Crib-Biting Behaviour in Horses (*Equus caballus*)

Annotated Bibliography

The annotated bibliography entries are organized by theme, in the approximate order that the themes are mentioned in the topic summary. The bibliography begins with articles that provide an overview of crib-biting, followed by crib-biting and health, crib-biting and stress, environmental factors influencing crib-biting, and ending with the prevention of crib-biting. Since more than ten sources were cited, the source that does not have an annotated entry is cited at the bottom of the bibliography.

Overview of Crib-Biting

Wickens, C. L., & Heleski, C. R. (2010). Crib-biting behavior in horses: A review. *Applied Animal Behaviour Science*, *128*(1–4), 1–9. https://doi.org/10.1016/j.applanim.2whatis010.07.002

Summary:

This article provides an overview of research into crib-biting, a stereotypic behaviour in horses. It reviews research conducted since the mid-1990s focusing on factors contributing to the development of crib-biting. Stereotypies are abnormal repetitive behaviours indicating compromised welfare. Crib-biting is an oral stereotypic behaviour that has been linked to poor physical condition, dental problems, and colic.

Management factors implicated in the development of crib-biting include the feeding of concentrates and a lack of turnout and social contact. Demographically, male horses, as well as the Warmblood and Thoroughbred breeds, are at a higher risk of developing the behaviour. The neurotransmitters dopamine and serotonin have been linked to crib-biting. Crib-biting horses have lower basal serotonin levels, and serotonin reuptake inhibitors are reported to decrease stereotypic behaviour. Crib-biting horses were found to have different dopamine receptor densities and difficulties with response–outcome tasks linked to dopamine abnormalities. Opioid agonists have been found to reduce stereotypic behaviours; however, studies of β-endorphin levels in stereotypic horses produced conflicting results, requiring further study.

Gastrointestinal irritation is another potential underlying cause of crib-biting, as gastric ulceration was present in a greater proportion of crib-biting foals than control foals, and antacid supplementation has been found to reduce crib-biting. Crib-biting has been hypothesized as a method of stress management, with heart rate and cortisol levels found to decrease following episodes of crib-biting. Cortisol studies in crib-biting horses have produced conflicting results requiring further research. Crib-biting horses are highly motivated to perform the behaviour, and short-term physical prevention led to an increased rate of crib-biting upon removal of the preventatives. Pharmacological agents have been successful in reducing crib-biting but are labour-intensive and may have negative health impacts. Overall, the reduction of crib-biting is best achieved by addressing the underlying factors, particularly management causes, leading to its development.

Contribution:

This article summarizes crib-biting behaviour in horses, with a particular focus on its underlying causes, examining management and physiological factors implicated in its development. The article identifies well-supported causes, areas in need of further research, and the types of studies needed to uncover this information. This review generally supports previous findings, as it agrees with many of the conclusions of the articles reviewed. When primary studies reach contradicting conclusions, this review indicates that further research is required. Additionally, this article provided an excellent source of primary literature to provide a deeper understanding of crib-biting.

Cooper, J. J., & Albentosa, M. J. (2005). Behavioural adaptation in the domestic horse: potential role of apparently abnormal responses including stereotypic behaviour. *Livestock Production Science*, *92*(2), 177–182. https://doi.org/10.1016/j.livprodsci.2004.11.017

Summary:

This article reviewed previous research into stereotypic behaviour in horses to determine if stereotypic behaviour plays an adaptive role in the captive environment. Horse behaviours evolved in response to challenges of the natural environment. Many of these challenges are nonexistent in the captive environment, but the need to respond to them may remain, causing behaviours not observed under natural conditions. Such behaviours may be a necessary adaptation to the challenges of captivity or indicative of compromised welfare.

Equine environmental challenges can be categorized in three ways; challenges in the captive environment that a horse can naturally respond to, challenges solved by the captive environment that horses are still motivated to respond to, and insurmountable challenges. Stereotypic behaviours are repetitive, apparently purposeless behaviours that may be a response to the aforementioned three challenges. Stereotypic behaviours are associated with reduced social interaction and a concentrate-rich diet, both abnormal conditions for horses. Horses are naturally social and increased social contact has been shown to reduce stereotypic behaviour. Free-roaming horses primarily feed on low-quality forage instead of high-quality concentrates. Physical prevention of stereotypic behaviour without addressing underlying causes is generally unsuccessful, leading to modified forms of the behaviour and possibly causing stress.

Evidence for stereotypic behaviour being a general coping mechanism is poor due to previous studies being highly contradictory. Stereotypic behaviours may be a response to specific environmental challenges, as evidenced by a link between gastrointestinal acidity and oral stereotypies. The behaviours may fail to overcome the environmental challenges, necessitating human intervention. The best way to prevent stereotypic behaviour is to reduce the motivation to perform them by changing the environment. Future studies should examine physiological changes associated with the development of stereotypies rather than focusing on horses already exhibiting the behaviours to provide more concrete evidence for a possible adaptive function.

Contribution:

This article primarily supports previous studies and points out where results contradict. It synthesizes previous research to propose an overarching explanation for stereotypic behaviour in captive horses, which is vital in understanding what these behaviours indicate and what should be done with a horse performing these behaviours. Understanding what stereotypic behaviour such as crib-biting indicates is crucial to the proper management of stereotypic animals. The article also provides a direction for future research and suggests methodologies for use by future researchers to examine the possible adaptive function of stereotypic behaviour more conclusively.

Crib-Biting and Equine Health

Escalona, E. E., Okell, C. N., & Archer, D. C. (2014). Prevalence of and risk factors for colic in horses that display crib-biting behaviour. *BMC Veterinary Research*, 10(S1), S3. https://doi.org/10.1186/1746-6148-10-S1-S3

Summary:

This study examined the prevalence of colic in crib-biting and windsucking (CBWS) horses and the risk factors for colic within this population. CBWS are stereotypic behaviours in horses. Crib-biting involves gripping a fixed surface and pulling backwards, sucking air into the esophagus. Windsucking is the same behaviour without grasping. Previous studies have found an association between CBWS and colic, a severe health condition characterized by gastrointestinal distress. The researchers used a postal questionnaire to gather data from 367 CBWS horses to understand this relationship better. The questionnaire examined environmental factors and the prevalence of colic.

Many horses had multiple episodes of colic, consistent with research indicating an increased prevalence of recurrent colic in CBWS horses. 35.4% of the horses had one or more colic episodes, higher than the estimated frequency of colic in the general equine population. The severity of CBWS also increased the likelihood of colic.

Environmental factors increasing the risk of colic included feeding haylage, CBWS while consuming forage, and stabling during autumn. Since the annual composition of haylage is known to vary, the researchers believed that a confounding variable causes this association. The association between CBWS, forage, and colic contradicts previous studies that indicate feeding forage decreases CBWS. This result may suggest that some CBWS horses have an abnormal response to forage, increasing their colic risk. This theory requires further study. Previous studies have found that colic is more common during transitional months. Changing seasonal management practices may lead to greater colic risk during autumn.

The higher prevalence of colic in CBWS horses supports an association between CBWS and colic. Since there is no clear evidence that CBWS causes colic, there may be a shared causal factor that requires further study to identify. Longitudinal studies are recommended to clarify the relationship between colic and CBWS.

Contribution:

Understanding the relationship between crib-biting and colic is critical to properly managing crib-biting horses since colic can be a fatal condition. The results of this study are partially consistent with previous research. The greater prevalence of colic in CBWS horses is consistent with previous research; however, some environmental factors associated with this risk contradict previous studies. These contradicting results may be a result of confounding variables or unknown factors requiring further investigation. This study provides a starting point for future research and indicates the types of research that may be most beneficial.

McGreevy, P., & Nicol, C. (1998). Physiological and behavioral consequences associated with short-term prevention of crib-biting in horses. *Physiology & Behavior*, 65(1), 15–23.
https://doi.org/10.1016/S0031-9384(98)00070-5

Summary:

The purpose of this study was to determine if prevention of crib-biting leads to physiological or behavioural changes indicating crib-biting has a stress-coping function. Crib-biting is an equine stereotypic behaviour theorized to develop as a method of coping with stress. As such, the prevention of the behaviour may lead to increased stress as indicated by changes in behaviour, heart rate, oro-caecal transmit time (OCTT), cortisol, and β-endorphin concentration. OCTT is a measure of gut motility. The authors alternatively prevented six crib-biting and control horses from feeding, crib-biting, or both, and their behavioural and physiological responses were analysed.

There were no significant differences in baseline β-endorphin concentration and heart rate between the two groups. Crib-biting horses had a slightly higher baseline cortisol concentration still within the normal range. Preventing crib-biting increased β-endorphin levels and did not significantly impact cortisol levels in crib-biting horses, indicating stress reduction is not a primary function of crib-biting. Time devoted to eating increased in stereotypic horses when they were prevented from crib-biting. Preventing both feeding and crib-biting decreased OCTT and increased cortisol levels in stereotypic horses. When combined with the increased feeding behaviour and unchanged cortisol level of stereotypic horses prevented from crib-biting, these results may indicate that crib-biting horses compensate for an inability to crib-bite through alternate forms of oral stimulation. The decreased OCTT indicates gut stasis and suggests that crib-biting horses require free access to food and crib-biting for normal digestive functioning.

The results of this study further emphasize the complex relationship between crib-biting and feeding. The study suggests that further research should examine the relationship between crib-biting and gut function in crib-biting horses and look for a potential feedback loop involving crib-biting and feeding. The study also indicates that the primary purpose of crib-biting is not to cope with stress.

Contribution:

Understanding the purpose of crib-biting is key to managing crib-biting horses. This study advances the understanding of the causes of crib-biting by examining the relationship between crib-biting and feeding and indicating that crib-biting is not a stress-coping mechanism. The study results are mostly consistent with previous research as previous research supports a relationship between feeding and crib-biting, and research into crib-biting and stress is often contradictory. This research provides a starting point for a more in-depth study into the physiological mechanisms that may explain this study's outcomes.

Crib-Biting and Stress

Bachmann, I., Bernasconi, P., Herrmann, R., Weishaupt, M. A., & Stauffacher, M. (2003). Behavioural and physiological responses to an acute stressor in crib-biting and control horses. ***Applied Animal Behaviour Science, 82(4)*****, 297–311. https://doi.org/10.1016/S0168-1591(03)00086-8**

Summary:

This study attempted to determine whether crib-biting in horses is a method of coping with stress by examining the responses of crib-biting horses to a stressful stimulus. The exact function of crib-biting is unknown, but it has been hypothesized as a means of coping with stress. However, previous studies of stress responses have produced inconsistent results. This study monitored the behaviour, heart rate, and cortisol levels of 11 pairs of crib-biting and non-stereotypic horses under normal and stressful conditions. Before the experiment, researchers housed the horses under identical conditions and monitored their behaviour via video. During the experiment, the horses were conditioned to receive food from a specific bucket. To induce stress, the bucket was presented, but the horses were not fed.

Based on video analysis, crib-biting horses spent 10 - 64% of their time crib-biting under normal conditions. Heart rate and arousal behaviour increased in both groups of horses when stressed. The frequency of crib-biting decreased in response to stress, indicating that it is not a method of coping with short-term stress. Cortisol measurements produced insignificant results, potentially due to the stimulus being insufficiently stressful or the horses adapting to the relatively common stressor of short-term feeding restriction. There was no difference in the baseline and stress-induced heart rate, cortisol level, and arousal behaviour between crib-biting and control horses. There was a significant difference in resting heart rate variability between crib-biting and control horses, indicating that crib-biting horses may be more sensitive to stress and less flexible in their stress response than non-stereotypic horses.

This study suggests that crib-biting is not a response to short-term stress; however, the potentially greater stress sensitivity in crib-biting horses indicates that stress plays some role in crib-biting. Further research is necessary to understand the relationship between stress and crib-biting properly.

Contribution:

The results of this research are consistent with the conflicting nature of stress studies on crib-biting horses, as the results are consistent with some studies and inconsistent with others. This study indicates that crib-biting is not a response to short-term stress; however, its relationship with chronic stress requires further study. It found that crib-biting is likely related to stress, but further research is necessary to uncover the nature of that relationship. Understanding the significance of crib-biting is crucial in determining the implications of the behaviour on horse welfare and how best to manage crib-biting horses.

Crib-Biting, Feeding, and Social Contact

Bachmann, I., Audigé, L., & Stauffacher, M. (2010). Risk factors associated with behavioural disorders of crib-biting, weaving and box-walking in Swiss horses. *Equine Veterinary Journal, 35(2),* 158–163. https://doi.org/10.2746/042516403776114216

Summary:

This study sought to identify risk factors associated with stereotypic behaviours in the Swiss horse population. Stereotypic behaviours are constant, repetitive, and have no apparent function. While the precise causes of horse stereotypic behaviours remain unknown, previous research indicates both environmental and demographic factors influence the behaviour. This study used a questionnaire to gather data on management methods, farm and horse characteristics, and behaviour from 662 stables. 60 potential risk factors were statistically analyzed to determine the significance of the results and adjust for confounding variables. 11 out of the 60 factors were significant.

The study found a lower incidence of stereotypic behaviours than previous studies potentially due to examining different populations and behaviours. Demographically, horses older than four years, horses believed to be more reactive, and Thoroughbred and Warmblood breeds were more likely to exhibit stereotypic behaviour. The type and amount of work a horse performed were not found to influence stereotypic behaviour. Free movement time outside of the stable and social contact were found to reduce stereotypic behaviour. The feeding of concentrates increased the frequency of stereotypic behaviours, especially crib-biting. While researchers did not analyze forage feeding due to inconsistent responses, horses fed concentrates generally receive less forage. The likelihood of stereotypic behaviour was highest when food was provided four times a day, potentially caused by stress associated with food anticipation. Feeding less often decreases the time spent anticipating food and feeding more often may be equivalent to ad libitum feeding.

Overall, the study found that barn-related factors were more influential than demographic factors on stereotypic behaviours. Even if some horses are predisposed to developing stereotypic behaviour, it can be reduced or prevented by changing associated management factors. Further research examining the factors identified by the study in greater detail is necessary.

Contribution:

The results of this study are mostly consistent with previous research, and it reconciled inconsistencies as likely being due to differences in populations and analysis methods used by other studies. This study provides a basis for future research into known specific risk factors and proposes a potential management strategy to reduce stereotypic behaviour in horses. Horses should be primarily given forage and kept in an environment that allows social contact and free movement. Understanding factors related to the development of stereotypic behaviour and their relative significance is vital to successfully reducing stereotypic behaviour.

McGreevy, P. D., Cripps, P. J., French, N. P., Green, L. E., & Nicol, C. J. (1995). Management factors associated with stereotypic and redirected behaviour in the Thoroughbred horse. ***Equine Veterinary Journal*****, *27*(2), 86–91. https://doi.org/10.1111/j.2042-3306.1995.tb03041.x**

Summary:

The purpose of this study was to understand the relative influence of different management factors on the risk of developing abnormal behaviours. Stereotypies are constant, repetitive, and purposeless behaviours. Redirected behaviours are behaviours directed towards an improper target. The precise causes of both abnormal behaviours are unknown despite extensive research. A questionnaire was used to gather information on abnormal behaviours and management factors from 159 Thoroughbred trainers. 22 management factors were examined, most significantly, the type and amount of forage, number of horses, amount of contact between horses, and bedding type. Statistical and regression analyses were performed to determine the significance of the results and account for confounding relationships.

86 out of the 149 trainers surveyed provided usable results, and there were no significant differences between respondents and non-respondents. Horses from yards with more than 75 horses exhibited significantly less abnormal behaviour than expected, whereas yards with less than 75 horses exhibited more. Stalls allowing for visual or tactile contact were associated with substantially less abnormal behaviour, suggesting social contact is important in reducing abnormal behaviours. Horses kept on non-straw bedding exhibited significantly more abnormal behaviour than expected. Horses fed less than 6.8 kg of forage per day, fed forage three times a day, or provided only hay forage were significantly more likely to perform abnormal behaviours. Since non-hay forage is often more variable, these results suggest increased food variety is linked to decreased abnormal behaviour. Horses fed less forage may have more "free time," and this excess time may lead to the development of abnormal behaviours.

Understanding risk factors for the development of abnormal behaviours is key to preventing them. Management factors associated with stabling had the greatest effect on abnormal behaviours, particularly stereotypies. Future studies are necessary to uncover demographic and weaning-related risk factors.

Contribution:

This study advances the understanding of the relationship between management factors and abnormal behaviours, including stereotypies. It provides insight into the relative effects of different factors, indicating which factors most impact the development of abnormal behaviours. A detailed understanding of how stereotypic behaviours develop is key to understanding their significance and mitigating them if necessary. The study's results are consistent with other research, as the management factors identified by the study are similar to those previously implicated in the development of abnormal behaviours. This study also provides a starting point for further research and proposes other areas for investigation.

Waters, A. J., Nicol, C. J., & French, N. P. (2010). Factors influencing the development of stereotypic and redirected behaviours in young horses: Findings of a four-year prospective epidemiological study. *Equine Veterinary Journal*, *34*(6), 572–579.
https://doi.org/10.2746/042516402776180241

Summary:

The goal of this study was to determine factors associated with the development of stereotypic behaviours in horses. Stereotypies are repetitive, consistent behaviours with no apparent purpose that may indicate reduced welfare. Epidemiological studies such as this can provide better evidence for cause-and-effect relationships than studies on mature horses exhibiting established behaviours. The study examined 225 Thoroughbred and part-Thoroughbred foals before, during, and after weaning, using a questionnaire and direct observation to gather data for analysis.

Stereotypic behaviour was most likely to develop within the first nine months of a foal's life. Offspring of socially dominant mothers were more likely to develop stereotypies. The explanation for this is unclear and requires further study. Weaning-related factors significantly impacted the risk of developing stereotypic behaviour, possibly due to weaning being a high-stress period for juveniles. Abrupt weaning involving sudden separation from the mother increased the likelihood of developing stereotypic behaviours. Foals weaned abruptly are known to exhibit redirected suckling behaviours, which may develop into oral stereotypies. Foals weaned in a paddock environment, abruptly or not, were less likely to develop stereotypic behaviour, possibly as a result of calm conspecifics reducing stress. Feeding concentrated food post-weaning increased the risk of stereotypic behaviour, particularly the risk of crib-biting, which increased fourfold. Both concentrated feed and crib-biting have been associated with gastrointestinal acidity.

The researchers found the rate of stereotypic behaviour to be greater in this study than in studies on similar populations of mature horses. This discrepancy could result from the owners of mature horses being reluctant to confess undesirable behaviours, stereotypic foals having a higher natural mortality rate, or time and changing environment leading horses to cease performing stereotypies. Overall, avoiding the risk factors identified in the study during the care and weaning of young horses may reduce stereotypic behaviours.

Contribution:

The results of this study were primarily consistent with previous literature, and explanations were proposed when contradictions occurred. The nature of the study was essential, as focusing on juveniles before, during, and after the development of stereotypies allows more accurate detection of cause-and-effect relationships. It provides a basis for future research examining why factors identified in this study affected stereotypic behaviour. Of particular interest for further research is why the mother's social rank affected the risk of stereotypic behaviour in the foal. The study also provides recommendations for management changes to prevent stereotypic behaviours from developing and becoming established.

Preventing Crib-Biting

Whisher, L., Raum, M., Pina, L., Pérez, L., Erb, H., Houpt, C., & Houpt, K. (2011). Effects of environmental factors on cribbing activity by horses. *Applied Animal Behaviour Science*, *135*(1–2), 63–69. https://doi.org/10.1016/j.applanim.2011.09.001

Summary:

This study sought to quantify crib-biting behaviour, identify behaviours associated with it, and determine if sweetened feed, enrichment toys, and exercise affect crib-biting. Crib-biting is a stereotypic behaviour where a horse grips a fixed surface and flexes its neck, drawing air into the esophagus. The prevalence of crib-biting varies depending on the populations and breeds examined by previous studies. Crib-biting is known to be influenced by environmental factors. 16 crib-biting horses were studied. The horses were continuously filmed, with instantaneous scan sampling used to record and analyze behaviour. Six horses were fed either sweetened or unsweetened feed. The researchers randomly provided six horses with one of seven enrichment toys, alternating toys until each horse had interacted with every toy. Six horses were exercised for increasing time every other day for a week.

Horses spent approximately five hours per day crib-biting, cribbed more frequently at night, and crib-biting was often preceded by licking the surface. Sweetened feed significantly increased the rate of crib-biting, possibly due to the ingestion of sugars stimulating endogenous opioid release, or the fact that sweet feed was provided in lower quantities to equalize energy intake with the horses fed non-sweetened food. Exercise non-significantly increased crib-biting rate, potentially due to fatigue or stress caused by the forced activity. Only one toy which did not allow biting significantly reduced crib-biting; the remaining six failed to impact crib-biting. This may indicate that other forms of enrichment such as social interaction and foraging behaviour are preferable in reducing crib-biting.

Understanding factors influencing crib-biting allows management practices to be adjusted to reduce the frequency of the behaviour. Diet, exercise, and enrichment are all factors that affect crib-biting. Food availability, human presence, and daylight should be investigated in future studies as possible factors influencing crib-biting due to the increased crib-biting frequency at night.

Contribution:

Previous research indicates that reducing the motivation to crib-bite is preferable to physical prevention and understanding environmental factors possibly affecting crib-biting is critical in reducing this motivation. This study clarifies the context of crib-biting by quantifying it daily and identifying behaviours, particularly licking, which precede it. The study also identifies environmental factors which influence crib-biting, how these factors may be used to modify the behaviour, and what factors require further examination. The study results are generally consistent with those of previous studies, particularly the association between food, other oral behaviours, and crib-biting.

McGreevy, P. D., & Nicol, C. J. (2010). Prevention of crib-biting: a review. *Equine Veterinary Journal, 30(S27)*, 35–38. https://doi.org/10.1111/j.2042-3306.1998.tb05143.x

Summary:

This article provides an overview of research into methods to prevent crib-biting, a stereotypic behaviour in horses. As a stereotypy, crib-biting is repetitive, invariant, and has no obvious function. A horse grasps a fixed object during crib-biting and pulls backward, flexing the neck and sucking air into the esophagus. Crib-biting is seen as undesirable by many horse owners, with many methods employed to prevent it.

Surgical methods attempt to prevent air intake or affect the musculature used to perform the behaviour. The removal of surfaces and aversive methods such as electric shocks are used to block grasping. Cribbing collars prevent neck flexion. Prevention through environmental enrichment by increasing forage and time with conspecifics and operant feeding methods are common. Pharmaceutical methods and alternative treatments such as acupuncture have also been utilized.

The success rate of preventative methods varies dramatically, with most being relatively ineffective, indicating that crib-biting is highly persistent. Pharmaceutical prevention via opioid antagonists appears to be the most successful short-term prevention; however, it necessitates constant medication administration. Data on acupuncture and operant feeding is insufficient to draw any conclusions. Some preventative methods may have adverse physical impacts, with surgical procedures risking causing pain and disfiguration and overly tight cribbing collars causing injury. Additionally, attempts at prevention often lead to alternative forms of the behaviour, including grasping onto conspecifics or an animal's own body or crib-biting without the grasping component (windsucking). Aversive methods may lead to novel behavioural problems, and pharmaceutical methods can conceal underlying welfare issues.

Despite extensive research, no method of permanently preventing crib-biting has been discovered. As such, future research would do best to focus on why crib-biting develops and how to prevent this development, rather than preventing the behaviour once established.\

Contribution:

This article provides an excellent summary of commonly used preventative methods for crib-biting and the effectiveness and risks of these methods. It generally agrees with previous findings and identifies where research is contradictory. By determining that many standard preventative methods are either ineffective or potentially risky, this article identifies an area where future research will be most valuable. Specifically, future research should focus on preventing the development of crib-biting. By preventing the development of the behaviour, crib-biting can be prevented successfully without the risk of compromising an animal’s welfare by using conventional preventative methods.

Additional Source (Crib-Biting and Health):

Patiño, J. J., Vélez, S. A., & Martínez, J. R. (2020). Ethological, endocrinological, and gastroscopic evaluation of crib-biting Colombian creole horses. *Journal of Veterinary Behavior*, *40*, 92–97. https://doi.org/10.1016/j.jveb.2020.10.005