hoof trimming and shoeing once every three weeks for racehorses and once every six weeks for riding horses.

Foot disorders are considered the most common cause of lameness in horses. Hoof disorders lead to a reduction in horse durability, decreased welfare, horse dysfunction, and economic losses for horse owners [2 - 4].

The primary hoof disorders of horses are as follows. Thrush is a painful bacterial infection involving the central cleft and the collateral sulci of the frog. Quittor is a chronic, deep-seated infection of the lateral cartilages of the coffin bone. Laminitis is a metabolic and vascular disease that involves the inner sensitive structures of the feet. A crack is a separation or break in the hoof wall. Wounds of the feet are common in horses. All such wounds become contaminated and are frequently complicated by infections and abscesses [5]. Expensive racehorses and riding horses are increasingly imported, and the mismanagement of diseases can result in large economic costs. Surgical treatments among the racehorses that were raised and managed by the Seoul Race Course from 2003 to 2007 were predominantly related to disorders of the musculoskeletal system, wounds, and eye diseases. Few studies have investigated hoof disorders, which are closely associated with musculoskeletal diseases in horses in Korea. Therefore, the purpose of the present study was to investigate hoof disorders during regular hoof trimming in Korea to gather basic data for the management of racehorse and riding horse hooves.

2. MATERIALS AND METHODS

A total of 2,891 horses (1,305 racehorses from the Seoul Racing Course Park (SRC), 936 racehorses from the Pusan-Kyungnam Racing Course Park (PRC), and 650 riding horses) that are currently in use were examined in this study. Racehorses that are systematically managed and riding horses that are active in the inland were chosen. Information about the presence of hoof disorders was collected from the racehorses and riding horses distributed across northern and southern South Korea, which have the highest density of horseracing courses in the country.

The racehorses were managed by the Korea Racing Authority (KRA) and were held in dry stables that consisted of wood shavings for almost 20 hours per day, except for during sporting events. The riding horses were managed according to the KRA specification manual at public and private equestrian parks.

Hoof disorders in the racehorses and riding horses were examined during regular foot trimming in the winter (December 2017 to January 2018). These horses were examined by 30 experienced farriers, who were selected based upon their qualifications, experience, working area, and willingness to participate, in collaboration with the Board of the Korean Association of Certified Farriers. The farriers that participated in the study have received licenses by the South Korean government and currently serve as farriers in South Korea.

Before the start of the study, the farriers examined clinically healthy horses and horses with hoof disorders from racetracks and riding courses where horses regularly underwent hoof trimming, with the participation and consent of the owner. As each farrier is likely to use different criteria for identifying hoof disorders in horses, the diagnosis was standardized using the criteria of the Korean Farriers' Association (KFA). Information about the horses (age, stable status, frequency of hoof kicking, and status of hoof management) was obtained from the owners.

The hoof disorders that were scored and recorded were: Thrush (T), White Line Disease (WLD), Superficial Hoof Wall Cracks (SHWC), Hoof Wall Separation (HWS), Defects of the Hoof Wall (DHW), Wounds (W), Inflammation of the Bulb (IB), Quittor (Q), and Laminitis (L). Each lesion was scored as absence (normal) or presence (mild, moderate, or severe) upon inspection and was determined as mild, moderate, or severe with regard to the pain test. The severity and pain of each lesion were determined according to the criteria of the KFA. A positive diagnosis of having a hoof disorder was when abnormalities were found in one or more of the hooves of each horse.

3. RESULTS

3.1. Horses and Hoof Disorders

The density of the participating horses was similar to that of non-participating horses in South Korea. Most of the participating horses originated from two main racetracks (Seoul and Busan) and an inland riding course, which has the highest horse density in South Korea (Fig. **1**). The mean age of the 2,241 racehorses and 650 riding horses was 5.5 years (from 2 to 9 years old) and 14.5 years (from 3 to 26 years old), respectively. The lesions that were found, with a short definition and prevalence of the associated disorder are presented in (Table **1**). According to the survey on hoof disorders in domestic horses (2,891 horses), the most prevalent hoof disorder was thrush (mean 4.2%, 120/2,891). The prevalence of this disorder among the locations was 4.5% (58/1,305) in the SRC, 3.3% (31/936) in the PRC, and 4.4% (31/650) in the RC by region. The prevalence of thrush in the racehorses and riding horses was 4.0% (89/2,241) and 4.8% (31/650), respectively. Other disorders that were identified were SHWC (1.2%, 33/2, 891), WLD (1.0%, 29/2, 891), HWS (0.6%, 18/2, 891), DHW (0.5%, 16/2, 891), laminitis (0.3%, 8/2, 891), wounds (0.2%, 5/2, 891), quittor (0.1%, 1/2, 891), and IB (0.0%, 0/2, 891). More than half of the participating horses were male (38% stallions and 23% geldings). Overall, the lesions based on the pain and inspection test were classified as severe (SHWC, HWS, laminitis), moderate (thrush, HWS, DHW), and mild (wounds, quittor).

Table 1. Overview of the lesions found, a short definition and prevalence of hoof disorders in 2,891 horses in South Korea.

Disorder	Description	Region			Prevalence (%)
		SRC (%)	PRC (%)	RC (%)	
Thrush	Affliction of the frog mostly in the central sulcus	4.5	3.3	4.8	4.2
SHWC	Superficial (until white line) hoof wall cracks	0.9	1.4	1.2	1.2
WLD	Lesion of the white line	0.1	2.4	0.9	1.0
Quittor	Infection of lateral cartilage	0.0	0.0	0.1	0.1
HWS	Hoof wall separation	0.6	0.7	0.5	0.6
DHW	Defect of the hoof wall	0.1	1.6	0.0	0.5
Wounds	Injury of sole	0.2	0.2	0.0	0.2
Laminitis	Irreversible damage within the lamellar region of the foot	0.3	0.0	0.6	0.3
IB	Inflammation of the bulb	0.0	0.0	0.0	0.0
Total	-	6.6	9.6	8.2	7.9

Abbreviations: SRC, Seoul Race Course; PRC, Pusan Race Course; RC, Riding Course; 2,891 selected horses (1,305 Thoroughbred racehorses in SRC, 936 Thoroughbred racehorses in PRC, 650 Thoroughbred and pony riding horses in RC).

Fig. (1). Location of study site, Seoul Race Course (SRC) and Pusan-Kyungnam Race Course (PRC), South Korea (Citation in caption Maps from Google Maps, Google). SRC and PRC site were located 35°47'54"N, 128°38'55"E and 35°54'16"N, 128°35'30"E, respectively.

3.2. Management Factors

The horse bedding traditionally used in South Korea was rice straw, but now it is wood shavings. Studies have shown that different bedding types do not significantly affect the prevalence and severity of hoof disorders.

4. DISCUSSION

Many diseases affect horse hooves, and some, such as T, WLD, SHWC, HWS, DHW, W, IB, Q, and L, can be severe. Rarer diseases of the hoof are canker, hypersecretion, burns, sidebone, calcification of the lateral cartilages, pedal osteitis, knuckling over, ringbone, degenerative joint disease, short pastern bone periostitis, and bone spavin [6]. These diseases have a marked influence on the use of horses and on their racing or riding ability. We evaluated the prevalence of the most common hoof disorders in horses in South Korea, with the goal of hoof disease prevention and improving equine welfare. The three racing courses in South Korea involved Thoroughbred horse flat races on a sand track, with the exception of the Jeju Racing Park (where Jeju ponies are raced). During the study, the average temperature (-4°C) of the racetrack at the SRC was lower than that of the racetrack at the PRC (average 2°C), and more than three times the amount of salt was used to prevent freezing of the sand on the racetrack.

The higher prevalence of thrush in the riding horses (4.8%) than in the racehorses (SRC 4.5%, PRC 3.3%) may be attributed to the poor stable management and hoof trimming of the riding horses in contrast to that of the racehorses, which are systematically managed by the Korea Racing Authority (KRA). The higher rates of SHWC and DHW in the racehorses from the PRC (1.4% and 1.6%, respectively) than in those from the SRC and in the riding horses may be due to dry stable conditions and rigorous training at the PRC.

Hoof disorders can also markedly affect lameness. Therefore, it is necessary to study this relationship in greater detail. A retrospective study by Ross *et al*. [7] reported that

stallions and geldings showed a higher risk of lameness compared with mares, which may be due to the strength of their movement. Conditions such as HWS, laminitis, and SHWS are difficult to treat and take a long time to heal at the PRC. In addition, although the incidences of wounds, IB, and quittor are low, these conditions result in lameness. Furthermore, because the occurrences of thrush and WLD are closely related to management specifications, future research regarding risk factors associated with management is advisable for preventing or minimizing the occurrence of these disorders.

The state of the bedding material appears to influence disease prevalence. Thrush has been shown to be significantly more prevalent in damp bedding [8]. Therefore, if thrush is the major hoof problem, owners should be advised to reconsider how often stables are cleaned and to use fresh wood shavings as the bedding material. The bedding material has traditionally been rice straw, but now wood shavings are used in South Korea. Studies have shown that different bedding types do not significantly affect the prevalence and severity of hoof disorders.

Thrush is a common disease of the foot caused by a bacteria (*Spherophorus necrophorus* or *Fusobacterium necrophorum*) which can live only in an anaerobic, or no air, environment. Thrush is caused by the lack of proper foot care that results in a build-up of mud and manure that prevents air from getting to the frog. During routine hoof trimming, the clefts of the frog should be pared back so that the hoof can self-clean. When this is not done, the frog tissue flaps can seal in debris, which makes it impossible to clean out the frog with a hoof pick. To prevent this disorder, regular cleaning of the stable floors and hoof management are recommended. Injuries near the lateral cartilages, such as those that occur when being struck by another foot, often precede the appearance of quittor, as do penetrating injuries of the sole. Quittor can be prevented through regular hoof care. White line disease (seedy toe) caused by bacteria, yeast, or fungus occurs when horses are kept in a wet stall, a walk in wet grass or muddy paddocks, and are not trimmed regularly. To prevent this disorder, cleaning the floors of the stable and regular hoof management are recommended. Grass cracks often occur in unshod hooves where the bearing surface of the hoof wall is not trimmed and becomes too long. A common cause of hoof cracking and peeling is the exposure of the hoof to too much moisture. A moisture content of around 30% is recommended to prevent cracks [5].

Horses living outdoors on varied terrain wear and grow their hooves in a natural fashion. In contrast, domestic horses living in paddocks and stables, with infrequent exercise and limited opportunity to toughen their feet, are susceptible to a number of hoof problems. A program of daily inspections and hoof cleaning, routine hoof trimming, and horseshoes for those that require them, will prevent many of these problems. Good stall and paddock sanitation are essential for good foot care. Corrals, paddocks, and stalls that contain a build-up of urine and wet manure predispose horses to thrush and canker. It is important to clean a horse's hooves before and after each workout. Unclean hooves contaminated with feces or soil can suffer from SHWC, thrush, and WLD. If the hoof is too dry, the elastic tissues harden, compromising their function, and as a result, the development of the heel is aggravated. In particular, the frog and the heel become smaller and the material quality worsens, which results in the rupture of the hoof wall and potentially to SHWC. Intervals between trimming that are longer than six weeks and sand were associated with higher risks of WLD and SHWC, respectively. Shoeing of the hooves is associated with a lower risk of SHWC [5]. In order to prevent horse hoof disorders in advance, daily hoof care, hoof trimming, and providing horseshoes must be performed periodically.

Anthauer *et al*. [9] reported that good hoof horn quality is related to good nutrition, and regular attention to diet is generally recommended. Additionally, a United Kingdom study showed that horn quality can be influenced by external factors, such as stress, and that the presence of a disorder is associated with poor horn quality [10].

The results of a total of 117 fatally damaged horses (tendonitis) in South Korea, which occurred in Let's Run Park Seoul in the last 10 years (2009~2018), it has been reported that the rainy season, saturation, and female and mare are highly occurring (not published). The association between these results and hoof disorder in this study should be studied in the future. Further clarification of the influence of genetics, nutrition, and other factors on the prevalence of hoof disorders in horses is necessary. This study describes a variety of hoof disorders and their prevalence in horses in South Korea, which has not been reported previously. It is expected that the basic data presented here will be used to prevent hoof disorders in horses and to develop plans for the welfare of horses in South Korea.

CONCLUSION

This study investigated hoof diseases in 2,241 racehorses and 650 riding horses in South Korea. Hoof disorders were observed during regular hoof trimming in the winter (from December 2017 to January 2018) by 30 experienced farriers.

The mean age of the racehorses and riding horses was 5.5 years (from 2 to 9 years old) and 14.5 years (from 3 to 26 years old), respectively. According to the survey of hoof diseases in domestic horses, the most prevalent hoof disorder was thrush (4.2%). Although hoof diseases in horses have a variety of causes, they have not been reported in South Korea to date. The basic data presented here can be used to prevent hoof disorders in horses and to develop plans for the welfare of horses in South Korea.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

It was a routine hoof grooming in horses and was not approved by the Research Ethical Committee.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this study are available within the article.

FUNDING

This research was supported by SGER through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology (NRF-2017R1D1A1A02018652).

CONFLICTS OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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