



Retrospective evaluation of crib-biting and windsucking behaviours and owner-perceived behavioural traits as risk factors for colic in horses

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Summary

Reasons for performing study: Although crib-biting (cribbing)/windsucking has previously been associated with 2 types of colic, additional research into the possible role of other behaviours on incidence of colic by type and severity has not been undertaken.

Objectives: To investigate: a relationship between cribbing/windsucking and colic; a relationship between cribbing/windsucking and different types of colic, both medical and surgical; and whether horses displaying specific behaviour traits were more likely to have had colic.

Methods: A matched case-control retrospective study was conducted evaluating horses with various surgical and medical colic diagnoses, admitted to a referral hospital over a 3 year period. Computerised records and a validated internet questionnaire were used to obtain information on owner-perceived behavioural traits and repetitive behaviours.

Results: Cribbing/windsucking was significantly associated with colic but was unassociated with one category or severity of colic over another. No other repetitive behaviour was associated with colic. Age (≥ 20 years) was significantly associated with colic. An anxious temperament was not associated with risk of colic.

Conclusion: Animals at higher risk for colic may be identified based on history of cribbing/windsucking behaviour, but this behaviour was unassociated with increased risk for a particular category or severity of colic. Horses characterised as being more anxious were not at increased risk for colic.

Potential relevance: There is a need to elucidate a causal relationship between cribbing/windsucking and gastrointestinal function as development of more effective and humane strategies to treat cribbing/windsucking behaviour may help to improve equine welfare and reduce the risk of colic.

Introduction

An association between crib-biting (cribbing)/windsucking, a stereotypic behaviour, and 2 specific types of abdominal colic in

horses has been established (Hillyer *et al.* 2002; Archer *et al.* 2008). Colic can have many causes, can be mild to severe, and is often fatal.

Stereotypies are defined as invariant and repetitive behaviour patterns that seemingly have no function (McGreevy 2004). They tend to develop in captive animals and may be indicative of reduced welfare (Waters *et al.* 2002). Stereotypic behaviours can be grouped into oral and locomotory types. Cribbing is an oral stereotypy that involves the act of grasping a fixed object, usually a horizontal surface, with the incisor teeth. The horse emits a grunting sound with or without aspirating air into the cranial part of the oesophagus. Windsucking is a similar behaviour but the horse does not grasp a fixed object (McGreevy 2004). Cribbing may develop as a means to cope with stress and inhibiting this behaviour may diminish this function (Nagy *et al.* 2009). These horses may be stressed more easily than unaffected horses (Bachmann *et al.* 2003a). Cribbing is an undesirable behaviour, and attempts to inhibit this behaviour through the use of anti-crib or other physical devices may significantly impact equine welfare by reducing the horse's ability to cope with stress without addressing the underlying cause (Nagy *et al.* 2009).

Research has shown associations between cribbing/windsucking and stress, intestinal function/motility and diet (Minero *et al.* 1999; McGreevy *et al.* 2001; Bachmann *et al.* 2003b). Animals that are stressed may be more susceptible to gastrointestinal disorders and there may be a link between acute or chronic stress and colic. Given that cribbing/windsucking has been shown to be a risk factor for specific types of colic and appears to be related to both gastrointestinal function and stress, the question has been posed as to whether horses who colic are more likely to have specific behavioural traits, such as anxiety. Temperament or behavioural traits of horses have been evaluated by objectively scoring horses' responses to certain stimuli and evaluating physiological and behavioural responses (Anderson *et al.* 1999; Visser *et al.* 2001; Momozawa *et al.* 2003). Additionally, observation of temperament by caretakers can accurately reflect behavioural and physiological responses to novel stimulus tests, and provides a consistent means of objectifying long-term subjective behavioural evaluations (Momozawa *et al.* 2003, 2005, 2007). The aims of this study were to investigate: a relationship

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between cribbing/windsucking and colic; a relationship between cribbing/windsucking in horses and different types of colic, both medical and surgical; and whether horses displaying specific behaviour traits, specifically anxious or nervous behaviour, were more likely to have a history of colic. Our hypotheses were that: cribbing/windsucking behaviour increases the overall incidence of colic; cribbing/windsucking does not increase the risk of specific forms of colic among horses with colic; and anxiety and other related personality traits do not increase the risk of colic. Information obtained from this study may improve the ability to identify animals that are at higher risk for colic, thereby placing emphasis on prevention and improved animal welfare.

Materials and methods

Case and control selection and definition

Computerised records at the University of California, William R. Pritchard Veterinary Medical Teaching Hospital (VMTH) were searched for horses who were aged ≥ 1 year and who presented to a VMTH veterinarian within 3 years (January 2006–December 2008) prior to initiation of the study. These horses had been either treated for colic (Case) or another disease process unrelated to colic (lameness, ophthalmic disease, or wounds - Control). Horses that were euthanised or had died during or after the treatment period were excluded from the study (Case and Control groups).

For this study, colic was defined as abdominal pain originating from the gastrointestinal tract. Medical colic was defined as colic that improved or resolved with medical treatment alone. Surgical colic was defined as colic for which surgery was performed as part of the diagnosis or treatment. The diagnoses of colic included, but were not limited to, colonic displacement and volvulus, strangulations, epiploic foramen entrapment (EFE), impactions, sand colic and enterolithiasis, gas colic, open diagnosis and 'other'. Physical examination had been performed on each horse by a VMTH veterinarian, and appropriate diagnostic tests were performed, including observations made during surgery.

Cases and Controls (1–2 per case) were matched for time of presentation, within 2 months of each other.

Questionnaire design and data collection

The survey was pilot tested among horse caretakers not included in the final survey, and was subsequently refined based upon the responses and comments received. The purpose of the pilot survey was to eliminate structural errors and to ensure that the questions could be easily understood.

Caretakers were mailed a postcard requesting their participation. Each postcard included a URL for a website where they would gain access to the specific internet survey according to the group. Control (A) and Case (B) surveys were filled out by the primary caregivers of Case and Control horses, respectively. Where applicable, the wording of questions in each of the surveys was modified so that it pertained to the Control or Case diagnosis but otherwise the surveys were identical (SurveyMonkey, <http://www.tinyurl.com/horse-a>; <http://www.tinyurl.com/horse-b>). Reminder postcards were sent to nonrespondents one month later. Internet surveys have been used to collect data for veterinary research and data collection in this form as been shown to be consistent with findings from traditional methods (Gobar and Kass 2002; Tynes *et al.* 2007).

The survey was divided into the following categories: demographic information on horses and caretakers; behaviours 24 h prior to most recent presentation to the VMTH; repetitive behaviours and other problem behaviours in the horses' lifetime; and questions pertaining to behavioural traits and temperament. Sets of questions regarding behavioural traits of horses followed those used in previously published papers (Momozawa *et al.* 2003, 2005) (Table 4). Where applicable, questions were in direct reference to the most recent visit for which the horse presented to the VMTH. Many of the horses had a history of presenting for multiple episodes of colic or other ailments and therefore it was necessary to identify a specific episode of colic or control condition. Caretakers were asked to enter a date and their horse's patient number (provided on the postcard) in order to verify that their answers were in reference to the correct time period in the VMTH medical records.

Statistical analysis

The data were evaluated using conditional logistic regression to control for confounding introduced by matching on time of case occurrence. Cases were compared to Controls with respect to their history of cribbing/windsucking and anxiety as potential risk factors. Among Cases, a Chi-squared test for independence was performed to analyse cribbing/windsucking as a predictor for colic type. The individual colic types were assigned to broader category groups to increase the statistical power of analyses and these groups were based on similar underlying pathophysiology. Strangulation and displacement were combined as both are considered to be secondary to a dysfunction in motility of the gut (Smith 1996). The 4 groups consisted of: 1) strangulation and displacements (large intestinal displacement or volvulus, $n = 27$; small intestinal strangulation, $n = 13$; EFE, $n = 4$); 2) sand colic ($n = 20$) and enterolithiasis ($n = 17$); 3) impactions ($n = 37$); and 4) open/gas colic ($n = 103$). Other colic types were omitted due to a small sample size or if they did not fit into one of the major colic categories. P values < 0.05 were considered statistically significant. Data were analysed by use of statistical software¹.

Results

Of the 2802 postcards sent out, 890 (32.5%) online surveys were submitted and a total of 574 (227 Cases, 347 Controls) surveys were included in the study (20.4% of the postcards sent) (Fig 1).

Sixty-five percent (148/227) of Case horses were treated medically and 34.8% (79/227) of horses were treated surgically. The risk of medical vs. surgical colic was not different given a history of cribbing/windsucking (OR = 0.78, 95% CI 0.33–1.82, $P = 0.56$). Cribbing/windsucking was not a risk factor for any one category of colic over another ($P = 1.0$).

The demographics of horse breed, age and gender are in Table 1. Horses that were in the age groups 20–24 years (OR = 2.85, 95% CI 1.38–5.88, $P = 0.0047$) and ≥ 25 years (OR = 2.43, 95% CI 0.99–5.93, $P = 0.052$) were more likely to have been treated for colic than those in younger age groups. There were no other significant associations of age, breed or gender on the incidence of colic. No association was found between age category and specific categories of colic ($P = 1.0$) or whether they were amenable to medical or surgical treatment ($P = 0.89$).

Table 2 outlines changes in specific behaviours or specific behavioural traits within 24 h prior to presentation to the VMTH,

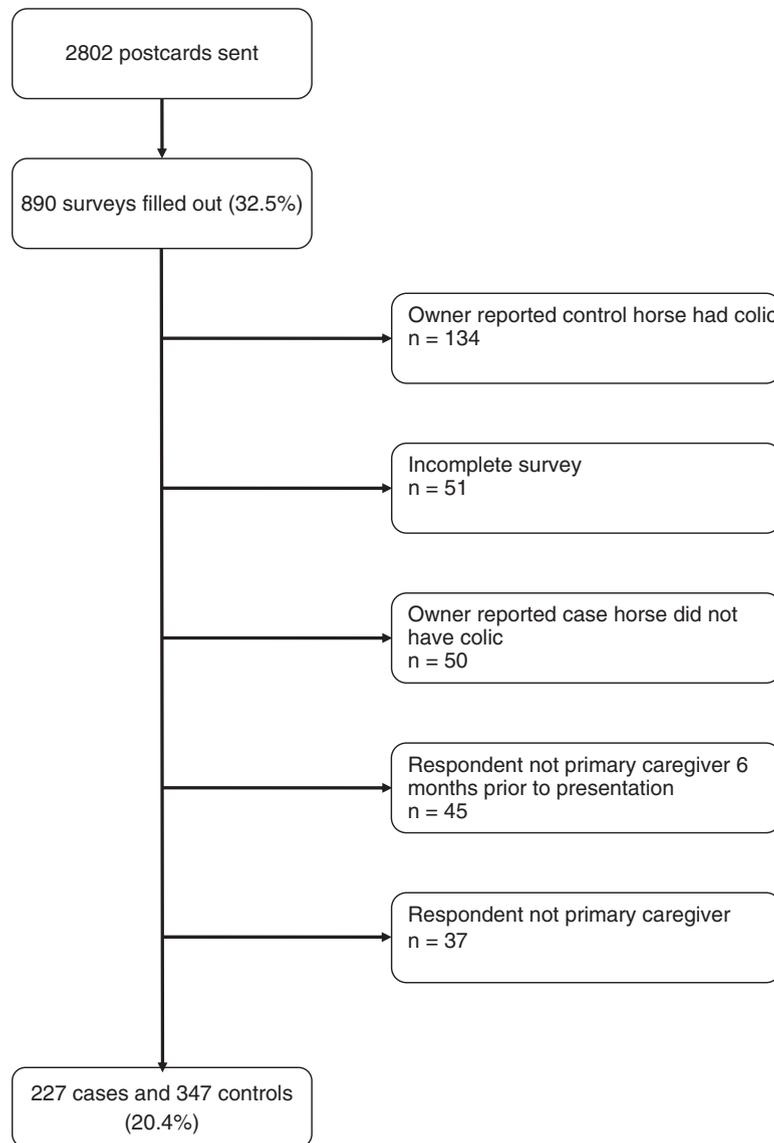


Fig 1: Flow chart detailing recruitment of horses into the study.

related to colic. Forty-two percent (93/219) of horses with colic had experienced an environmental change in the week prior to the episode (OR = 3.93, 95% CI 2.64–5.84, $P \leq 0.001$). Having an anxious temperament was not predictive of any specific type of colic.

Horses that had a history of cribbing or windsucking were more likely to have had colic than those that did not crib (OR = 2.19, 95% CI 0.99–3.46, $P = 0.032$) after adjusting for age. This was corrected for age. None of the other individual repetitive behaviours, as well as when combined into locomotory or oral, were associated with colic (Table 3).

Discussion

To the authors' knowledge this is the first large scale case-control study to evaluate cribbing/windsucking and temperament as risk factors for different types of colic. The prevalence of cribbing/windsucking in the current control group was 6.8%. This is similar to the overall prevalence of 4.4% reported for horses in the USA (Albright *et al.* 2009). The prevalence of cribbing/windsucking in

the colic group was significantly higher (11%). The results support an association between cribbing and gastrointestinal disorders or colic.

This study attempted to evaluate whether cribbing/windsucking was significantly associated with specific types of colic. Categories consisted of colic types that could share similar underlying pathophysiology and consisted of those treated either medically or surgically.

In this study, there was no evidence that cribbing/windsucking was any more a risk factor for one type of colic over another. Additionally, cribbing/windsucking was no more likely to be a risk factor in a horse whose colic was treated medically compared to those that were treated surgically. Therefore, a history of cribbing/windsucking does not appear to be related to type or severity of colic, assuming that those requiring surgery for diagnosis or treatment were more severe.

A previous study showed a much higher prevalence of cribbing in horses with EFE compared to horses with other strangulating small intestinal lesions (Archer *et al.* 2004). Cribbing/windsucking as it relates specifically to EFE was not evaluated in our study due

TABLE 1: Odds ratio of demographic information of the horses in relation to colic

	Control (n = 347)	Colic (n = 227)	P value	Odds ratio	95% CI
Breed					
Thoroughbred	54	29		1	
Warmblood	20	11	0.98	1.01	0.41–2.48
Morgan	11	10	0.19	1.90	0.72–4.99
Arabian	42	34	0.25	1.50	0.76–2.97
Quarter Horse	107	52	0.68	0.89	0.50–1.57
Mix	33	31	0.18	1.63	0.80–3.31
Other	76	58	0.2	1.45	0.82–2.56
Mustang	4	2	0.77	0.76	0.13–4.63
Age category					
1–4	55	25		1	
5–9	104	53	0.67	1.13	0.64–2.02
10–14	107	71	0.20	1.46	0.81–2.93
15–19	44	34	0.17	1.57	0.83–3.00
20–24	24	31	0.0047	2.85	1.38–5.88
≥25	13	13	0.052	2.43	0.99–5.93
Gender					
Mare	133	84		1	
Gelding	198	126	0.79	1.05	0.73–1.51
Stallion	16	17	0.15	1.70	0.83–3.44

to the small sample size of horses diagnosed with EFE (n = 4) at the VMTH in the 3 years prior to this study. This may have been due to a shorter time of recruitment in our study, the lower number of horses suffering from EFE in California, or that horses suffering from EFE are less likely to be referred to the VMTH than elsewhere.

A causal relationship between cribbing/windsucking and colic has not been elucidated and further investigation into how cribbing/windsucking and gastrointestinal function is co-related is warranted. Previous research has demonstrated that longer total gut transit times were recorded in horses that cribbed compared to those that did not, but the oro-caecal transit times did not differ (McGreevy *et al.* 2001). When horses are prevented from cribbing or eating, a relative stasis in the motility of the foregut can occur, suggesting that normal gut function in these animals depends on *ad libitum* access to food and to suitable cribbing substrates (McGreevy and Nicol 1998). Another study suggested that increased intestinal transit time in cribbing horses may be associated with a mechanism for the increased risk of simple colonic obstruction and distention associated with cribbing (Hillyer *et al.* 2002).

Age category was associated with a risk of colic in this study. The age categories of horses 20–24 years and ≥25 years was most significantly associated with colic, with 56% (31/55) and 50%

TABLE 2: Odds ratio of horses demonstrating changes in specific behaviours or specific behavioural traits within 24 h prior to presentation to the VMTH, related to colic

Variable	Control	Colic	P value	Odds ratio	95% CI
Cribbing/windsucking					
No change	33	27	0.18	0.93	
Decreased	1	3	0.27	3.67	0.36–37
Increased	1	0	0.97	∞	∞
Repetitive behaviours other than cribbing or windsucking					
No change	42	21		1	
Decreased	1	1	0.63	2	0.12–33.58
Increased	3	6	0.067	4	0.90–17.6
Anxiety					
No change	89	37		1	
Decreased	4	3	0.45	1.80	0.39–8.46
Increased	38	70	<0.001	4.43	2.56–7.68
Aggression toward people					
No change	62	33		1	
Decreased	1	4	0.077	7.52	0.81–70.01
Increased	9	5	0.94	1.044	0.32–3.37
Aggression toward horses					
No change	93	50		1	
Decreased	2	4	0.14	3.72	0.66–21.02
Increased	14	7	0.88	0.93	0.35–2.45
Pawing					
No change	90	31		1	
Decreased	2	5	0.022	7.26	1.34–39.33
Increased	7	75	<0.001	31.11	12.96–74.66
Kicking					
No change	62	29		1	
Decreased	1	5	0.034	10.69	1.19–95.69
Increased	11	18	0.0048	3.50	1.47–8.35
Lying down					
No change	135	32		1	
Decreased	3	4	0.029	5.63	1.20–26.39
Increased	11	137	0.001	52.54	25.44–108.50
Rolling					
No change	139	36		1	
Decreased	2	6	0.003	11.58	2.24–59.82
Increased	3	108	<0.001	139	41.68–463.5

Numbers for each characteristic may not equal the total number of horses in each group because some respondents did not answer all questions, due to their horse not performing the behaviour or not displaying the behavioural trait.

TABLE 3: Odds ratio of horses demonstrating repetitive behaviours at some point in their lifetime, related to colic

Variable	Colic	Control	P value	Odds ratio	95% CI
Cribbing/windsucking				1	
No	202	325			
Yes	25	22	0.032	1.85	0.99–3.46
Wood chewing/eating				1	
No	154	260			
Yes	73	87	0.083	1.40	0.96–2.053
Tongue/lip play (when not being ridden)				1	
No	194	276			
Yes	33	71	0.11	0.69	0.44–1.087
Stall walking				1	
No	205	320			
Yes	22	27	0.37	1.32	0.72–2.40
Weaving				1	
No	216	335			
Yes	11	12	0.154	1.35	0.55–3.30
Pawing				1	
No	171	250			
Yes	56	97	0.38	0.85	0.58–1.23
Stall kicking				1	
No	208	321			
Yes	19	26	0.7	1.14	0.60–2.17
Other repetitive behaviour				1	
No	198	316			
Yes	29	31	0.19	1.43	0.84–2.44
Any repetitive behaviour (including cribbing or windsucking)				1	
No	88	144			
Yes	139	203	0.5	1.13	0.79–1.60

Numbers for each diagnosis may not equal the total number of horses in each group because some respondents did not answer all questions, due to their horse not performing the behaviour or not displaying the behavioural trait.

TABLE 4: Questionnaire items used to assess anxiety

Question	Score from 1 to 9
This horse's behaviour around insects, noises, etc.	Very calm → Very nervous
This horse's tendency to get excited easily	Not excitable → Very excitable
This horse's tendency to have abnormal fear and panic in different situations	Never → Always
This horse's predictability from day to day	Very consistent → Very inconsistent
This horse's tendency to be vigilant about its surroundings	Never → Always
This horse's tendency to get surprised easily	Not skittish at all → Very skittish
This horse's tendency to be timid in a new environment	Not timid at all → Very timid

Derived from Momozawa *et al.* (2005).

(13/26) of horses having had at least one episode of colic, respectively. This differs from another study, which did not show an association between age and colic when age was considered as a categorical variable; however, horses aged >15 were considered as one category (Hudson *et al.* 2001). Although horses that were ≥20 years were more likely to suffer from colic, there was no association with a particular colic category in our study. This differs from other studies that show young and older horses appear to be at less risk of simple colic (Tinker *et al.* 1997) and middle-aged horses have been reported to be at higher risk than older horses (Proudman 1992).

Results indicate that a change in the frequency of pawing, kicking, lying down and rolling 24 h preceding the colic episode was significantly associated with colic. However, more horses displayed increased rather than decreased frequency of these behaviours. For example, horses that are in pain can be observed by their caretakers to pace more or, separately, to have decreased movement, therefore pacing less. The same can be said for the behaviour of kicking, as they can kick more, at their abdomen, or kick less, if the owner is describing kicking at the stall.

While management risk factors associated with colic were not the focus of this study, the finding that an environmental change within a week of the colic episode was significantly associated with colic is similar to another study that found that the risk of colic was significantly increased in horses with a history of travel in the previous 24 h (Hillyer *et al.* 2002).

Studies have shown a link between animal temperament and disease in other species, including interstitial cystitis in cats and gastric dilation volvulus (GDV) in dogs. The risk of GDV was increased by 257% in dogs characterised as fearful vs. nonfearful (Glickman *et al.* 1997). Cats with interstitial cystitis are more susceptible to stress (Buffington *et al.* 2006). In this study, the temperament trait 'anxiety' was assessed by caretakers based on specific questions derived from a validated questionnaire to determine if horses who had suffered from colic were considered to be more anxious than control horses (Momozawa *et al.* 2003, 2005). This questionnaire, on which ours was based, has been validated as a reliable means to assess equine temperamental traits, especially those related to anxiety, which can be assessed more reliably in comparison to other

temperament traits of the horse by either questionnaire or behavioural evaluation.

In this study, several questions (Table 4) evaluating anxiety were asked in order to increase reliability of the answers given by the caretaker. Our results suggest that colic is not related to inherent temperament of a horse.

One limitation of this study includes recall bias of the caretakers with regard to certain behaviours or temperament assessment, or the caretakers' inability to accurately identify cribbing/windsucking behaviours. To reduce recall bias, caretakers were asked to recall behaviours with respect to the most recent episode of colic when evaluating acute behavioural changes prior to colic. It was not feasible to train respondents or assess their ability to accurately identify and differentiate cribbing/windsucking behaviours and chewing; however, the terms 'cribbing' and 'windsucking' were clearly defined within the survey in order to improve their ability to accurately identify these behaviours. Since this study had a control group, it is unlikely that a higher percentage of either Control or Case group would incorrectly identify these behaviours.

Another limitation was that although care was taken to exclude horses with a known history of colic in the Control group, it is possible that some were missed if the entire medical history of the horse was not known by the respondent or could not be recalled accurately. Additionally, when categorising colic as surgical or medical, we did not consider whether surgery was for diagnostic purposes only. This could be a confounding factor if those that were diagnosed via surgery did not actually receive surgical intervention and the colic resolved medically. However, for the purpose of this study it was assumed that horses that underwent surgery, regardless of whether it was for exploratory purposes or for treatment, reflected those horses that were considered to be more ill. Owners of horses that died or were euthanised were not solicited to be in the study in order to spare the owners' feelings. While it was not expected to bias results as the potential determinants of colic in this study (e.g. cribbing), as they are not determinants of mortality, we acknowledge the possibility that it may have, as horses with more severe forms of colic may have been at a higher risk of dying or being euthanised. Sixty-eight percent of solicited owners did not access the survey; if owner propensity to participate was related to equine behavioural determinants of colic, then study findings could be affected, although we consider this unlikely (Fowler 2009).

Animals at higher risk for colic may be identified based on a history of cribbing/windsucking behaviour within their lifetime. In this study, there was no evidence that cribbing/windsucking is a risk factor for a particular category of colic over another nor was this behaviour more likely to be associated with more severe cases of colic such as those requiring surgery. Also, horses that are characterised as being more anxious are not at increased risk for colic. These statements assume that horses treated at the VMTH represent the general horse population; however, the association of cribbing/windsucking to colic should be limited to our hospital population and other assumptions labelled as speculation. Investigation of a causal relationship between cribbing/windsucking and colic could allow for development of management strategies to improve equine welfare and reduce the risk of disease in addition to the development of more humane treatment modalities for cribbing.

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Manufacturer's address

¹Statistics and Epidemiology Research Corporation, Cytel Software Corporation, Cambridge, Massachusetts, USA.

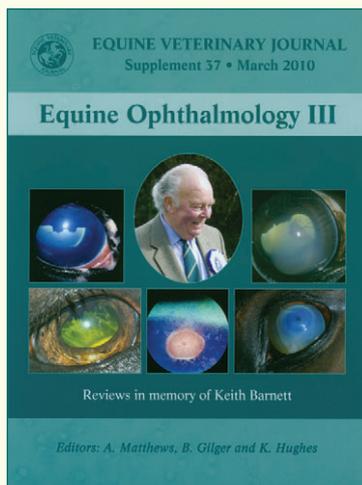
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