RESEARCH ARTICLE

IJVAR *International Journal of Veterinary and Animal Research*
E-ISSN: 2651-3609 3(2): 29-33, 2020

Prevalence and Cost of Colic Cases in Sport Horses in Turkey

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Received: April 05, 2020
Accepted: June 07, 2020

Abstract
One of the most common diseases in horse breeding is colic. Colic cases are the leading cause of horse loss and economic loss in Turkey as well as the whole world. Failure to effective management of colic is a major obstacle in obtaining the desired yield of sport horses in Turkey and it is thought that most people are away from horse breeding and equestrian sports due to this reason. The objectives of this study are to set forth the prevalence and cost of colic cases in sport horses for two years and, present the rate of recurrent colic cases in the same period respectively. Throughout the study, economical and some technical parameters related to the course of the disease were obtained between January 2017 and December 2018. Interviews and data collection were conducted from 984 sport horses in all ages and gender for 24 months. The collected data were recorded and processed in the database created via MS Excel 2010 and IBM SPSS 22 for Windows. The average cost of colic management for a 4-day treatment in 2018 was $215.60. The rate of recurrent colic cases was 48.2% and the development of laminitis was 11.9% in a year following the treatment. As a result, it was estimated that the average annual economic loss of colic in 984 horses was $36806 in addition to horse losses. Horses that survived spontaneously, without any invasive treatment, and suffering from different disorders other than colic, were removed from the study. It is concluded that reduction of cost in colic cases and prevention of recurrent colic cases and post-colic diseases, such as laminitis, would increase horse welfare and yield from horses in Turkey.

Keywords: Colic, economics, horse, prevalence, Turkey.

INTRODUCTION

According to 2018 data, the equestrian industry has an economic volume of over 300 billion United States dollars ($) worldwide and employes 1.8 million people (Anonymous-1, 2019). Equestrian sports are usually considered as hobbies and sports but have become an important source of industry and income in many developed countries in recent years (Belloy and Bathe, 1996). The largest turnover in the horse industry is the European Union with an annual $133 billion. However, the United Kingdom (UK) has a maximum gain of $500 million per year in terms of annual earnings (Anonymous-1, 2019). This high gain increased interest in equestrian sports in many countries which did not concern horsemanship and equestrian sports until the early 2000s (Anonymous-1, 2019). The high economic volume of the horse industry and the economic value of horses used in all fields of equestrian sports increases the importance of disease control and management (Kösemen and Şeker, 2018). In fact, horses used in competitions provide significant earnings and employment despite high costs of treatment, loss of time and labor, and high veterinary service costs for the treatment, as well as death and yield losses due to diseases (Egenvall et al., 2008).

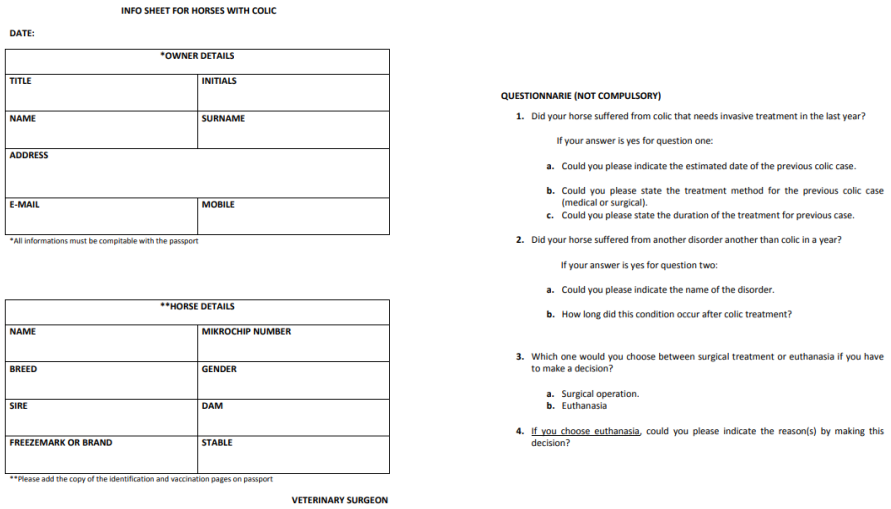
One of the most common diseases in horse breeding is colic (van den Hoven, 2003). Today, colic is a common term used in the definition of all abdominal disorders with abdominal pain in horses and ranging from mild to severe (Anonymous-2, 2008). In developed and developing countries, colic is reported as one of the most important causes of death and hundreds of millions of dollars of economic losses per year in the equestrian industry (Christophersen et al., 2014; Briceno et al., 2018). Someplans are needed to minimize the prevalence of colic and colic related disorders' cost by ensuring the comfort of the horse, therefore it is essential to determine the prevalence of colic (Granot et al., 2008). Some countries that set out from this idea periodically prepare their own, National Horse Disease Management Programs (Freeman and Curtis 2015, Anonymus-3, 2016). Colic in Turkey as well as in other countries is the leading factor in equine diseases that cause economic damage with plenty of horse losses. Although almost everyone involved with horse sports knows it, there are no current data available about the prevalence and economic impacts of colic cases in Turkey.

This study aims to demonstrate the prevalence and average economic costs of colic in sport horses in Turkey for the first time. It is our first aim that the data obtained from this study could be used as the source of resources for breeders, veterinarians, and researchers afterwards.

MATERIALS AND METHODS

According to official data obtained from the Turkish Statistical Institute (TÜİK), there are 114047 horses in Turkey (Anonymus-4, 2019). Those horses are evaluated in different categories such as racehorse, sport horse, hobby horse, and wild horses respectively. According to the Turkish Equestrian Federation, there are 3,317 registered sport horses out of 114047 and, 2162 (65%) of them are settled in Istanbul (Anonymus-5, 2019). The materials of this study consist of the horses living in the Istanbul region because of the intensity of the horse population and equestrian events regularly held in this region throughout the whole year. All data about horses are obtained from the Turkish Equestrian Federation, equestrian clubs, and horse

veterinarians working in this region. A questionnaire wasused during the interviews for data collection (Figure 1) and, Equine Comfort Assessment Scale, prepared by Colorado State University, was used by the veterinarians to define the severity of colic (Figure 2) (Blossom et al., 2007).



INFO SHEET FOR HORSES WITH COLIC

DATE:

*OWNER DETAILS	
TITLE	INITIALS
NAME	SURNAME
ADDRESS	
E-MAIL	MOBILE

*All informations must be compitable with the passport

**HORSE DETAILS	
NAME	MIKROCHIP NUMBER
BREED	GENDER
SIRE	DAM
FREEZEMARK OR BRAND	STABLE

**Please add the copy of the identification and vaccination pages on passport

VETERINARY SURGEON

QUESTIONNARIE (NOT COMPULSORY)

1. Did your horse suffered from colic that needs invasive treatment in the last year?

   If your answer is yes for question one:

   a. Could you please indicate the estimated date of the previous colic case.

   b. Could you please state the treatment method for the previous colic case (medical or surgical).

   c. Could you please state the duration of the treatment for previous case.

2. Did your horse suffered from another disorder another than colic in a year?

   If your answer is yes for question two:

   a. Could you please indicate the name of the disorder.

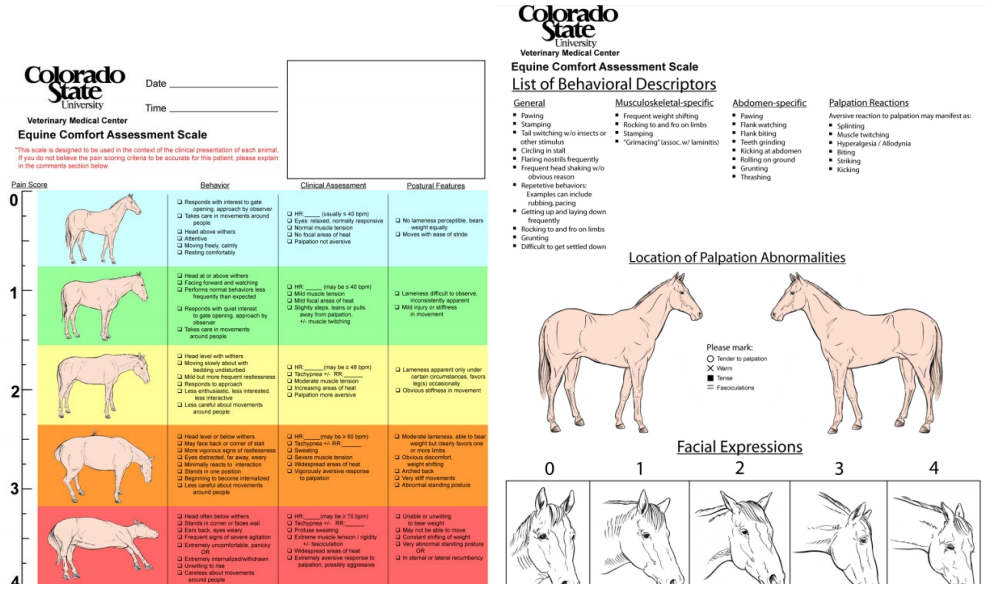
   b. How long did this condition occur after colic treatment?

3. Which one would you choose between surgical treatment or euthanasia if you have to make a decision?

   a. Surgical operation.
   b. Euthanasia

4. If you choose euthanasia, could you please indicate the reason(s) by making this decision?

Figure 1. Questionnarie to inform the owners and collect data about the horse



Colorado State University
Veterinary Medical Center
Equine Comfort Assessment Scale

Date _____
Time _____

*This scale is designed to be used in the context of the clinical presentation of each animal. If you do not believe the pain scoring criteria to be accurate for this patient, please explain in the comments section below.

Pain Score	Behavior	Clinical Assessment	Postural Features
0	❑ Responds with interest to gate opening, approach by observer ❑ Takes care in movements around people ❑ Head above withers ❑ Attentive ❑ Moving freely, calmly ❑ Resting comfortably	❑ HR: _____ (usually ≤ 40 bpm) ❑ Eyes: relaxed, normally responsive ❑ Normal muscle tension ❑ No focal areas of heat ❑ Palpation not aversive	❑ No lameness perceptible, bears weight equally ❑ Moves with ease of stride
1	❑ Head at or above withers ❑ Facing forward and watching ❑ Performs normal behaviors less frequently than expected ❑ Responds with quiet interest to gate opening, approach by observer ❑ Takes care in movements around people	❑ HR: _____ (may be ≤ 40 bpm) ❑ Mild muscle tension ❑ Mild focal areas of heat ❑ Slightly skips, leans or pulls away from palpation, +/- muscle twitching	❑ Lameness difficult to observe, inconsistently apparent ❑ Mild injury or stiffness in movement
2	❑ Head level with withers ❑ Moving slowly about with bedding undisturbed ❑ Mild but more frequent restlessness ❑ Responds to approach ❑ Less enthusiastic, less interested, less interactive ❑ Less careful about movements around people	❑ HR: _____(may be ≥ 48 bpm) ❑ Tachypnea +/- RR: _____ ❑ Moderate muscle tension ❑ Increasing areas of heat ❑ Palpation more aversive	❑ Lameness apparent only under certain circumstances, favors leg(s) occasionally ❑ Obvious stiffness in movement
3	❑ Head level or below withers ❑ May face back or corner of stall ❑ More vigorous signs of restlessness ❑ Eyes distracted, far away, weary ❑ Minimally reacts to interaction ❑ Stands in one position ❑ Beginning to become internalized ❑ Less careful about movements around people	❑ HR: _____(may be ≥ 60 bpm) ❑ Tachypnea +/- RR: _____ ❑ Sweating ❑ Severe muscle tension ❑ Widespread areas of heat ❑ Vigorously aversive response to palpation	❑ Moderate lameness, able to bear weight but clearly favors one or more limbs ❑ Obvious discomfort, weight shifting ❑ Arched back ❑ Very stiff movements ❑ Abnormal standing posture
4	❑ Head often below withers ❑ Stands in corner or faces wall ❑ Ears back, eyes weary ❑ Frequent signs of severe agitation ❑ Extremely uncomfortable, panicky OR ❑ Extremely internalized/withdrawn ❑ Unwilling to rise ❑ Careless about movements around people	❑ HR: _____(may be ≥ 70 bpm) ❑ Tachypnea +/- RR: _____ ❑ Profuse sweating ❑ Extreme muscle tension / rigidity +/- fasciculation ❑ Widespread areas of heat ❑ Extremely aversive response to palpation, possibly aggressive	❑ Unable or unwilling to bear weight ❑ May not be able to move ❑ Constant shifting of weight ❑ Very abnormal standing posture OR ❑ In sternal or lateral recumbency

Colorado State University
Veterinary Medical Center
Equine Comfort Assessment Scale
List of Behavioral Descriptors

General	Musculoskeletal-specific	Abdomen-specific	Palpation Reactions
▪ Pawing ▪ Stamping ▪ Tail switching w/o insects or other stimulus ▪ Circling in stall ▪ Flaring nostrils frequently ▪ Frequent head shaking w/o obvious reason ▪ Repetetive behaviors: Examples can include rubbing, pacing ▪ Getting up and laying down frequently ▪ Rocking to and fro on limbs ▪ Grunting ▪ Difficult to get settled down	▪ Frequent weight shifting ▪ Rocking to and fro on limbs ▪ Stamping ▪ "Grimacing" (assoc. w/ laminitis)	▪ Pawing ▪ Flank watching ▪ Flank biting ▪ Teeth grinding ▪ Kicking at abdomen ▪ Rolling on ground ▪ Grunting ▪ Thrashing	Aversive reaction to palpation may manifest as: ▪ Splinting ▪ Muscle twitching ▪ Hyperalgesia / Allodynia ▪ Biting ▪ Striking ▪ Kicking

Location of Palpation Abnormalities

Please mark:
○ Tender to palpation
✕ Warm
■ Tense
= Fasciculations

Facial Expressions

0 1 2 3 4

Figure 2. Equine Comfort Assessment Scale composed by Colorado State University (Blossom et al., 2017)

All of the horse owners have been informed by the veterinarians about treatments and informations obtained during study. The horses, whose owners were not agreed to share the info and suffering mild colic (considered as 0 or 1 in the pain scale) that recovered spontaneously without invasive treatment, have been dismissed from this study. The diagnoses were placed under the supervision of three veterinarians and approved by all of them at the same time. Interviews and data collection were conducted in the years 2017-2018 and 24 months data of 984 horses were recorded. Throughout the study, the prevalence of colic cases in horses, the average costs in colic cases, and some technical parameters related to the course of the disease were obtained between January 2017 and December 2018. The collected data were recorded and processed in the database created via MS Excel 2007 and SPSS 16 forWindows. Descriptive statistics were used to analyze the data. In the cost calculation, 1 US dollar ($) was accepted as equal to 5.66 Turkish Liras (TL).

RESULTS

Three hundred and ten (310) of the horses that have been observed during this study were settled in the Anatolian side whereas the other 674 were settled in the European side of Bosphorus. Table 1 provides information about monthly average care and treatment costs in equestrian clubs.

According to our study, the most important expense is the monthly maintenance cost of a horse with 56.8%, followed by other expenses and groom/farrier expenses with 18.2% and 17.1% respectively. Other costs include joint support products, harness materials, and ongoing costssuch as engagement costs. Depending on the interviews, the

prevalence and varieties of colic cases in sports horses between 2017 and 2018 are presented in Table 2.

Table 1. Monthly average care-treatment costs and rates of a sport horse

Regular monthly expenses	Amount of expenses ($)	%
Maintenance (stable and feeding)	441.7	56.8
Groom / farrier	132.5	17.1
Veterinary medicine	53.0	6.8
Vaccinations	8.8	1.1
Other expenses	141.4	18.2
Total amount of expenses	777.4	100

Table 2. Types and prevalence of colic cases

Types of colic (between 2017 and 2018)	Number	Prevalance
Spasmodik colic	182	56.5%
Impaction colic	79	24.5%
Sand colic	33	10.3%
Twisted gut and displacement of intestinal structures	28	8.7%
Total	322	100%

When Table 2 is examined, it is seen that while the rate of horses with colic in total horse population was 17.07% in 2017, it decreased to 15.65% in 2018, hereby the average of colic cases in two years was found as 16.36%. Depending on the severe colic, 38 horses were euthanized within 2 years, within the knowledge and approval of the owner, and the rate of euthanasia application in colic cases was determined as 11.80% (Table 3). Three veterinarians have diagnosed horses with colic at the same time, with spasmodic colic, impaction colic, sand colic, and twisted gut (Table 2). In the study, it was determined that spasmodic colic was the most common colic type in horses with 56.5%, followed by impaction colic, sand colic, and twisted gut respectively. The technical and economic parameters related to colic cases and the medicines used in the treatment of colic are presented in Table 4.

Table 3. Horses suffered from colic in two years

Collected Data	2017		2018	
Amount of horses	984	100 %	984	100 %
Horses that suffered from colic at least once	168	17.07 %	154	15.65 %
Number of colic surgeries	2	1.19 %	1	0.65 %
Euthanaised horses	21	12.50 %	17	11.03 %

Table 4. Technical and economical parameters of colic cases between 2017 and 2018

A. Technical parameters	Data
Mean duration of treatment in colic	4 days
Mortality in colic cases	2%
Rate of recurrent colic cases in a year after treatment	48.2%
Rate of laminitis in a year after the treatment	11.9%
Rate of not encountering any problem within a year after treatment	39.9%
B. Economic parameters (Average of 2017 and 2018)	
Average Treatment costs	
Veterinary expenses (per horse with colic)	$109.5
Hospitalization expenses (per day)	$17.7
Transportation expenses (per horse)	$35.3
Average expenses (per horse)	$215.6
Treatment expenses in 2017 (168 cases)	$36.220
Treatment expenses in 2018 (154 cases)	$33202
Total Treatment expenses in two years	$69422
Average cost of medicines used for euthanasia (per horse)	$79.5
Average cost of transportation and interment (per horse)	$132.5
Total average cost for euthanasia and interment (per horse)	$212
Total cost of euthanasia in 2017 (21 cases)	$4452
Total cost of euthanasia in 2018 (17 cases)	$3604
Total euthanasia cost in two years	$8056
Total expenses paid for colic cases in 2017 (168 survival + 21 euthanized)	$40672
Total expenses paid for colic cases in 2018 (154 survival + 17 euthanized)	$36806
Total expenses paid for colic cases in two years	**$77478**

During the interviews with veterinarians, it was also determined that the surgical operation was not preferred by the horse owners in the treatment of colic horses due to the low rate of recovery, the chance of occurrence of significant complications after the operation and the high cost of operation (min: $620; max: $4500). In the economic appraisement, it was determined that total treatment cost was $215.6 with an additional $212 euthanasia cost if a horse with colic were euthanized. Within the data obtained due to colic cases in sport horses in Turkey in 2018, it was determined that the total economic loss of colic in 984 horses was $36806 in addition to horse losses. In interviews with veterinarians, it has been reported that feed additives, special feeding, changes in the training program, and/or rest application are recommended after the treatment to prevent relapses in a patient with colic and to increase the comfort of the horse. For horse owners with financial means, it was learned that the horse was recommended to send to a stud farm for rehabilitation for one or two seasons outside the club. However, in the event that, if the horses do not return to their pre-disease condition, it has also been learned that those horses are used for hobby purposes or, rarely, they are sold below their value (Figure 1).

DISCUSSION AND CONCLUSION

Types of colic cases seen in horses are given in detail in Table 2, and the findings are different from the previous studies (White 2005, Wormstrand et al. 2014). In this study, it is founded that spasmodic colic is the most common colic case in Turkey. In a study conducted parallel to this finding it was reported that Strongylus spp. infestations are important reasons for spasmodic colic cases (Goncalves et al., 2002).

According to data obtained from the study, it was determined that the rate of colic in sport horses in the Istanbul region was 17.07% in 2017 and 15.65% in 2018 and this value was close to the studies performed in other countries (Table 3). As reported before, depending on the age of the horse and the geographic region where it is located, the prevalences of colic among the horses were 3.5-18.6% in Sweden (Egenvall et al., 2008); 4.2-10.6% in the United Kingdom (UK) (Hillyer et al., 2001) and 4% -10% in the United States of America (USA) (White 2005). In this case, it could be said that the colic risk for horses living in various geographical regions of the world is approximately the same. In this study, it was also determined that the success rate of medical treatment in colic cases was 39.9%, and the treatment cost was about $109.5, but during the 4-day treatment, this value increased to $215.6 with the transport and hospitalization costs (Table 4). This value was found as $904 in a previous study performed in Sweden (Egenvall et al., 2008). The difference between the economic situation of both countries and the colic treatment procedures may differ from one another and, this could be the reason for cost differences between countries. However, thanks to the advanced insurance systems in Sweden, the horse owners, and veterinarians do not discuss material issues often, hereby it could be said that veterinarians in Sweden could be more comfortable while diagnosing and practicing during treatment comparing to Turkey.

In our study, the recurrent colic rate was determined as 48.2% following the colic treatment within one year. Veterinary intervention and invasive treatment were also required in all of those cases. Compared with Turkey, this rate is fairly low in developed countries that implement national colic management programs. For instance, recurrent colic rate requiring invasive intervention has been reported as 10-15% in the USA, which is one of the leading countries in the horse industry (White 2005). The UK study reported that the incidence of recurrent colic in one year was 36.5% but not all of them required invasive treatment (Scantlebury et al., 2011). Based on these data, it can be said that effective management program implementations could significantly reduce the recurrence rate of colic within a year even if it does not eliminate recurrent colic cases.

In our study, the rate of colic operations in horses was approximately 1% as shown in Table 3, which was reported as 4.3% and 12.5%, respectively, in the UK studies (Hillyer et al., 2001; Scantlebury et al., 2011). The main reasons for unwillingness for surgical intervention among horse owners in Turkey are the low chance of recovery after colic surgery and the high cost of surgical operations respectively. Whereas, postoperative recovery and survival rates were reported as 46% -54.5% even in developed countries (Goncalves et al., 2002; White, 2005). In parallel with these findings, it is reported in a study conducted in 2008, all of the complications were detected between postoperative 0-12 days. According to the same study, the most common complications were diarrhea (46%), recurrent colic (27%), wound complications (27%), and laminitis (17%) (Granot et al., 2008).

Colic surgery is not preferred in cases requiring surgical intervention in Turkey, instead, medical treatment is kept longer or euthanasia is chosen as a last resort. Consequently, the average euthanasia rate in colic cases in Turkey was found as high as 11.8% in this study, which is higher than Hillyer study findings (3.9%) (Hillyer et al., 2001), while near to Scantlebury study findings (9.1%) (Scantlebury et al., 2014). In the event that euthanasia is administered to the horse, the cost of euthanasia medication is $79.5 and the transport-burial cost of the horse is $132.5. Hence, the total cost of euthanasia becomes $212.

However, in interviews with veterinarians, it is noticed that the operation cost is about a minimum of $620 and this amount could increase up to $4500 depending on the operation technique and complications during and after the operation. Similar to our findings, the cost of colic surgery was found to be $3872 in a study conducted in the USA in recent years (Traub-Dargatz et al., 2001). In a Swedish study, it was reported that colic surgeries were at least as high as twice related to postoperative ileus (Egenvall et al., 2008). Rate of colic surgeries in developed countries such as the UK, the USA, and Sweden are higher than in Turkey, despite all of those high costs, low success rate and the risk of post-operative complications (Traub-Dargatz et al., 2001; Egenvall et al., 2008; Scantlebury et al., 2011; Scantlebury et al., 2014). The reasons for this outcome are thought of as the existence of advanced insurance systems for horses in those countries, that reducing the economic burden of horse owners and the effective implementation of national horse disease management programs respectively.

The risk of colic in horses in Turkey is as high as other horses settled in other regions of the world. Likewise, the recurrent colic risk is high in horses recovered from colic, and the cost of colic calculated as a sum of $215.6 (Table 4). In this regard, in addition to the cost of treatment; recurrent colic cases, laminitis, other colic related health problems and, deaths could cause serious economic losses to horse owners and breeders every year. In this context, it also could be alleged that inability to fight against colic effectively is a major obstacle in obtaining the desired yield from sports horses and most people are distanced from horse breeding and equestrian sports due to this reason. Therefore, it is concluded that the horse owner's reluctancy

to undertake the economic cost of all kinds of interventions may be an important factor for deciding in both medical intervention and surgical operation and it also seems like a prospective obstacle for increasing the horse welfare in Turkey.

In conclusion, it seems possible to increase horse welfare by reducing the economic burden on horse owners' shoulders due to colic and colic related health problems. Expansion of the scope of insurance services for horses may help this issue on behalf of improving horse welfare. Hereby, it is also possible to increase the number of people who are professionally interested in equestrian sports and the number of sports horses in Turkey. This would pave the way for Turkish equestrians to benefit from the economic and social opportunities of the ever-growing world equestrian industry, which has an economic volume of over $300 billion annually. Also, it would be possible to improve horse welfare in Turkey by providing advanced and excellent veterinary services for horses.

Acknowledgements
Great thanks to Erdil Veteriner/İstanbul and horse owners, for all of their support and contribution

Financial Support
This study has not been supported by any institution or foundation.

Conflict of Interest
The authors declare that there is no conflict of interest in the content of the article

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