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PREVALENCE AND DETECTION OF EQUINE GASTRIC ULCER SYNDROME (EGUS) IN HIGH-PERFORMANCE HORSES IN TERENGGANU, MALAYSIA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF VETERINARY MEDICINE

FACULTY OF VETERINARY MEDICINE
UNIVERSITI MALAYSIA KELANTAN

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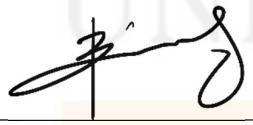

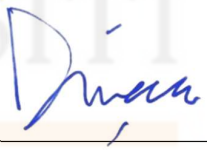

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Prevalence And Detection Of Equine Gastric Ulcer Syndrome (EGUS) In High-Performance Horses In Terengganu, Malaysia

ABSTRACT

This study investigates the prevalence of EGUS in high-performance horses participating in 120 km endurance races in Terengganu, Malaysia. Gastroscopic examination revealed a 55.6% prevalence of EGUS, predominantly in Equine Squamous Gastric Disease (ESGD). As endurance horses are highly susceptible to gastric ulceration due to intensive training, feeding patterns, and physiological stress, this research aims to provide baseline data on the occurrence of EGUS within this specific athletic population. A total of nine horses were examined via gastroscopy. Lesions were evaluated and graded according to the EGUS Council scoring system for Equine Squamous Gastric Disease (ESGD) and Equine Glandular Gastric Disease (EGGD). The findings revealed that 5 out of 9 horses (55.6%) were positive for EGUS, with ESGD being more prevalent than EGGD. Three horses exhibited combined ESGD and EGGD, while two horses demonstrated squamous ulceration only. The remaining four horses showed no visible lesions. Factors such as recent high-intensity racing and previous gastric issues appeared to correlate with ulcer presence, although the small sample size limited statistical analysis. There are limited studies on equine gastric ulcer syndrome (EGUS) in Malaysia, highlighting the need for routine screening, improved management strategies, and further research with larger sample populations.

Keywords: *Endurance horses, EGUS, gastroscopy, ESGD, EGGD, Terengganu, Malaysia.*

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Prevalens Dan Pengesanan Sindrom Ulser Gastrik Ekuin Dalam Kalangan Kuda Lasak di Terengganu, Malaysia

ABSTRAK

Kajian ini menyiasat prevalens EGUS dalam kuda berprestasi tinggi yang mengambil bahagian dalam perlumbaan kuda 120 km di Terengganu, Malaysia. Pemeriksaan gastroskopi mendedahkan prevalens EGUS sebanyak 55.6%, yang kebanyakannya adalah dalam bentuk Penyakit Gastrik Skuamus Ekuin (ESGD). Oleh kerana kuda lasak terdedah kepada ulser gastrik akibat latihan intensif, pemakanan, dan tekanan fisiologi, kajian ini bertujuan untuk menyediakan data asas mengenai kewujudan EGUS dalam populasi ini. Sebanyak 9 ekor kuda telah diperiksa melalui gastroskopi dan telah dinilai dan diberikan skor berdasarkan sistem pemarkahan Majlis EGUS bagi Penyakit Gastrik Skuamus Ekuin (ESGD) dan Penyakit Gastrik Glandular Ekuin (EGGD). Hasil kajian menunjukkan bahawa 5 daripada 9 ekor kuda (55.6%) merupakan positif EGUS, dengan kadar ESGD lebih lazim berbanding EGGD. Tiga ekor kuda menunjukkan kombinasi ESGD dan EGGD, manakala dua ekor kuda hanya mengalami ulser pada bahagian skuamus iaitu ESGD. Empat ekor kuda selebihnya tidak terjejas. Faktor seperti perlumbaan intensiti tinggi yang baru disertai dan kejadian EGUS atau masalah gastrik sebelum ini kelihatan berkait dengan kewujudan ulser, tetapi walau bagaimanapun, saiz sampel yang kecil mengehadkan analisis prevalen bagi populasi tersebut. Kajian tentang sindrom ulser gastrik kuda (EGUS) di Malaysia amat terhad, ini menekankan keperluan untuk pemeriksaan rutin, strategi pengurusan yang lebih baik dan penyelidikan lanjut dengan populasi sampel yang lebih besar.

Kata kunci: *Kuda lasak, EGUS, gastroskopi, ESGD, EGGD, Terengganu, Malaysia.*

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CERTIFICATION

This is to certify that we have read this research paper entitled **'Prevalence And Detection Of Equine Gastric Ulcer Syndrome (EGUS) In High-Performance Horses In Terengganu, Malaysia'** by **Batrisha Bt Ab Rahim,** and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirements for the course DVT 55204 – Research Project.

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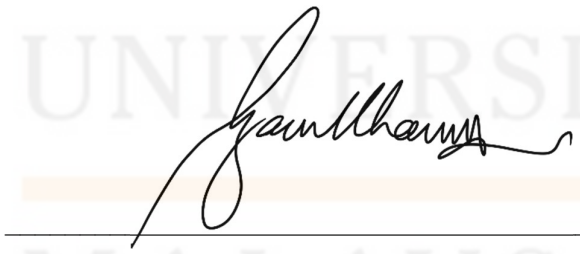

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ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to all those who have provided their support, guidance, assistance, and emotional and moral support in the completion of this project paper:

My Supervisor, Dr Mimi Armiladiana Bt Mohamad.

My Co-supervisor, Prof. Dr Mohd Azam Khan Bin Goriman Khan.

Doctors and Veterinary Assistants at the Veterinary Teaching Hospital, UMK – Dr. Shurim, Mr. Nizam, Mr. Paisal, Mr. Faisal, Mr. Aiman, Mr. Ilham.

Doctors at Terengganu International Endurance Park - Dr. Faz and Dr. Naqib.

My FYP partner, Liyana Insyirah

My classmates.

My family.

Thank you.

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DEDICATIONS

First and foremost, I would like to express my deepest gratitude to Allah SWT for granting me the strength, clarity, and resilience needed to complete this Final Year Project.

My heartfelt appreciation goes to my supervisor, Dr. Mimi Armiladiana Binti Mohamad, for her continuous guidance, encouragement, and unwavering support throughout this project. I am equally grateful to my co-supervisor, Prof. Azam, for his valuable insights and constructive advice, which greatly strengthened the direction of this work. My appreciation further goes to the HPV staff—Dr. Shurim, En. Nizam, En. Mad, En. Faisal, En. Aiman and En. Ilham—for dedicating their time and effort, including travelling to Terengganu with us and working tirelessly to support our project. I am also grateful to the TIEP staff, Dr. Faz and Dr. Naqib, for kindly granting us access to their facilities and allowing us to conduct our work at TIEP.

I would also like to extend my sincere thanks to my FYP partner, Buho, for being my constant companion at every step of this journey. Your teamwork and support made this experience meaningful and manageable. Lastly, I am deeply thankful to my family and friends for their endless support and encouragement. Their belief in me has been my greatest source of motivation.

Your collective support has been essential in bringing this project to completion, and I am deeply grateful to each of you.

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LIST OF ABBREVIATIONS

EGUS	Equine Gastric Ulcer Syndrome
ESGD	Equine Squamous Gastric Disease
EGGD	Equine Glandular Gastric Disease
TIEP	Terengganu International Endurance Park
CEI2	Concours de Raid d'Endurance International

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CHAPTER 1: INTRODUCTION

1.1 Background

Equine Gastric Ulcer Syndrome (EGUS) is a general term describing ulcerative diseases of the equine stomach. It is further divided into terms that more specifically describe the affected region anatomically. First is Equine Squamous Gastric Disease (ESGD), which involves lesions in the squamous region, and second, Equine Glandular Gastric Disease (EGGD), which involves lesions located in the glandular portion of the stomach. (Banse and Andrews, 2019)

EGUS is a common disease in horses worldwide, with different prevalence among different categories, such as performance level. That is why, in this study, our focus is on endurance horses that participate in the 120 km category, as they are one of the highest performance levels in equine sports. Endurance horses in Malaysia compete in four main categories based on distance: 40 km (amateur), 80 km (intermediate), 120 km (advanced), and 160 km (professional). These categories align with the levels of endurance riding promoted by the Equestrian Association of Malaysia, with events held at premier venues like the Terengganu International Endurance Park. The 120 km endurance ride, classified as a CEI (Concours de Raid d'Endurance International) event by the FEI, is a demanding advanced-level competition requiring horses and riders to cover the distance within a set time while passing each veterinary checkpoint. In order to qualify for a 120 km race, horses must also complete two 40 km races, two 80 km races, and two 100 km races. They must also be at least 7 years old to compete in a 120 km race, which undoubtedly requires intense training. The scheduling of CEI endurance events in Malaysia are limited, with the annual frequency in recent years being three events in 2025, two in 2024, and one in 2023 (Equestrian Association of Malaysia, 2025).

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The horse's stomach is relatively small, holding about 7.5 to 15 liters. It consists of two main regions: the upper non-glandular area lined with squamous epithelium, and the lower glandular area lined with columnar epithelium, separated by the margo plicatus. The glandular region continuously secretes hydrochloric acid and has protective mechanisms like bicarbonate-rich mucus, high blood flow, and rapid cell repair. In contrast, the squamous region lacks these defenses and is vulnerable to acid damage. Equine gastric ulcer syndrome (EGUS) arises when acid injures the squamous mucosa, causing ulcers. Clinical signs in horses include poor appetite, weight loss, behavioral changes, and mild colic, while foals may show excessive salivation or diarrhea. Horses are natural grazers, having evolved to consume fiber-rich forage constantly for approximately 16 to 18 hours a day, whilst producing hydrochloric acid in their stomach continuously even when they're not eating. When the horse doesn't feed for a certain amount of time or is fed high-grain diets, this acid can damage the squamous mucosa, leading to ulcer formation. If the horse doesn't feed for more than six hours, it can increase the risk of Equine Gastric Ulcer Syndrome (EGUS) by up to four times. (Sykes *et al*., 2015)

The EGUS council has developed a scoring system to grade these ulcers during a gastroscopy. The gastric ulcers are classified based on gastroscopy findings from grade 0 (normal mucosa) to grade 4 (extensive, deep ulcerations). Early detection is crucial because untreated ulcers can progress to more severe lesions, causing chronic pain, poor growth, behavioral problems, and complications such as bleeding, anemia, or even gastric perforation in rare cases. Additionally, ulcers can lead to pyloric stenosis, which delays gastric emptying and exacerbates symptoms. Failure to diagnose and treat ulcers promptly can result in prolonged suffering and reduced athletic performance (Sykes *et al*., 2015).

1.2 Research Problem Statement

Despite global studies that highlight the high prevalence of EGUS in high-performance endurance horses, there is limited local data on Equine Gastric Ulcer Syndrome (EGUS) in Malaysia. This study aims to determine the prevalence of EGUS in high-performance horses, particularly in Terengganu, Malaysia. Determining the prevalence highlights how common the condition is and raises awareness among veterinarians and trainers. It provides data that, in the future, will help identify possible risk factors such as intense training, specific feeding practices, and management routines. While these studies don't prove what causes EGUS, they provide valuable data that guide further research, inform prevention strategies, and support early screening and intervention to protect horse health.

1.3 Research Questions

1. What is the prevalence of EGUS in high-performance endurance horses in Terengganu, Malaysia?
2. What is the association between high-performance endurance and the risk of developing EGUS in horses?

1.4 Research Hypothesis

1. There is a moderate to high prevalence of EGUS in high-performance endurance horses in Terengganu, Malaysia.
2. There is an association between high-performance endurance and the risk of developing EGUS in horses.

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1.5 Research Objectives

1. To determine the prevalence of EGUS in high-performance endurance horses in Terengganu, Malaysia.
2. To investigate the association between high-performance endurance and risk of developing EGUS in horses.

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CHAPTER 2: LITERATURE REVIEW

2.1 Prevalence

The prevalence of EGUS has been reported extensively in the literature. They vary by the groups sampled and the exercise programs. In a study conducted on high-level endurance horses competing in 90-160 km races, the prevalence of squamous gastric ulcers was 48% in the interseason period and increased to 93% during the competition season, with a mean grade. This difference between the two seasons was highly significant (P = 0.001). Majority of lesions involved the squamous portion of the stomach, but 33.3% of horses showed glandular lesions. Significant influence of training and performance level on the gastric grade (according to the distance of the ride preceding the second gastroscopy) was shown (P = 0.038). There was also a significant influence of housing on the gastric grade (P = 0.002), showing higher grades in the horses kept totally on pasture compared to horses housed in a mixed environment (stable + pasture). Both the pastured and mixed environment (stabled + pastured) groups were receiving a grain supplement, but the pastured group received a higher daily starch intake, which might explain the higher ulcer prevalence. There was no influence of age, breed, or gender on the gastric grades. (Tamzali Y *et al*., 2011)

Beyond these observations, EGUS is recognized as a prevalent condition among horses, with its occurrence varying based on breed, temperament, and training regimen (Feudo *et al*., 2022). Racehorses, in particular, demonstrate a high prevalence, up to 95% during periods of intense training and competition, identifying exercise frequency as a major risk factor (Feudo *et al*., 2022).

Equine Glandular Gastric Disease, a specific form of EGUS, is gaining increased recognition, with its prevalence and impact influenced by primary risk factors such as frequent exercise and stress (HE & FM, 2019). Management strategies designed to mitigate exercise-related stress are therefore crucial in addressing EGGD (HE & FM, 2019). The transition of

horses from extensive pasture-based management to formal training can also influence the incidence and severity of both equine squamous gastric disease and EGGD, highlighting how changes in management practices and behavioural factors contribute to ulcer development (Lúthersson *et al*., 2022).

2.2 Risk factors

2.2.1 Exercise level

Vatistas *et al*. (1999) successfully induced and sustained squamous gastric ulcers in horses for a duration of six weeks by exposing them to simulated race training. Despite this, only one out of thirty horses showed signs of abdominal pain. Interestingly, serum cortisol levels were found to be lower at the conclusion of the study, which might indicate a diminished stress response, although it could also suggest the effects of overtraining (Golland *et al*., 1999). During exercise, pressures within the abdomen and stomach increased progressively from walking to trotting to galloping, causing the stomach's lumen to nearly close at trot and gallop (Lorenzo-Figueras, 2002). This pressure forces acidic gastric contents against the squamous mucosa, potentially causing damage. Additionally, exercising horses exhibited elevated serum gastrin levels, which may promote increased hydrochloric acid secretion and thus heighten the risk of ulcer formation (Furr *et al*., 1992; Furr *et al*., 1994). The role of exercise in ulcer development is further supported by observations that the prevalence of Equine Squamous Gastric Disease (ESGD) rises during the racing season (Tamzali *et al*., 2011), with particularly high rates seen in racehorses.

2.2.2 Breed

Previous epidemiological studies have shown that signalment factors such as breed and sex can influence the occurrence of gastric ulceration in horses. A

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postmortem study of 3,715 horses examined over 72 years reported significant associations between the presence of ulceration and breed. Thoroughbred and Standardbred breeds were more likely to have ulcers than cold-blooded horses. The study also found a higher prevalence in stallions compared with mares and geldings (Sandin *et al*., 2000). Similar findings have been reported in clinical populations, where a retrospective study of 684 sport and leisure horses in the United Kingdom identified Thoroughbred breed as a significant risk factor for equine squamous gastric disease across different age groups (Sykes *et al*., 2015).

2.2.3 Nutritional factors

Studies have shown that increased starch and grain intake has been associated with a higher risk of ESGD in horses working at different intensities (Luthersson *et al*., 2009; Frank *et al*., 2005; Vatistas *et al*., 1999). A marked increase in ulceration was observed when non-exercising horses were stabled and fed grain at 1% body weight one hour before hay feeding (Frank *et al*., 2005). Similarly, starch intake exceeding 2 g/kg body weight per day has been linked to approximately a two-fold increase in the likelihood of ESGD grade ≥2/5 (Luthersson *et al*., 2009). ESGD also developed in all horses within 14 days after removal from pasture, stabling, feeding of 6 kg concentrate per day, and simulated training (Vatistas *et al*., 1999).

2.2.4 Non-Steroidal Anti-inflammatory Drugs

Despite their common use in equine medicine, NSAIDs have a narrow safety margin and can cause fatal side effects. There are three main side effects of NSAIDs in horses, which are right dorsal colitis (RDC), gastroduodenal ulceration, and renal

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papillary necrosis. (Flood, J., 2022) The mechanism of action of NSAIDs is by inhibiting COX enzymes, which reduces prostaglandin production. Their role in causing Equine Gastric Ulcer Syndrome (EGUS) and Equine Glandular Gastric Disease (EGGD) is debated. (Sykes *et al*., 2015) While high doses of NSAIDs can cause gastric glandular ulcers, there is limited evidence that the therapy can contribute to EGUS. The development of EGUS from the use of NSAIDs is complex, as COX inhibition affects multiple protective mechanisms. It increases gastric acid secretion, lowering pH and reducing bicarbonate and mucus production. It also reduces vasodilation and gastric blood flow. Prostaglandins like Prostaglandin E (PGE) and Prostaglandin I2 (PGI2) are essential for mucosal health, repair, epithelial cell turnover, and maintaining tight junctions crucial for healing and barrier function. (Flood *et al.,* 2021)

2.3 Anatomy of the equine stomach

In comparison to the horse's body size, the stomach is a small organ with a capacity of about 5 to 15 liters, which is 8% of the total volume of the GI tract of an adult horse (Dyce *et al.* 2010). The equine stomach can be divided into two main regions: the upper non-glandular region which is lined by stratified squamous epithelium, and the lower glandular region, which is lined by simple columnar epithelium (A Durham, 2014). The lining of the stomach is divided by a ridge or fold of the mucosa called the margo plicatus (Dyce *et al*.2010). The glandular mucosa contains glands that secrete hydrochloric acid (HCL) continuously, leading to prolonged exposure of the glandular mucosa to low pH (Sykes *et al*., 2015). It also secretes pepsin, bicarbonate, and mucus (Sykes *et al*., 2015). In the glandular mucosa, more natural antacid defense mechanisms have been recognized, which are prostaglandin-dependent protective mechanisms (A Durham, 2014). First is the secretion of bicarbonate-rich mucus, second is the high rate of mucosal perfusion, and third is rapid epithelial coverage and regrowth following epithelial cell death (A Durham, 2014). In the squamous epithelium, the

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glycoconjugate substances containing bicarbonate are secreted by the stratum spinosum cells (A Durham, 2014). The pH of the gastric content in horses is generally less than 2.0, and decreases when the horse has not eaten for as little as 2 hours (M.J. Murray, 1997).

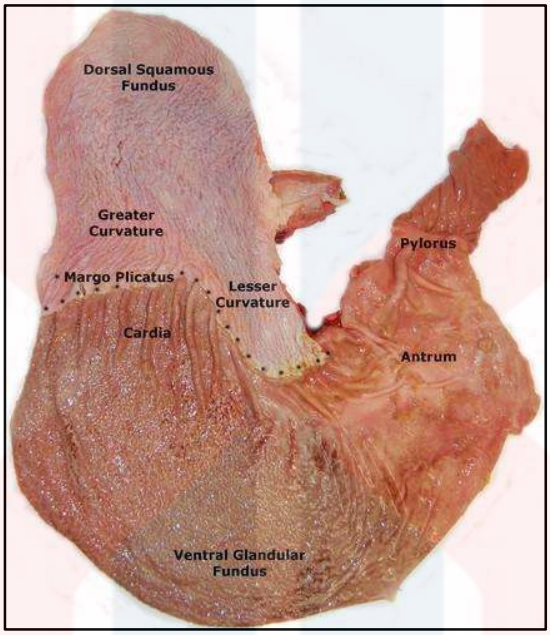

Figure 1. Equine Stomach. (Sykes *et al*.,2015)

2.4 Pathophysiology

The pathophysiology of EGUS begins with exposure of the squamous region of the stomach to gastric acid. This squamous region lacks protective mucus and bicarbonate, resulting in mucosal damage and ulceration. The glandular region is better protected but can also develop ulcers if mucosal blood flow is compromised or if protective factors are reduced. Other than that, it involves increased intra-abdominal pressure during intense exercise, which pushes acidic gastric contents upward against the squamous mucosa that lacks protective mucus and bicarbonate, resulting in mucosal injury and ulcer formation (Lorenzo-Figueiras *et al*., 2021). Exercise also stimulates acid secretion through increased serum gastrin and reduces gastric blood flow by diverting blood to skeletal muscles, impairing mucosal perfusion and repair (Sykes & Hewetson, 2013). Stress associated with training elevates cortisol and ACTH

levels, further compromising mucosal defenses (Luthersson *et al*., 2009). Cortisol reduces blood flow to the stomach lining, thereby limiting oxygen and nutrient delivery essential for mucosal cell repair and regeneration. This diminished blood flow weakens the stomach's protective barrier, allowing acid to penetrate deeper into the mucosa and cause ulceration. Additionally, cortisol decreases mucus production, which normally coats and protects the stomach lining from corrosive gastric acid, further increasing vulnerability to damage. Elevated cortisol in response to stressors, such as exercise, has been documented in horses with glandular gastric disease, indicating a link between stress sensitivity and ulcer development.

Furthermore, frequent fasting or intermittent feeding increases the risk of EGUS in horses as it reduces saliva production and buffering capacity, allowing prolonged acid exposure to the stomach lining (Nadeau *et al*., 2003). Without regular feed intake, the stomach remains empty longer, allowing gastric acid to accumulate and directly contact the unprotected squamous mucosa. Studies have shown that fasting, especially before transport or competition, significantly lowers gastric pH and increases ulcer grades in horses, highlighting the importance of continuous feeding or access to forage to maintain a protective gastric environment. The lack of roughage reduces the ball-of-forage, as roughage (hay or pasture) provides bulky, fibrous material that physically fills the stomach and forms a fibrous mat or ball. This ball of forage acts as a physical barrier that soaks up and buffers gastric acid, protecting squamous mucosa from direct acid formation. This, combined with the increased acid production during exercise, creates a highly acidic environment that leads to ulcer formation. Therefore, management practices that minimize fasting duration and provide continuous access to forage are critical in reducing EGUS risk.

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EGUS also alters metabolic parameters by contributing to systemic acid-base disturbances. Horses with EGUS often exhibit early lactate accumulation and post-exercise acidosis, which correlates with decreased aerobic capacity and increased fatigue (Orsini *et al*., 2011). This metabolic imbalance may result from abdominal pain limiting exercise tolerance and altered gastrointestinal absorption, leading to weight loss and poor body condition (Ferrer *et al*., 2015). EGUS-associated inappetence reduces feed intake, exacerbating energy deficits (Hepburn, 2019). The syndrome may also contribute to dehydration because when the horse is in pain, it will likely refuse water intake, which leads to fluid loss into the gastrointestinal tract due to mucosal damage (Stewart, 2016). Furthermore, EGUS-associated colic and decreased gut motility can impair normal fluid absorption and transit. Reduced gastric motility, partly due to decreased mucosal blood flow and inflammation, delays gastric emptying, increasing the risk of further acid exposure and ulcer progression. This impaired motility also disrupts normal digestive processes, potentially leading to secondary gastrointestinal complications.

In summary, EGUS arises from increased gastric acid exposure, compromised mucosal defenses, and reduced gastric blood flow, all exacerbated by exercise and management stressors (Syke & Hewetson, 2013). Its effects extend beyond local gastric injury to systemic metabolic disturbances, dehydration, and impaired gut motility, collectively contributing to poor performance and health in affected horses (McClure *et al*., 2005).

2.5 Clinical signs

There are several clinical signs associated with gastric mucosal disease in horses, including colic, weight loss, poor body condition, dull coat, decreased appetite, diarrhea, teeth grinding (bruxism), flehmen response, behavioral changes, and reduced performance. There is evidence to suggest an increased incidence of colic and post-eating discomfort exists in horses with both ESGD and EGGD (Vokes.J.,2023) Studies have also demonstrated a

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relationship between gastric disease and low body condition in Standardbred racehorses, mostly diagnosed with ESGD and horses with severe EGGD. (Bezdekova, B.,2020)

In terms of behavioral changes related to gastric diseases in practice, reports in the literature supporting this are variable. A cross-sectional study of 50 show horses identified that horses with nervous behavior are more likely to have ESGD. Multiple studies have shown a relationship between ESGD and crib biting. One of the common behaviors described by owners is 'girthiness', such as signs of pain, discomfort, and negative behavior during girthing. However, studies have failed to show a relationship between girthing behavior and ESGD or EGGD. However, the behaviors attributed to ESGD and EGGD are not specific for gastric disease; thus, other gastrointestinal diseases, such as sand enteropathy and non-gastrointestinal (musculoskeletal) diseases, should remain as differentials. Other than girthiness, poor performance is one of the most common reported signs, despite studies failing to demonstrate its lack of specificity for gastric disease, as there is a wide scope of interpretation of performance level. It is suspected to be due to gastric pain limiting stride length and oxygen consumption in racehorses. (Vokes, 2023)

It is important to differentiate between Equine Squamous Gastric Disease (ESGD) and Equine Glandular Gastric Disease (EGGD) when interpreting these signs, as most research focuses on ESGD, and recent findings show no clear connection between owner-reported symptoms and EGGD. Additionally, some evidence suggests that horses with gastric disease may exhibit no clinical signs at all, and in some cases, horses showing symptoms do not necessarily improve even after the gastric disease is resolved. (Vokes, 2023)

2.6 Diagnosis

2.6.1 Gastroscopy examination

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Gastroscopy is the definitive method for diagnosing Equine Gastric Ulcer Syndrome. However, concerns are increasing about how well visible glandular lesions correlate with the symptoms patients present and their underlying histological changes. While gastroscopy shows moderate consistency for diagnosing ESGD, there is significant variability when describing EGGD lesions.

Table 1. Grading system for ESGD adapted from the 1999 EGUS Council

Grade	Squamous Mucosa
0	Intact mucosa with no signs of hyperemia
I	Intact mucosa with no signs of hyperemia
II	Intact mucosa with some areas of reddening
III	Small single/ multifocal superficial lesions (<5mm)
IV	Large single/multifocal lesions or extensive superficial lesions (>5mm)

2.6.2 Histopathological examination

Histopathology is increasingly being used to assess glandular mucosal disease. One study comparing the appearance of EGGD lesions during gastroscopy with histopathological findings found a poor correlation: 71% of stomachs that appeared normal grossly still had mild gastritis under the microscope, and all EGGD lesions showed varying degrees of gastritis, regardless of their apparent severity. Another study identified both lymphoplasmacytic and eosinophilic inflammation in the glandular stomach tissue in a small sample group. When comparing biopsy techniques, the 'double bite' method during endoscopy provided the best quality samples compared to full-thickness post-mortem samples. For larger lesions, such as glandular polyps, using a snare to obtain bigger biopsy samples is recommended (Vokes *et al*., 2023).

2.6.3 Changes in Proteins in Saliva and Serum in Equine Gastric Ulcer Syndrome Using a Proteomic Approach

Muñoz-Prieto *et al*. (2022) describes the changes in proteins in saliva and serum in Equine Gastric Ulcer Syndrome (EGUS) using a proteomic approach. Researchers analysed the saliva and serum of 6 horses with EGUS, 6 horses with EGGD, and 10 healthy horses as controls. Changes in the salivary proteome were evaluated using high-resolution LC-MS/MS analysis of TMT-labelled peptides. Saliva samples were collected before gastroscopy, centrifuged at 3000× g for 10 minutes at 4°C, and stored at −80°C until analysis.

In this study, horses with ESGD and EGGD showed different protein profiles in saliva when analysed by proteomics with a TMT-based approach. The most upregulated proteins in EGGD were related to immune activation, whereas in horses with ESGD, the proteins that changed were related to squamous cell regulation and growth. The proteins identified in this study, in addition to providing novel information about the pathophysiological mechanisms in these diseases, could have the potential to be new biomarkers for diagnosis or monitoring of EGGD and ESGD. Furthermore, this data provides additional evidence that EGGD and ESGD have two different pathophysiological mechanisms of disease and suggests that they should be considered two different diseases rather than being combined into a single syndrome of EGUS (Muñoz-Prieto *et al*., 2022).

2.7 Treatment

Treatment of equine squamous gastric ulcers primarily involves the proton pump inhibitor omeprazole, administered orally at 4 mg/kg once daily for at least 3 to 4 weeks (Boehringer Ingelheim Animal Health USA Inc., 2020; Hewetson & Tallon, 2021;

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Veterinary Medicines Directorate, 2025). Omeprazole irreversibly blocks the hydrogen-potassium ATPase enzyme in parietal cells, reducing gastric acid secretion and raising stomach pH to promote ulcer healing (Boehringer Ingelheim Animal Health USA Inc., 2020; Veterinary Medicines Directorate, 2025). Its effectiveness is enhanced when delivered in gastroprotected formulations, such as buffered pastes or enteric-coated products, which protect the drug from stomach acid and improve absorption (Hewetson & Tallon, 2021; Young & Magdesian, 2019). Healing rates with omeprazole range from 67% to over 90%, depending on the formulation, horse population, and management conditions (Gough *et al*., 2020; Hewetson & Tallon, 2021). Intramuscular injectable omeprazole is an alternative for horses unable to take oral medication (Gough *et al*., 2020; Rendle *et al*., 2018; Sykes *et al*., 2017).

Supportive care includes dietary management, emphasizing low-starch grains and alfalfa hay to buffer stomach acid, along with management changes like reducing intense exercise and providing pasture turnout to decrease ulcer recurrence (Andrews, 2024; Nadeau *et al*., 2000; Young & Magdesian, 2019; Veterinary Medicines Directorate, 2025). Sucralfate, a mucosal protectant that forms a protective barrier and stimulates mucus and bicarbonate secretion, is often used adjunctively, especially for glandular ulcers (Banse & Andrews, 2019; Rendle *et al*., 2018; Young & Magdesian, 2019). However, sucralfate alone has limited efficacy for squamous ulcers (Andrews, 2024; Rendle *et al*., 2018).

Histamine-2 receptor antagonists such as ranitidine and cimetidine are less effective than omeprazole and require frequent dosing, limiting their use (Andrews, 2024; Banse & Andrews, 2019; Dowling, 2025). Antacids neutralize stomach acid temporarily but are impractical due to short duration and high dosing frequency (Andrews, 2024; Dowling, 2025). For equine glandular gastric disease, misoprostol, a prostaglandin analogue that inhibits acid secretion and enhances mucosal defenses, is more effective than omeprazole (Dowling, 2025; Rendle *et al*., 2018; Varley *et al*., 2019). Combining omeprazole with sucralfate is commonly

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used as a first-line option for EGGD, but reported healing rates vary across studies; misoprostol has demonstrated superior healing compared with omeprazole–sucralfate in at least one clinical trial (Banse & Andrews, 2019; Rendle *et al*., 2018; Varley *et al*., 2019).

Overall, treatment success depends on combining pharmacological therapy with dietary and management modifications, and follow-up gastroscopy is recommended to confirm healing before ending therapy (Hewetson & Tallon, 2021; Rendle *et al*., 2018; Veterinary Medicines Directorate, 2025; Young & Magdesian, 2019).

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CHAPTER 3: METHODOLOGY

3.1 Ethics statement and permit approval

The IACUC approved this study of UMK to involve the use and care of animals with the ethics code: UMK/FPV/ACUE/FYP/013/2025.

3.2 Study Area

The study area was Terengganu, specifically the Terengganu International Endurance Park (TIEP), Malaysia. TIEP was established in 2007 in Lembah Bidong, Setiu, Terengganu, as a world-class facility dedicated to equestrian sports such as endurance. It was built to promote and develop endurance riding in Malaysia and the region, providing modern stabling, veterinary, and training facilities to support both local and international riders. TIEP hosted major international events, including the 12th FEI Endurance World Championship in 2008, which attracted 146 riders from 42 countries, as well as endurance events during the 2017 SEA Games. The park served not only as a competition venue but also as a center for equestrian education, talent development, and cultural exchange, combining challenging endurance trails with Malaysia's natural beauty and hospitality.

3.3 Study design

This study was conducted as a prospective cohort study where gastroscopy was performed in 9 (n=9) horses.

3.4 Study Population

In the Sultan Mizan Cup 2025, 23 horses participated in the 120 km category, 28 in the 100 km category, and 75 in the 80 km category, respectively.

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3.4 Selection criteria

3.4.1 Inclusion Criteria

Inclusion criteria for this study are high-performance horses that have participated in 120 km, 100 km and 80 km endurance races. All were chosen by convenience sampling.

3.4.2 Exclusion criteria

There were no exclusion criteria for this study.

3.5 Sampling Method and Procedures

3.5.1 Data collection on the management of horses

Signalment (name, age, sex, breed), management (diet, housing conditions (pasture, stable, or mixed), and history (clinical signs, occurrence of EGUS, and medication use) was collected by interviewing the owner/groom and accessing public FEI data, including horse profiles through the FEI collaborated app, Yamamah. This data is summarized in Table 2

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3.5.2 Gastroscopy

Standing gastroscopy was conducted using a 2-meter video endoscope to visualize the gastric mucosa and determine the presence, size, and extent of lesions in the gastric mucosa and to determine their EGUS grading (0–4).

3.5.3 Data analysis

All data were recorded manually using gastroscopy and tabulated in Google Sheets. After that, data analysis was conducted using IBM SPSS (Statistical Package for the Social Sciences). To summarize the ordinal data (EGUS grades), the median and interquartile range were used to describe the severity of EGUS in this cohort. Fisher's exact test was used to test the association between the presence of EGUS and other categorical variables.

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CHAPTER 4

4.0 Results

A total of nine (n = 9) horses out of the total population of 26 horses participating in the 120 km category underwent gastroscopy examination. Although the study aimed to include ten horses, one horse could not be examined due to logistical constraints. The gastroscopy examination findings for each horse are represented in Table 2.

Table 2. Gastroscopy findings.

Sample No.	ESGD Grade (0-4)	Remarks	EGGD	Remarks
1	2	Multifocal(<5mm)	Yes	Focal raised hemorrhagic ulcer (>5mm)
2	4	Multifocal(>5mm)	No	–
3	2	Focal (<5mm)	Yes	Multifocal flat fibrinosuppurative (<5mm)
4	1	Irregular hyperkeratotic mucosa	Yes	Superficial and hyperemic
5	0	–	No	–
6	0	–	No	–
7	0	–	No	–
8	1,4	Multifocal flat hyperemic (<5mm)	Yes	Multifocal depressed fibrinosuppurative (>5mm)
9	0	–	No	–

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4.1 Prevalence of Equine Gastric Ulcer Syndrome (EGUS)

In this study, a total of 9 horses were examined for EGUS. Of these, 5 horses (55.6%) were diagnosed with EGUS, while 4 horses (44.4%) showed no visible lesions. These results are presented in Table 3.

Table 3. Frequency of EGUS.

Category	No. of sample	Percentage (%)
EGUS (positive)	5	55.6
EGUS (negative)	4	45.4
Total	9	100

4.2 Data Collection Summary

Information on each horse's age, sex, breed, diet, management practices, and any prior medical history, including medication usage and past occurrences of Equine Gastric Ulcer Syndrome (EGUS), were gathered to provide context for the analysis of the prevalence of EGUS. This data is essential for understanding potential correlations between management practices, horse characteristics, and the presence of gastric ulcers in high-performance endurance horses. The summary of the data collected is presented in Table 4.

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Name	Age (Years)	Sex	Breed	Body Weight (kg)	Diet Category	Diet Details	Management	Drug use	History
M M Daykiri	11	Female	Arabian	483	Performance diet	Grain, hay, Maxwin Performance, fed 4×/day	Stabled	Ranitidine (May - now)	Colic & inappetence in May
Ashva Farishta	10	Female	Arabian	432	Performance diet	Grain, hay, Maxwin Performance, fed 4×/day	Stabled	Omeprazole daily for 1 month (Feb 2025). Ranitidine from March until now	None
FG Maquita	11	Female	Arabian	420	Performance diet	Grain, hay, Maxwin Performance, fed 4×/day	Stabled	Ranitidine 1 week before & after SMC 2025	None
Ifo Fame Fabry	11	Male	Arabian	425	Performance diet	Grain, hay, Maxwin Performance, fed 4×/day	Stabled	Ranitidine 1 week before & after SMC 2025	None
Ashva Puma	9	Female	Arabian	398	Basic diet	Grain AM, hay PM	Stabled	Ranitidine (April 2025)	Bloody diarrhoea 2 races ago (April 2025)
Cazon Yacare	10	Female	Arabian	420	Basic diet	Grain AM, hay PM	Stabled	Ranitidine 1 year ago	Stress & inappetence 1 year ago
Ras Chipre	8	Male	Arabian	412	Basic diet	Grain AM, hay PM	Stabled	None	Tendon injury, both FL, and chronic skin issues
Yallaroo Dolce	9	Female	Arabian	405	Basic diet	Grain AM, hay PM	Stabled	None	None
Mallima	10	Male	Arabian	412	Basic diet	Grain AM, hay PM	Stabled	None	Pyrexia 2 days prior

Table 4. Summary of data collected.

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4.3 Distribution and Severity of ESGD and EGGD

Out of the 5 EGUS-positive cases, 1 horse (11.1%) was diagnosed with ESGD only, while 4 horses (44.4%) exhibited a combination of both ESGD and EGGD. No horses in the sample were diagnosed with EGGD alone. The severity of ESGD ranged from mild (Grade 1) to severe (Grade 4), with 2 horses (40%) showing Grade 4 ESGD lesions, 2 horses (40%) showing Grade 2 lesions, and 1 horse (20%) showing Grade 1 lesions. The severity of EGGD lesions varied, with most cases being mild to moderate. These findings emphasize the greater prevalence of ESGD compared to EGGD in this study and highlight the range of severity in ESGD lesions.

Table 5. Frequency of Horses Diagnosed with ESGD and EGGD.

Category	Number of Samples	Percentage
ESGD only	1	11.1%
EGGD only	0	0%
ESGD + EGGD	4	44.4%
Total EGUS Positive	5	55.6%
EGUS Negative	4	44.4%
Total	9	100%

4.3.1 Squamous (ESGD) Findings

Among the 5 horses diagnosed with ESGD, the majority (4 horses, 80%) exhibited Grade 0 lesions, indicating no visible ulceration. However, 1 horse (20%) had mild (Grade 1) lesions, 2 horses (40%) showed moderate (Grade 2) lesions, and 2 horses (40%) had severe (Grade 4) lesions. These findings show a range of severity within ESGD, with the most severe cases showing extensive

ulcerations, which are consistent with the pathophysiology of ESGD in high-performance horses subjected to intense physical stress and exercise.

Table 6. Distribution of ESGD Cases According to Ulcer Grade (0–4)

ESGD Grade	Number of Samples	Percentage (%)
Grade 0	4	80
Grade 1	1	20
Grade 2	2	40
Grade 3	0	0
Grade 4	2	40

4.3.2 Glandular (EGGD) Findings

The severity of EGGD varied from mild mucosal irritation to focal depressed ulceration. Among the 9 horses, 3 exhibited mild to moderate glandular lesions, characterised by flat fibrinous or hemorrhagic changes within the glandular fundus or ventral to the margo plicatus. One horse showed generalized glandular hyperaemia, consistent with early or mild glandular irritation. One horse demonstrated more severe glandular involvement, presenting with depressed fibrinous ulceration suggestive of advanced EGGD. The remaining 4 horses showed no significant glandular pathology, with normal pyloric and glandular mucosa on endoscopic evaluation. Overall, most glandular lesions were mild, with only a small proportion showing more advanced ulcerative changes.

4.4 Association with Risk Factors

4.4.1 Performance level

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The performance levels are categorized based on distance and the frequency of EGUS positive samples are summarized in Table 7.

Table 7. Number of Horses Diagnosed with EGUS According to Performance Level

Category	EGUS	No EGUS	*Total*
120KM	4	1	5
100KM	1	2	3
80KM	0	1	1
Total	5	4	9

The Fisher's exact test statistic value is 0.1667. The result is not significant at $p < .05$.

4.4.2 Breed

In this study, all horses (n=9) were Arabian breed. As there was no breed diversity, statistical analysis for breed was not conducted.

4.4.3 Nutritional factors

5 horses were being fed a high performance diet that consists of grain, hay, MaxWin Performance Feed, and the other 4 were fed a basic diet consisting of grain and hay only. This is summarized in Table 8.

Table 8. Frequency of EGUS According to Diet Type.

Category	EGUS	No EGUS	*Totals*
High-performance diet	4	1	5
Basic Diet	0	4	4
Totals	4	5	9

The Fisher's exact test statistic value is 0.0476. The result is significant at $p < .05$.

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4.4.4 Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

None of the samples (n=9) had reported use of NSAIDs upon data collection. Thus, no statistical analysis for NSAID use was conducted.

4.4.5 Housing

All horses had similar housing where they were kept fully in stable. As there is no diversity in housing, no statistical analysis was conducted.

4.4.6 History of EGUS Clinical Signs

Ulcers were more common in horses that had previous gastrointestinal issues, such as demonstrating signs of EGUS. This is summarized in Table 9.

Table 9. Number of Horses with a History of EGUS Clinical Signs

History of EGUS clinical signs	**EGUS**	**No EGUS**	***Totals***
Present	1	2	3
Absent	4	2	6
Totals	5	4	9

Fisher's exact test statistic value is 0.5238. The result is not significant at $p < .05$.

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CHAPTER 5

5.0 Discussion

This study evaluated the prevalence and detection of Equine Gastric Ulcer Syndrome (EGUS) in high-performance endurance horses competing in 120 km events at the Terengganu International Endurance Park (TIEP), Malaysia. Although the initial aim was to examine ten horses, nine horses were successfully scoped due to logistical constraints. Despite this limited sample size, the findings provide important preliminary insight into the status of EGUS within Malaysian endurance horses—a population for which scientific data has previously been minimal.

5.1 Prevalence of Equine Gastric Ulcer Syndrome (EGUS) in High-Performance Endurance Horses

The results of this study indicate that 55.6% of the horses examined for EGUS were diagnosed with the condition. This prevalence aligns with the findings of Tamzali *et al*. (2011), who reported a similar range of EGUS prevalence in high-performance horses, ranging from 48% to 93% depending on the season and intensity of training. The high incidence observed in this study is consistent with other studies investigating endurance horses participating in long-distance races, where physiological stress, training intensity, and dietary factors are known to contribute significantly to the development of EGUS (Sykes *et al*., 2015).

Several horses had a history of clinical signs commonly associated with EGUS, including inappetence, colic, stress-related behavior, and previous use of anti-ulcer medications. Notably, multiple horses were receiving ranitidine at the time of or before gastroscopy. Ranitidine is known to provide weaker and shorter-duration acid suppression compared to omeprazole, which may explain the persistence or recurrence of lesions despite

treatment. Studies have demonstrated that ranitidine, while effective in reducing gastric acid, does not provide the prolonged acid suppression that omeprazole does, which may contribute to the recurrence of lesions (MacAllister & Sangiah, 1993; Murray, 1997). This study observed that ranitidine was being used in several horses, but the relationship between ranitidine use and EGUS recurrence was not investigated. This finding highlights the importance of selecting more effective medical protocols, such as omeprazole for long-term acid suppression, alongside a holistic approach to managing risk factors such as diet and stress in performance horses at high risk of EGUS (Sykes et al., 2015; Sykes & Andrews, 2003).

In this study, Equine Squamous Gastric Disease (ESGD) was observed to be more prevalent than Equine Glandular Gastric Disease (EGGD), a finding similar to Sykes *et al*. (2015) who reported that ESGD is the predominant form of EGUS in endurance horses. According to Sykes *et al*. (2015), endurance horses have an ESGD prevalence of 48% out of competition, which increases to 66–93% during competitive periods, reflecting a strong influence of training and exercise stress on EGUS development. EGGD prevalence in endurance athletes is reported at 16–33% depending on competition status. The findings of this study may also be attributed to the high-intensity exercise involved in endurance racing, where increased intra-abdominal pressure during physical exertion is believed to lead to acid splash and subsequent damage to the squamous mucosa (Furr *et al*., 1994). The predominance of ESGD in this study also supports a hypothesis by Murray (1997) that acidic gastric contents are more likely to damage the squamous region due to the lack of natural defense mechanisms, such as bicarbonate secretion and mucosal blood flow, which are more prominent in the glandular region.

5.2 Risk Factors for EGUS in 120 km Endurance Horses

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The findings of this study suggest that certain risk factors are associated with EGUS in 120 km endurance horses, particularly dietary practices and the intensity of training. Horses on high-performance diets, which included concentrated grain and performance feeds, demonstrated a significantly higher likelihood of EGUS ($p = 0.0476$). This is consistent with the observations of Sykes *et al*. (2015), who reported that high-starch diets can lower gastric pH, increase volatile fatty acid production, and predispose the squamous mucosa to acid-induced injury. Given the physiological demands of endurance racing, which require horses to perform over long distances, the combination of a high-grain diet and the associated exercise-induced gastric acid production likely contributes to the observed prevalence of EGUS.

In the literature, it is well-documented that EGUS can recur in high-performance horses due to factors such as dietary influences, stress, and NSAID use (MacAllister & Sangiah, 1993). Exercise-induced stress and the intensity of training are commonly recognized as contributing factors to the development of EGUS in endurance horses. However, in this study, none of the horses had been diagnosed with EGUS previously, and none reported NSAID use, so the role of non-steroidal anti-inflammatory drugs in the development of EGUS was not established.

No significant associations were detected for breed ($p = 0.4444$) or participation in 120 km races ($p = 0.1667$), although interpretation is limited by the small sample size.

5.3 Comparison to Existing Literature

The findings of this study are consistent with the results of Tamzali *et al*. (2011) and Sykes *et al*. (2015), who also reported a high prevalence of EGUS in endurance horses. However, in this study, it differs slightly in the severity of lesions observed. While Martineau *et al*. (2009) reported that glandular lesions were relatively mild and often limited to the pyloric region, the horses in our study exhibited more severe lesions extending into the glandular

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mucosa, particularly in the pyloric region. This discrepancy may be attributed to differences in gastroscopy timing, where acute lesions could have healed by the time of examination, as noted by Sykes *et al*. (2015).

Moreover, the glandular ulcers observed in our study were often associated with focal fibrinous ulcers, which aligns with findings from other studies investigating Equine Glandular Gastric Disease (EGGD) in endurance horses. Interestingly, our study did not find a direct relationship between NSAID use and the prevalence of EGUS, which contrasts with findings from Flood *et al*. (2022), where NSAID administration was linked to increased risk of gastric ulceration. However, this lack of association in our study may be due to the absence of NSAID use in the examined horses, suggesting that other factors, such as diet and training intensity, may be more influential in the development of EGUS in endurance horses.

5.4 Limitations

Although this study provides valuable insights into the prevalence and risk factors associated with EGUS in 120 km endurance horses, several limitations must be acknowledged. One complication encountered was sawdust ingestion, which obstructed complete visualization of the glandular mucosa in certain horses and may have resulted in underdiagnosis of EGGD. The small sample size (n=9) limited the statistical power of certain analyses, particularly those investigating the influence of age and sex on EGUS prevalence.

Additionally, gastroscopy timing varied. It is typically performed within 2 to 3 days after a race which is optimal for detecting acute ulceration induced by the physical stress and increased gastric acid exposure associated with intense exercise (Sykes et al., 2015). Performing gastroscopy more than 7 days after the race is generally considered too late for an accurate assessment, as healing can begin in the first week, potentially masking acute lesions and leading to an underestimation of the race's impact (MacAllister & Sangiah, 1993).

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Therefore, performing gastroscopy immediately post-race or within a few days provides the most accurate reflection of exercise-induced gastric lesions, before any healing takes place or ulceration is affected by treatments like acid-suppressive therapy. Several horses in this study were scoped weeks to months after their most recent race due to logistic constraints, potentially allowing partial healing of acute lesions and consequently underestimating true ulcer prevalence.

Future studies with larger, more diverse samples would improve the generalizability of the results and provide more robust data on the role of demographic factors in EGUS development. Additionally, the lack of a control group of horses not participating in endurance races restricts the ability to conclusively determine the impact of 120km endurance participation on the development of EGUS. It is recommended that future research incorporate multiple gastroscopies performed at regular intervals during the competition season to assess the chronicity and recurrence of EGUS in high-performance horses. Furthermore, studies investigating the effect of stress, dietary changes, and exercise regimens on EGUS could provide deeper insight into the pathophysiology of the disease and help in developing preventive strategies.

Despite these limitations, this study represents the first gastroscopy-based assessment of EGUS in Malaysian endurance horses and demonstrates that more than half of the examined horses were affected. Continued research involving larger sample sizes, standardized evaluation timelines, and broader inclusion of performance and environmental variables will be critical to enhancing understanding of EGUS risk factors and improving welfare and performance outcomes in Malaysian endurance horses.

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5.5 Clinical Implications and Management Strategies

The findings of this study emphasize the need for regular gastroscopic monitoring in high-performance horses, particularly those competing in 120 km endurance races, to ensure early detection of EGUS. Furthermore, dietary management should be optimized by reducing starch intake and focusing on forage-based diets, which have been shown to buffer gastric acid and reduce the risk of ulceration. The use of prophylactic treatments, such as omeprazole, and modifications in exercise regimens, including allowing for more pasture turnout and reducing training intensity, could help minimize the risk of EGUS in these athletes.

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CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study aimed to contribute to the understanding of EGUS in high-performance endurance horses competing in the 120 km category in Terengganu, Malaysia. While the prevalence and lesion distribution observed in this cohort align with international reports describing EGUS as common in endurance athletes, this study provides locally relevant data within the Malaysian endurance horse population, where published information remains limited.

Within this study, the association between a high-performance diet and ulceration reinforces existing evidence that dietary practices are critical in the development of gastric lesions. Although recent race participation and certain management variables were not statistically associated with ulcer presence in this study, this does not exclude their potential contribution. EGUS is multifactorial in nature, and its complex pathophysiology involves interactions between gastric acid exposure, mucosal defense mechanisms, feeding regimens, exercise-induced stress, and management factors.

This study also highlights the practical challenges of field-based gastroscopy in athletic horses, including timing of examination and environmental factors that may influence visualization, thus emphasizing the importance of standardized evaluation protocols when investigating exercise-associated gastric disease.

Although limited by sample size, this research contributes preliminary evidence that EGUS remains an important welfare and performance concern in Malaysian endurance horses.

Overall, this study reinforces the need for proactive gastric health management in endurance horses, integrating appropriate nutritional strategies, evidence-based pharmacologic protocols, and regular monitoring to optimize both welfare and athletic performance.

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6.2 Recommendations

Future research on Equine Gastric Ulcer Syndrome (EGUS) in Malaysian endurance horses should aim to address the limitations identified in this study while expanding the scope and depth of investigation. The small sample size (n = 9) in the present study restricted the statistical power of analyses and limited the ability to draw robust conclusions regarding associations between EGUS and various management, dietary, and performance factors. Therefore, future studies should include a larger and more representative population of endurance horses across different events, training centers, and regions in Malaysia. Increasing sample size will enable stronger statistical analyses, improve generalizability, and support more reliable detection of significant risk factors.

Standardization of gastroscopy timing is also strongly recommended. In this study, several horses were scoped beyond the optimal 1–7 day post-race window, which may have allowed partial mucosal healing and resulted in underestimation of ulcer prevalence or severity. Future research should strictly adhere to standardized post-competition gastroscopy intervals to better capture acute ulceration associated with endurance exercise.

Another limitation observed was obstruction of the gastric mucosa by sawdust ingestion in some horses, which compromised visualization of the glandular region. Future studies should implement controlled pre-gastroscopy management protocols—including fasting periods, removal of bedding, and supervised stabling—to prevent contamination and ensure accurate assessment of both squamous and glandular mucosa.

Additionally, the current study relied heavily on owner and groom-reported management histories, which may be subject to recall bias. Future studies should incorporate more objective and standardized data collection methods, including real-time monitoring of

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training intensity, feeding schedules, forage-to-concentrate ratios, and stress indicators such as heart rate variability or cortisol levels.

It is also recommended that future research evaluate the effectiveness of different prophylactic and therapeutic strategies, such as omeprazole protocols, dietary modifications, turnout management, and stress-reduction practices, in reducing the prevalence and recurrence of EGUS in Malaysian endurance horses. Longitudinal studies following horses across multiple racing seasons would further clarify the chronicity, healing patterns, and relapse rates of both ESGD and EGGD.

Finally, incorporating complementary diagnostic tools such as salivary or serum biomarkers, fecal occult blood testing, or proteomic profiling may help improve detection accuracy and reduce reliance on gastroscopy alone. These tools could provide insights into early disease processes and support the development of non-invasive screening methods suitable for field conditions.

In summary, future studies should focus on expanding sample size, standardizing gastroscopy timing, improving pre-procedure management, utilizing objective data collection methods, and exploring advanced diagnostic and preventive strategies. Addressing these limitations will enhance the understanding of EGUS in Malaysian endurance horses and contribute to evidence-based improvements in equine health, welfare, and performance.

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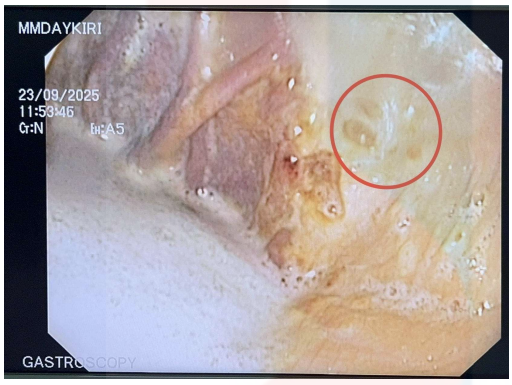
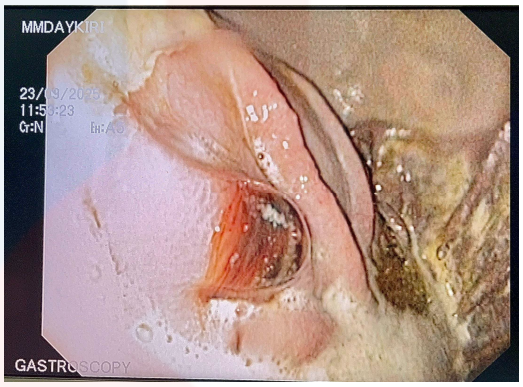
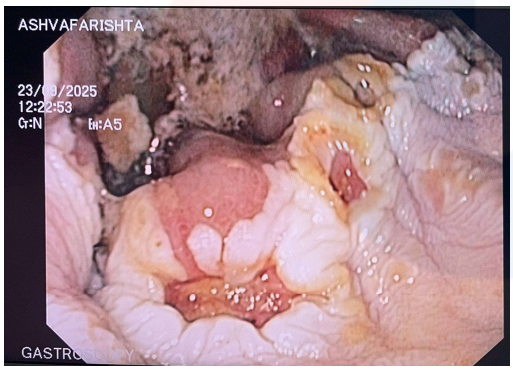
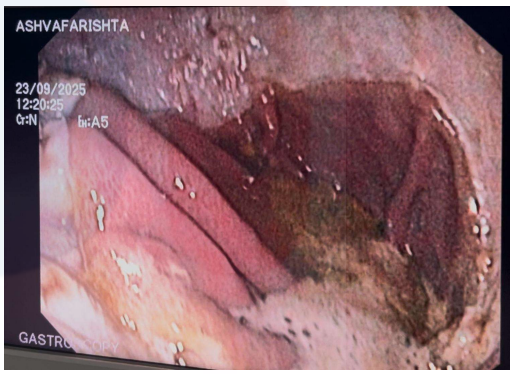
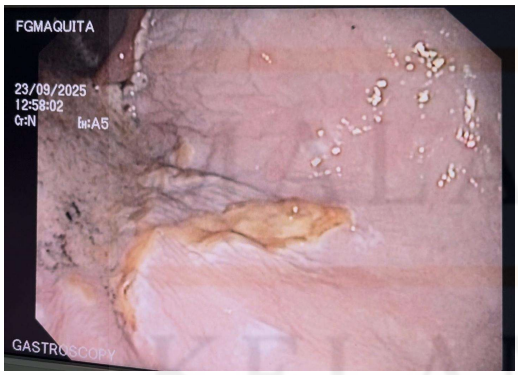
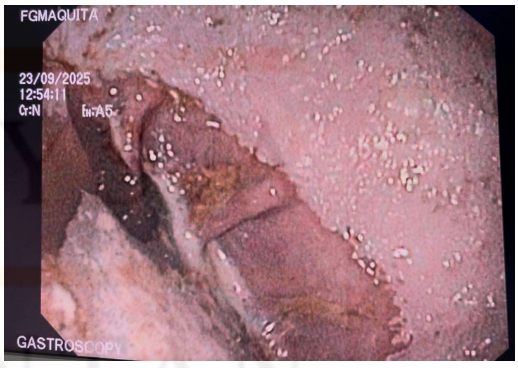
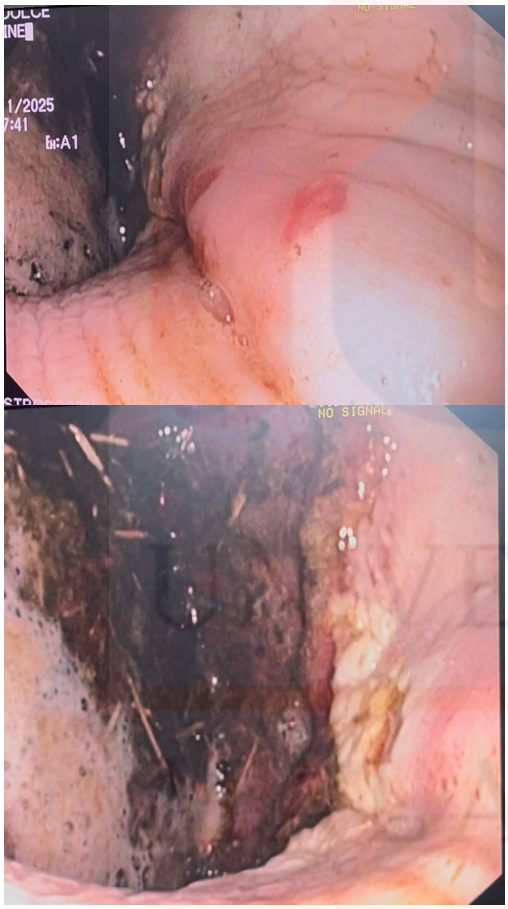
APPENDIX 1: Gastroscopy findings

No	ESGD	EGGD
1	**A:** Multifocal small (<5mm) ulcers	**B:** A large raised hemorrhagic ulcer (>5mm)
		
2	**A:** Multifocal deep ulceration (>5mm).	**B:** Normal
		
3	**A:** A single flat fibrinous lesion (<5mm)	**B:** Multifocal flat and fibrinous ulcers (<5mm)
		
4	**A:** Irregular thickened hyperkeratotic mucosa with a yellowish appearance	**B:** Hyperemic mucosa

FYP FPV

		
8	**A: (Grade 1)** Multifocal flat hyperemic ulcers (<5mm) **(Grade 4)** Multifocal depressed fibrinosuppurative (>5mm)	
		

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