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Abigail Pagel
Seattle Pacific University

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RELATIONSHIPS BETWEEN EQUINE MANAGEMENT PRACTICES AND INTESTINAL
PARASITE INFECTION

by

ABIGAIL PAGEL

FACULTY ADVISOR, CINDY BISHOP

SECOND READER, ERIC LONG

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Seattle Pacific University

2014

Parasitology is an important area of veterinary medicine, but the risk factors for high parasite loads are not well-understood. Equine intestinal parasites can cause extensive disease and death. In the current study, the relationship between equine intestinal parasite loads and adherence to veterinary guidelines for equine management practices was studied. Satisfactory adherence to guidelines regarding food, pasture, and flooding management was related to lower parasite loads. Adherence to guidelines regarding deworming, quarantine, bedding, and water did not appear to lower parasite loads. Still, adhering to these guidelines has been shown to improve equine welfare, even if they are not related to parasitic infection. High-quality management as a whole decreased parasite load. Parasitology research needs to continue in order to further the understanding of risk factors and adequate treatment for infected individuals.

Introduction

Parasitology is an important part of equine care. Equine intestinal parasites can cause anemia, aneurysms, enteritis, anal pruritus, ulcers, inflammation, diarrhea, colic, and many other diseases (Foreyt 2013, Proudman and Trees 1999). There are at least nine major intestinal parasites that infect horses. Currently, small strongyles, such as *Cyathostomum* spp., *Cylcocephalus* spp., and *Gyalocephalus* spp., are the most prevalent parasitic causes of disease, followed closely by large strongyles, like *Strongylus vulgaris*, and the equine roundworm, *Parascaris equorum* (Foreyt 2013, Kuzmina 2012, Nielsen *et al.* 2006). Tapeworms, such as *Anoplocephala perfoliata*, cause disease in many horses as well (Proudman and Trees 1999, Proudman *et al.* 1998). Research on parasite control is greatly lacking, even though it has been recognized as an important part of horse health for many years (Nielsen 2012). There are some studies in recent years that have provided new ideas for equine parasite control, but it needs to be researched further, especially in regards to prevention of infection (Nielsen 2012, Nielsen *et al.* 2006, Lloyd *et al.* 2000).

One aspect of equine care that may be related to parasitic infection and disease is management style. This broad subject encompasses such elements as deworming, feeding, stall cleaning, flood management, and pasture care, as well as other general parts of equine welfare (Mayhew 1888, Beede *et al.* 2000, Singer *et al.* 1999, Whay 2011). Veterinary recommendations for management are clear about most of these. Most veterinarians recommend that preventative deworming be performed every six months, although there is research that suggests that deworming only when positive fecal samples are found is a better way to prevent infection and antihelminthic resistance (Lloyd *et al.* 2000, Hinney *et al.* 2011, Kaplan 2002). Horses need plenty of food daily, and while in a stall, each horse should have an individual food

container and individual access to water as well. Stalls should be cleaned out and bedding fully replaced daily. Any area which horses have access to should be adequately protected from flooding (Whay 2011). About 60% of a horse's day should be spent on a pasture, and pastures should be rotated about once a week (Singer *et al.* 1999, Beede *et al.* 2000). Also, new horses should be dewormed and quarantined before being put in a barn with other individuals (Whay 2011). These guidelines are generally well-known, but that does not guarantee that a given horse-owner will adhere to them.

Following the guidelines about certain aspects of management may help keep parasite counts low, yet other important parts of management, as well as management as a whole, have not been sufficiently studied in relationship to parasitology. Environmental contamination, especially because of a lack of pasture rotation, has a strong correlation with high parasite levels (Kuzmina 2012). Similarly, infrequent stall cleaning is a risk factor for parasitic infection (Hinney *et al.* 2011). Rare deworming also increases the risk of parasitic infection (Hinney *et al.* 2011). Horses that have been given low-quality feed, which may include meat products, have been found to carry *Trichinella* spp., a meat-borne parasite to which horses, being herbivorous, should never even have access (Murrell *et al.* 2004). In cases like these, management style certainly affects parasite loads, yet beyond these few studies, the relationship between management practices and parasitic infection has rarely been considered.

In this study, I investigated whether level of parasitic infection was related to adherence to veterinary recommendations on several management aspects: preventative deworming, quarantine of new individuals, bedding and stall cleaning, water and food containers, pasture management, and flood protection. I also studied whether there was a threshold number of good management practices under which high parasite counts are more likely.

Methods

Data Collection

I collected fecal samples from eighteen stables in Snohomish and King Counties in Washington, USA. Each stable manager answered a questionnaire about his/her management practices (Appendix A). I compared the answer to each question to the veterinary recommendations for equine management (Whay 2011, Singer *et al.* 1999, Beede *et al.* 2000). I then categorized each answer as satisfactory or unsatisfactory per the guidelines presented in Table 1. At each stable, I collected fecal samples from at least four separate horses (mean horses ± 1 SD = 4.33 ± 1.115 ; N=78). I then performed standardized fecal flotation using ZnSO₄ on 1 g of each sample and counted the number of parasites per gram using a compound light microscope.

Statistical Analysis

To determine the effect of management style as a whole, I performed a linear regression with an independent variable of “stable’s number of satisfactory management practices” and a dependent variable of “mean parasites per gram.” To discover the effect of each management practice, I performed a one-tailed t-test comparing the mean parasite load (parasites/g) for satisfactory and unsatisfactory practices.

Results

Number of satisfactory management practices significantly reduced the average parasite load per stable ($R^2=0.38$, N=18, $p=0.006$) (Fig. 1).

One-tailed t-tests for each management practice suggest that some satisfactory management practices decreased parasite load (Fig. 2). Results of these t-tests are shown in Table 2. Satisfactory deworming, quarantine, bedding, and water management practices did not significantly decrease parasite load (Fig. 2). Food and pasture management practices that satisfactorily follow veterinary guidelines are related to significantly lower parasite load (Fig. 2). Satisfactory flooding management appears to have significantly lowered parasite load as well, but an outlier in the group with unsatisfactory flood management may give false significance (Fig. 2).

Discussion

The results of this study suggest that adherence to some equine management guidelines decreased parasite load. These guidelines concern food, pastures, and flooding management.

Adherence to equine food management guidelines significantly decreased parasite load. The food guideline studied states that horses should not share food while in stalls (Whay 2011). Sharing of food may allow parasite eggs a direct route for spread between individuals, which may explain the correlation between unsatisfactory adherence to this guideline and higher parasite loads. To prevent the spread of parasites from one horse to another, stable managers should provide horses with individual food containers when not in pasture. Veterinary personnel need to strongly encourage stable managers to adhere to this guideline and be especially attentive to horses in stables which fail to follow it.

Pasture management also appears to have an effect on parasite load. Grazing on a pasture is an important part of a horse's daily routine, and pastures need to be rotated regularly (Singer *et al.* 1999, Beede *et al.* 2000). As horses graze, they shed parasite eggs, which can be re-ingested

or spread to another individual. Pasture rotation allows for regrowth of vegetation and can provide enough time for certain eggs to become incapable of infecting a host. Stable managers need to regularly rotate pastures, and veterinary personnel must effectively communicate the importance of this practice to horse owners and appropriately attend to horses in stables that do not practice pasture rotation.

In addition, this study suggests that management of flooding has an effect on parasite load. The guideline for flooding management states that all areas a horse may access need to be protected from flooding or have adequate drainage (Whay 2011). This is suggested for many reasons, including the longevity and transmission of parasite eggs in water. Although it is well-known that parasite eggs can spread from one individual to another quickly in water, the results of this study on this point may be due to an outlier in the group with unsatisfactory adherence to this guideline. For this reason, it is difficult to say if flooding management truly has an effect on parasite load. Still, stable managers would be wise to ensure that horses are protected from flooding. Veterinary workers should urge horse owners to protect their horses from flooding and closely monitor parasite levels in horses that are exposed to floodwaters.

Several of the guidelines studied do not appear to affect parasite load significantly. Adherence to deworming, quarantine, bedding, and water guidelines did not significantly lower parasite load. This may mean that these practices do not affect the likelihood of parasite transmission from one individual to another. These guidelines should be followed for other reasons, such as equine welfare, but veterinary personnel may not need to monitor parasite levels especially closely in stables with unsatisfactory practices in these areas.

Although deworming, quarantine, bedding, and water guidelines do not seem to affect parasite loads individually, as a whole, management affects parasite load. The more guidelines

adhered to, the fewer parasites detected. For stable managers, this means that high-quality management is important if parasite loads are to be kept to a minimum. Veterinary personnel should suggest improvements in management practices to prevent high levels of parasitic infection. Adherence to veterinary guidelines appears to lower parasite infection while increasing equine welfare.

Further research should be done to determine if flooding management truly affects parasite load. In addition, other the relationship between other management practices and parasite load should be explored. Parasitology research needs to be encouraged, so that risk factors for high parasite infection may be identified.

Acknowledgements

I would like to thank the stable managers that graciously participated in this study. In addition, I would like to express my gratitude to Cindy Bishop, DVM, who taught me about how to study parasitology, oversaw my research, and acted as a first reader for my manuscript. Eric Long, Ph.D., my second reader, who helped me with statistics, also deserves my thanks. Lastly, I would like to thank everyone from the Seattle Pacific University Scholars Program, who supported me in this endeavor.

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Figure 1. Linear regression plot of stable's number of satisfactory management practices versus mean parasite load (mean \pm SE parasites/g). Positions of points have been adjusted slightly to make error bars clearer.

Figure 2. Mean parasite loads \pm 1 SE (parasites/g) for the following unsatisfactory and satisfactory management practices: deworming, quarantine, bedding, water, food, pastures, and flooding. Statistically significant differences marked with an asterisk (*).

Table 1. Guidelines for satisfactory and unsatisfactory answers to questions on the equine management questionnaire.

Table 2. Statistics for differences in parasite loads for unsatisfactory and satisfactory management practices. Practices with statistically significant differences marked with an asterisk (*).

Figure 1.

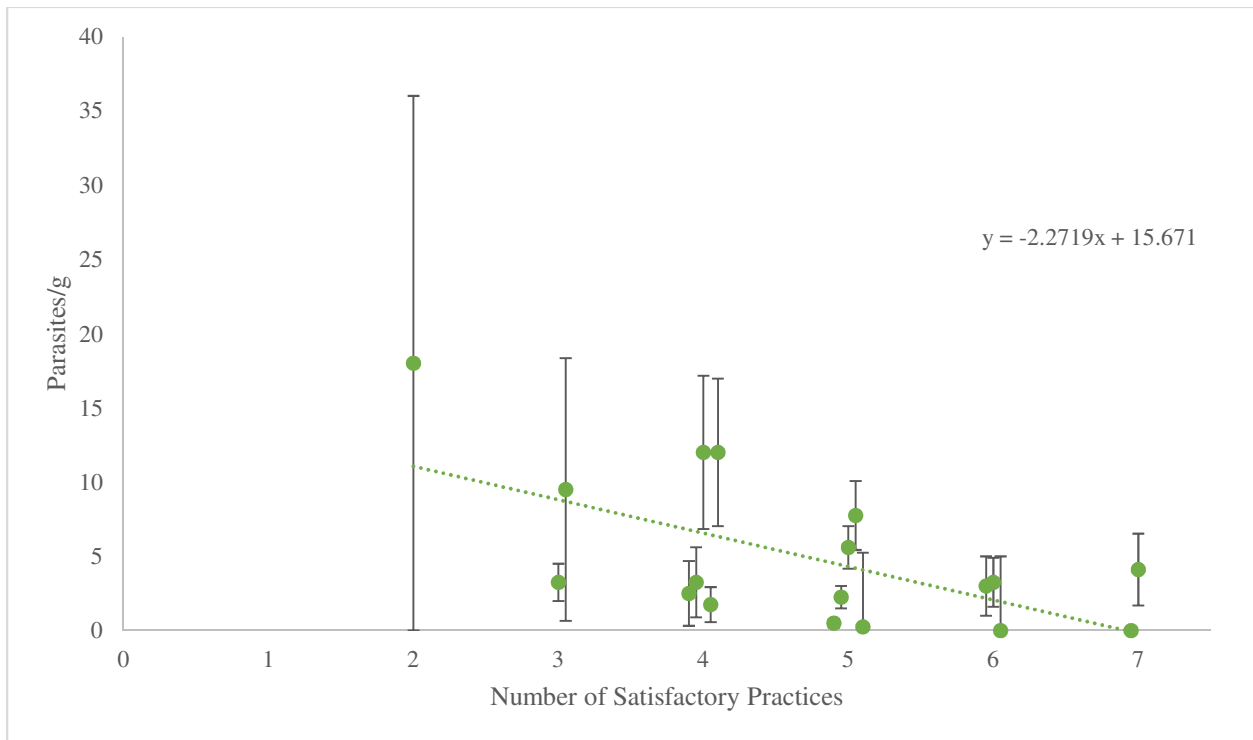


Figure 2.

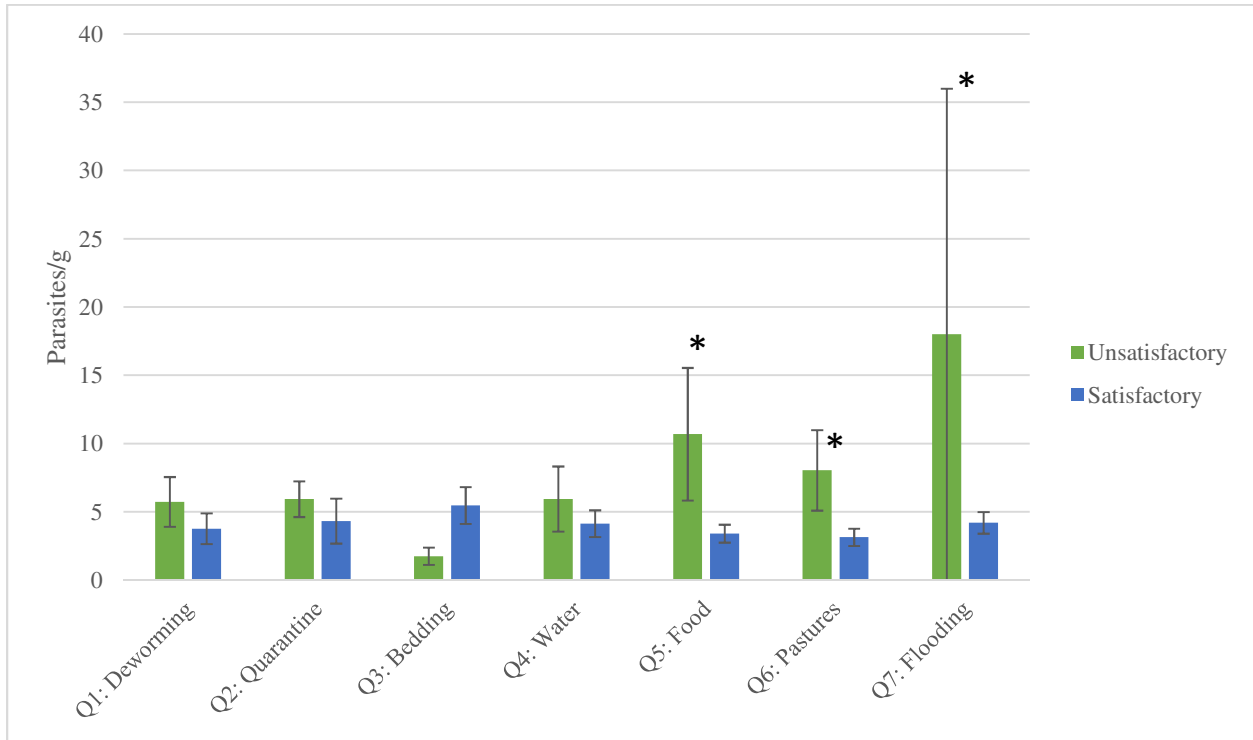


Table 1.

<i>Question</i>	<i>Satisfactory Answers</i>	<i>Unsatisfactory Answers</i>
	Once every six months	
Q1: Deworming	Rotating dewormer every three months	Any other answer
Q2: Quarantine	Yes	No
Q3: Bedding	Replace daily or more often.	Less often than daily.
Q4: Water	Do not share and changed at least daily. Do not share and auto-waterers.	Share water while in stalls. Changed less often than daily.
Q5: Food	Do not share and have a regular cleaning schedule.	Share food while in stalls. Do not have a regular cleaning schedule.
Q6: Pastures	Pastures rotated regularly and left fallow for at least twice the amount of time they are grazed.	Any other answer.
Q7: Flooding	Yes	No

Table 2.

<i>Management Practice</i>	<i>T(df)</i>	<i>P(T≤t) one-tail</i>
Deworming	0.85(76)	0.200
Quarantine	0.67(76)	0.253
Bedding	-1.17(76)	0.877
Water	0.77(76)	0.221
Food*	2.65(76)	0.005
Pastures*	2.08(76)	0.020
Flooding*	2.76(76)	0.004

Appendix A: Equine Management Questionnaire

Version Dated 3/4/13
Seattle Pacific University

For Research Purposes Only
The information on this form will not be shared outside the research group

Principal Researcher: Abigail Pagel
pagela@sp

Fecal Sample No. _____
Date Collected _____

Town _____
Date Read _____

Management Practices Questionnaire

1. Do you practice preventative deworming? How often? Do you deworm your horses, or do you have the veterinarian do so?
2. Do you deworm and quarantine new horses before putting them in with the rest?
3. How often do you replace the bedding in the stall(s)? Do you disinfect your stall(s)? If so, how often?
4. Do horses share a water trough? If so, how many share one trough? How often is the water changed? When you change the water, do you clean the trough?
5. Do horses share a food trough? If so, how many share? Do you ever disinfect food troughs? How often?
6. Are your horses allowed to graze on a pasture or paddock? If so, how often? Do you practice pasture rotation? If so, how often do you rotate pastures?
7. Are your stables protected from floodwaters? If so, how?

Appendix B: Faith Statement

I am a follower of Jesus Christ, and my relationship with God has always been extremely important in my life. Having been raised in the Evangelical tradition, I believe spreading the Gospel is something every Christian is commanded to do, and everything we do should point to the love of Jesus, as should the words we say. From the beginning of this project, I desired that it would be the kind of undertaking that helped me to spread the love of Christ in some way.

As soon as I began thinking about what to do for my honors thesis, I knew it had to be some kind of research with animals. As a pre-veterinary student, not only did this type of research make sense, it also excited me. Yet, I had no clue as to what animal I wanted to research or what aspect of that animal's existence on which to focus my efforts. Fortunately, during this time, I returned to Romania for a third time, knowing that God would do a great work while I was there. Little did I know just how great of a work He was planning.

While in Romania that summer, I rediscovered something about myself: although I am extremely passionate about animals and their health, I am even more passionate about people and their quality of life. Even more importantly, I am passionate about their spiritual well-being. While in Romania, God placed the Romanian gypsies, known as the Romani people, on my heart in such a way that I cannot get them off my mind. I realized that I can help the Romani, even while pursuing my dream occupation, veterinary medicine. The Romani have work animals, but in many cases these animals are not healthy enough to be used, which leaves their owners with no way to work. God has placed a passion within me to provide veterinary care for these animals, so that the Romani may have a chance to increase their quality of life and, through interaction with me, may learn about the love of Jesus Christ. Suddenly, I had a goal for after veterinary school, one toward which everything I study is leading.

When I returned to school, I chose to study the parasitology of horses because it is interesting to me and is an excellent opportunity to gain experience with a type of animal I have not had much contact with, but more importantly, I chose to study equine parasitology because it will directly help me to aid the Romani. If I could learn how management style affects the intestinal parasite load of horses, which are probably the species most often encountered by the Romani, I can help more effectively when, in several years, I am treating infected horses and am attempting to prevent the spread of infection. This project will allow me to be a better veterinarian in the future.

In addition to the advancement of my future goals, this study allowed me to interact with numerous amazing stable managers, many of whom wanted to know why I was so interested in equine parasitology. As I told them my future plans, I was able to tell them about God's love and how it affects my life. I cannot say if that changed their lives at all, but I know that it changed mine, because the more times I told my story, the more passionate about God I became.

As I performed this study, my desire to show the love of God to the Romani people, as well as others, only grew. As a Christian scholar, I feel that my scholarship should culminate in helping people, improving the world, and glorifying God. My scholarship peak, so far, is noticing the need of the Romanian gypsy people for healthy work animals and choosing to move to Romania in order to treat their animals and give them an opportunity for a livelihood. This is the way in which I feel called to be a Christian scholar. I will work for the glory of my Lord and in the service of the ones He loves. Overall, this study has strengthened my relationship with my God and solidified my resolve to do what He asks of me.