Girthiness

- can actions in connection with saddling influence the horse's reactions?

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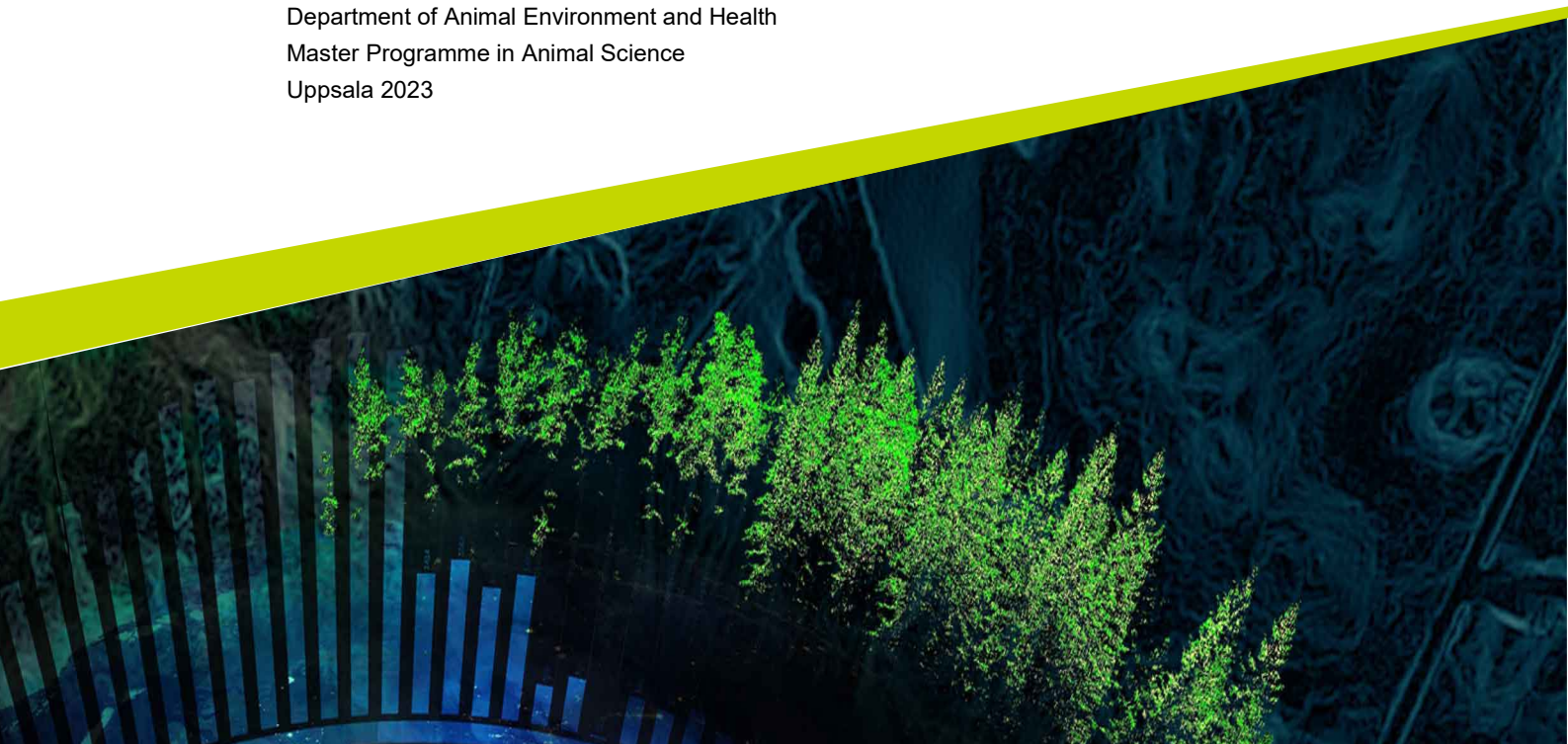

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Abstract

Girthiness and girth-aversion is range behaviors in horses during saddling, seemingly connected with aversion or discomfort in the situation. Girthiness may also involve over aggression towards the human performing the saddling. Girthiness does not have a widely accepted or known definition, and the underlying causes of the behaviors are not fully determined. Furthermore, prevalence and magnitude are unknown and the knowledge to reduce possible problems is lacking. The reason for girthiness has a variety of theories. People who own horses with this behavior seem to develop strategies to customize their way of saddling up to make it safer for themselves and/or more pleasant for the horse. The aim of this study was to investigate a potential way to make saddling less aversive for the horses. If successful in the short term, this method might even help stop the behavior in the long run. Food is used successfully in different types of horse trainings why it was chosen in this study. Ten horses were observed during saddling under two different conditions: with and without hay. In addition to behavioural observations the horses were tested for pressure sensitivity on three different body parts by using an algometer. The results show that when horses were given hay they showed less aversive behaviors, less mouth related behaviors and less hoof movement. Hence, in the short-term hay is a potentially successful way of alleviating girthiness. However the long term effects need to be studied further.

Keywords: girth-aversion, girthiness, algometer, saddling, mechanical nociceptive threshold

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1. Introduction

1.1 Background

In discussion about horses that engage in behaviour that is deemed problematic by equestrians, girthiness or girth-aversion is often mentioned. In a previous survey, where horse people were asked to answer the magnitude of problematic behaviors, their opinion on girthiness showed great variation. Opinions ranged from not problematic at all, to a very severe problem (Birgestrand Jönsson 2021). The reason for these varied answers might lay in the way girthiness is defined. (Bowen et al. 2017) define it as "every behaviour that shows discomfort or aversion during saddling". This includes everything from swishing tails and blowing out through the nostrils, to biting and moving away from the saddle. Girthiness can also occur when the rider mounts, often shown as some sort of movement disruption in the first steps after mounting or horses that are jumping straight up into the air with stiff legs (Dyson et al. 2022).

The casual factors behind girthiness are not established, but it has been suggested (van Iwaarden et al. 2012; Bowen et al. 2017; Millares-Ramirez & Le Jeune 2019) that one of the reasons for girthiness is pain, either from the girth itself or from the saddle that the girth is fixating on the horse's back, or pain originating from the inner organs in the chest or abdomen. This means that girth-aversion behaviors can be signs of pain (Millares-Ramirez & Le Jeune 2019). Millares-Ramirez & Le Jeune (2019) found that horses with stomach ulcers tended to show aversive behaviors when the girth was being tightened.

van Iwaarden et al. (2012) studied the cutaneous trunci muscle. The function of these muscles is to shake away flies. They react to the stimulus from the fly and produce a movement in the skin. The research show that this muscle is located where the pressure from the saddle is the greatest. When a stimulus is applied to the skin above this muscle, the skin will twitch to remove the stimulus. (van Iwaarden et al. 2012) believes that since these muscles are located under the panels of the saddle and beneath the girth, it is not impossible that pressure on these spots will lead to an adverse response to tightening the girth or backpain due to the saddle.

(Bowen et al. 2017) investigated if myofascial trigger points could have anything to do with girth-aversion behavior. Myofascial trigger points are a bundle of

contracted muscle fibers, harder than normal. They believe that the reason for their occurrence is various mechanical and nervous system stresses. In the study, these trigger points were more common to the right of the sternum, the cutaneous trunci and along the pectoral muscles. These are all points where the girth does touch, and Bowen et al. (2017) found that horses with girth-aversion behaviors had more myofascial triggerpoints (Bowen et al. 2017). Both the study by van Iwaarden et al. (2012) and the study by Bowen et al. (2017) suggest that stretching the front limbs after fastening the girth should help with the tenseness in the cutaneous trunci, thus reducing the aversive behavior.

Sensory testing is the best approach to gain insight into the physiology of small epidermal nerve fibers. This will determine mechanical nociceptive thresholds (Backonja & Lauria 2010). A way to do this is by using an algometer. Pressure algometry is a technique where the mechanical nociceptive threshold is measured by the algometer applying pressure gradually until the horse shows an avoidance reaction (De Heus et al. 2010). The results of the measurements varies depending on the individual but the accuracy of these tests also depends on the experience and technique of the tester. The mechanical nociceptive threshold also varies with where the stimulus is applied, muscle, bone or ligament (De Heus et al. 2010). When studying negative reinforcement Ahrendt et al. (2015) found that the horses were less sensitive to pressure on the right side compared to the left side, before they reacted.

When studying horse behavior, in relation to horse welfare, some behaviors can be categorized as negative welfare indicators. These are the behaviors seen when the horse is in pain, afraid or disliking something (McGreevy 2012), and positive welfare indicators behaviors are the behaviors are seen in calm, relaxed and happy horses (McGreevy 2012; Birt et al. 2015). Some examples of negative behaviors are biting and kicking, or threats preceding these behaviors. Moving away from the discomfort is another example. Horses that are stressed are often tense, holding their head high and not blinking as much as a relaxed horse (McGreevy 2012). Some examples of positive behaviors are standing resting, sham chewing, licking and yawning (Birt et al. 2015). Sham chewing and licking can be categorized as a negative welfare indicator as well, if performed as a repetitive/stereotypic behavior (Simpson & Candidate 2021), but this will not be the case in this study. Furthermore, eating behavior may be a sign of content in horses. Horses eat for a huge part of the 24 hours, up to 19 hours a day (McGreevy 2012). This means the horses intestines are adapted to have food to work with all the time.

In horse riding there is a variety of saddles, half-pads, girths, and saddle pads to use. Different equipment is used for a variety of disciplines but could also be used for solving issues. No matter the reason for the use, it is important that the equipment is well fitted to the horse and the rider. A good saddle-fitter would know what your horse need (Guire et al. 2017). A typical way of putting the saddle on is

to first put the saddle together with the blanket and eventual half-pad on the horses back, sliding it into the correct position. Then the girth is fastened, evenly on both sides to avoid an uneven pressure on the horses back (Owen & Bullock 1990). However, if the horse has girth-aversion or girthiness, the chances are high that the owner has customized their method to make it easier on their horse and safer for themselves.

To cure girthiness seems to be practically complex and the success of the curing strategy will depend on the underlying causes. It is possible that even if pain induced the behavior it may persist, as a learned response, even after the pain in alleviated. Hence, if the horse is physically sound and the saddle fitted by a professional saddle fitter, chances are that the horse will continue to show girthiness. Overshadowing is a training method where the goal is to change the feeling regarding a response (McLean 2008). This means applying two stimuli at once, where the stronger stimulus overshadows the weaker stimulus. This will result in the horse feeling less aversive towards for example girth pressure (McLean 2008). Furthermore, counter conditioning is a technique where classical conditioning is used to "reset" the horse's emotional response to a (previously) aversive stimuli (McLean 2008).

A way of studying the possibility of "curing" girthiness in horses would be to study horses that are physically healthy, have well-fitting saddles, but still show the behaviors.

1.2 Aim

The aim of this study was to see if there is a way to make saddling easier for the horses that experience girthiness. Based on the research on overshadowing and counter conditioning, as well as the knowledge that girth problems could potentially be caused by stomach problems, saddling the horse while eating hay seemed like a promising method to test in relation to girthiness.

1.3 Research questions

In this study three research questions were formulated:

1. To investigate if the horses' behavior differs during saddling with or without the presence of hay.

2. To investigate if the physiological reaction (heart rate) in horses, horses' demonstrating girthiness, is affected by offering them hay during saddling.

3. To find out if the mechanical nociceptive threshold of the horses will change if distracted with hay.

2. Method and materials

Horses with girthiness were observed as they were getting tacked up, either with hay or without. The horses were video recorded and from these videos the frequency and duration of different behaviors was registered. Their heart rate and their heart rate variability both at a baselevel and during the test were recorded, as well as the mechanical nociceptive threshold. It was a cross over study, where all the participants were exposed to both treatments. The participants were exposed to the treatments in a systematic order. It was conducted on location during the summer of 2022.

2.1 Materials

2.1.1 Survey

The questionnaire was based on information from scientific articles (van Iwaarden et al. 2012; Bowen et al. 2017; Millares-Ramirez & Le Jeune 2019; Dyson et al. 2022). The questions were constructed to ask about behavior of the horse, injuries, and the saddle itself. The survey consisted of 30 questions which should have taken about 10 minutes to answer, depending on how much the owners wanted to write in the free text answers. The questionnaire consisted of 16 multiple-choice questions, and 14 free text answers, to get as much information as possible, but at the same time simplify the analyzes of the results in the end. At the end of the survey all the respondents were offered the possibility to participate in the tacking study, leaving their email for further contact. The questions were published in the program Netigate (appendix 1). The survey was open for 77 days, which was the amount of time available before the data collection had to start.

The horse owners were found by an advertisement in the Swedish horse magazines Hippson and Ridsport. The advertisement was also published on Facebook and Instagram. The survey was aimed at Swedish horse owners; therefore, the questions were written in Swedish and was only spread in Swedish newspapers and websites. The advertisement asked for horse owners with horses that show symptoms of girthiness. To be included in the study the horses had to be healthy, checked by the veterinarian and their saddle had to be fitted by a saddle

tester. The horses also had to be ridden in 3 years and they had to be at least 6 years old.

2.1.2 Horses

The 10 horses for this part were chosen from the 45 answers received from the interview study. The area for the research was limited to the southern part of Sweden.

Table 1: Information about the 10 horses used in the study

Horsenumber	Sex	Age	Breed	Area of use
1	Mare	22	Warmblood	Dressage
2	Mare	14	Shetlandpony	Riding school
3	Gelding	15	Pony	Riding school
4	Mare	8	Mixed breed	Riding school
5	Mare	18	Warmblood	Jumping
6	Mare	12	Pony	Riding school
7	Mare	16	Pony	Riding school
8	Mare	19	Warmblood	Dressage
9	Gelding	15	Pony	Riding school
10	Mare	25	Pony	Allround

The six riding school horses are usually working for the riding school three times a week, roughly three times per day. The other days they all have their own rider taking care of them. In the study I was the one doing the saddling. Horse number 1 has one owner, a woman, who was the one doing the saddling in my study. Horse number 5 has two owners, both women. One of the owners was the one doing the saddling in my study. Both horse number 8 and horse number 10 had one adult owner and one younger owner, still both women. Both the owners were present at the study, but the saddling was done by the adult owner.

2.1.3 Tacking up

Horses were studied in their stable when tacked up by their usual rider/owner. The horses were tacked up with their own tack, the only difference was the heart rate monitor put on beforehand. All the horses used saddles of English type, 7 saddles were jumping/all-round saddles and the other three were dressage saddles. No horse had any special girths, 2 off the dressage girths were anatomically shaped, with one covered in sheepskin. All the jumping saddles had regular girths except one that had a stud girth. 3 off the horses had a half-pad with sheepskin under their saddle, and 2 of the horses had half-pads in a gel material. These two also had cruppers on their saddles. For one part of the research the horses were given hay, the same that they are fed daily. They hay was served in a hay bag, located either

in their crib or held by a person in a height where the horses head were in height with their withers. Every other horse started the research without hay, and the other half started with hay. This was to make sure that the results were depending on the hay, and not because the horses had gotten used to the touch.

The heart rate monitor used was a Polar H10. When checking the horses' mechanical nociceptive threshold, an algometer from Somedic sence lab, measuring in kPa, was used.

2.2 Method

The answers of the interview study were compiled and sorted.

When reading the answers from the interview, some new questions about the tacking procedures and behavior emerged which were used in the next study.

The owners were informed about what was about to happen and asked to sign a consent form. They were also told that they could stop the tests whenever they wanted. The research equipment and the hay were set up. The tack was hung were the owner usually put it when tacking up.

The horse was then put in its usual tacking place. Some horses stood in the stable passage, some in their stalls and some in the pasture. The camera was then mounted to get a good angle and the heart rate monitor attached to the horse. The owner was asked which side they usually fastened the girth at. When everything was in place, the heart rate monitor and the camera was started the same time. Both the heart rate monitor and the camera were on until the saddle was taken off after the last observation. Each research session started with measuring the horses' pressure sensitivity on three different places on each side of the body, the front of the saddle, the back of the saddle and the girth. The measured spots were chosen beforehand. All spots were measured three times. Measurements always started on the side where the owner usually did not fasten the girth or mount. When both sides were measured the owner took the horse for a walk, roughly 20 meters from the measure area, to help the horse start over. The measurements were then performed again, this time while the horse was eating. After measuring the pressure sensitivity, the owner took the horse for a walk again. It was then time to tack up the horse. The saddle should come from the same place as it does in the horses' regular days. For some horses it meant that the owner brought the saddle from the tack room, other owners usually put their saddle by the horse. The owner was told to put the saddle on in the same way as they always do it, as if the researcher or the camera was not there. The horses then had the saddle on for about three to five minutes, before the saddle was taken off again. Between the tests the horse was brought away from the test area again. When the saddle had been removed after the second test the observation was terminated. The treatment order hay/no hay was balanced.

The questions written down was asked during the test, that way the answers were filmed, and no information were lost. It was 5 questions, which sometimes led to follow up questions in order to avoid misinterpretations. All the results from the pressure test were written down by an independent person. The algometer were used by me, and the other person read the display and wrote down the numbers in the research protocol (appendix 2). That way the result was not affected by tester, and the measurements were only affected by the horses' reactions.

The filmed material where then decoded using an ethogram. All the movies were viewed once, listing of the observed behaviors. The descriptions of the behaviors are based on McDonnel (2003). The finalized ethogram is shown in appendix 3.

All the videos were then decode using this ethogram. The filmed material was viewed as many times as needed to make sure no behaviors were missed.

Since not all horses show all the behaviors in the ethogram, some behaviors were categorized in the analyzes phase. These categories are for example total negative behaviors, hoof movement, and mouth related behaviors. Negative behaviors contain the behaviors *total head movements*, *moves one hoof, bites surrounding, threatens, tail swish, licks lips, looking at stomach/saddle, walk, back, snort, paws, bites, headbob, kicks front leg* and *kicks back leg.* Some negative behaviors like *bouts of ears flattened* could not be included in this category since data was missing due to problems with watching the right part of the horse, for example the eyes or the ears. Hoof movement contained both the moving behaviors and the kicking behaviors, while mouth related behaviors included the different types of biting and playing with lips or tongue. Eating can be considered a positive behavior since it is not very common for a stressed or hurting horse to eat.

2.2.1 Statistical analyzes

The frequency of the observed behaviors was statistically analyzed in Minitab. The measurements from the algometer were also analyzed statistically. Means and standard deviations were calculated for all the categories used in the result. Paired t-tests were performed on the algometer data since the horses were only compared to themselves. A control group was not used, all the horses were its own control. When analyzing the numbers from the behavioral study a t-test was conducted.

For all t-tests a p-value of ≤ 0.05 was considered significant.

3. Results

3.1 Algometer measurements

The algometer measurements shows that eating hay has no effect on the horses' mechanical nociceptive threshold compared to when they are not eating hay. There is no difference between the left and the right side either. The results of the measurements are shown in table 2.

Table 2: Results from registrations of mechanical nociceptive threshold (kPa) in ten horses. Data is presented as mean and standard deviation (sd).

Without feed of hay (n=x)		**With feed of hay (n=Y)**		**p-value**
Lumbar right side (kPa)	256.37±82.83	**Lumbar right side (kPa)**	262.37±89.14	*0.725*
Lumbar left side (kPa)	231.30±75.16	**Lumbar left side (kPa)**	261.8±78.52	*0.224*
Saddle right side (kPa)	268.47±65.48	**Saddle right side (kPa)**	276.33±76.35	*0.641*
Saddle left side (kPa)	274.63±30.55	**Saddle left side (kPa)**	241.70±53.93	*0.214*
Girth right side (kPa)	194.64±28.75	**Girth right side (kPa)**	203.07±54.87	*0.652*
Girth left side (kPa)	220.53±60.27	**Girth left side (kPa)**	202.13±62.72	*0.315*

3.2 Tacking up

Several of the horses' behaviors were affected if the horses had access to hay while they were saddled. There was a significant difference in the frequency of total negative behaviors, *total head movements*, *moves one hoof, bites surrounding,*

threatens, tail swish, licks lips, looking at stomach/saddle, walk, back, snort, paws, bites, headbob, kicks front leg and *kicks back leg,* when the hay was present compared to when there were no hay (p=0.002). With hay present the horses showed fewer negative behaviors (indicating aggression or discomfort) (mean 6.42±6.67 behaviors per minute) than they did when the hay was not present (mean 14.00±13.99 behaviors per minute). This is shown in figure 1.

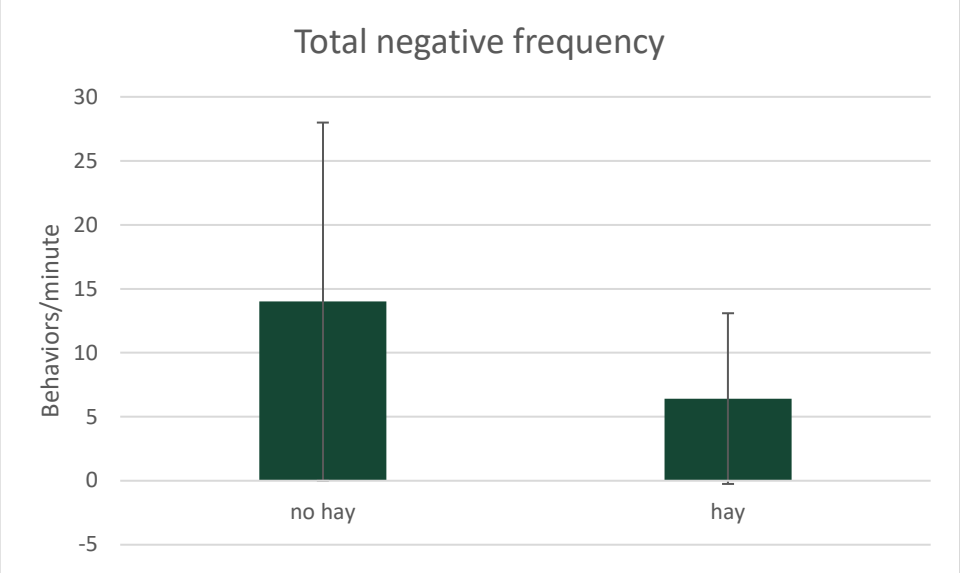

Figure 1: The difference between ten horses total negative behaviors per minute with or without hay during saddling.

When going into more detail the category *Total hoof movement,* which consists of both the kicking behaviors and the locomotive behaviors, these differed significantly difference between the two treatments (p=0.007). When the horses had access to hay, they showed a mean of 0.78±1.5 hoof movements per minute. When there was no hay, the mean rose to 2.43±3.00 hoof movements per minute. Mouth related behaviors, which includes both biting, licking and lip movements also showed a significant difference (p=0.000). The mean for mouth related behaviors with hay present was 0.25±0.74 behaviors per minute, while the mean for mouth related behaviors without the presence of hay was 6.40±10.44 behaviors per minute. These two categories are shown in figure 2.

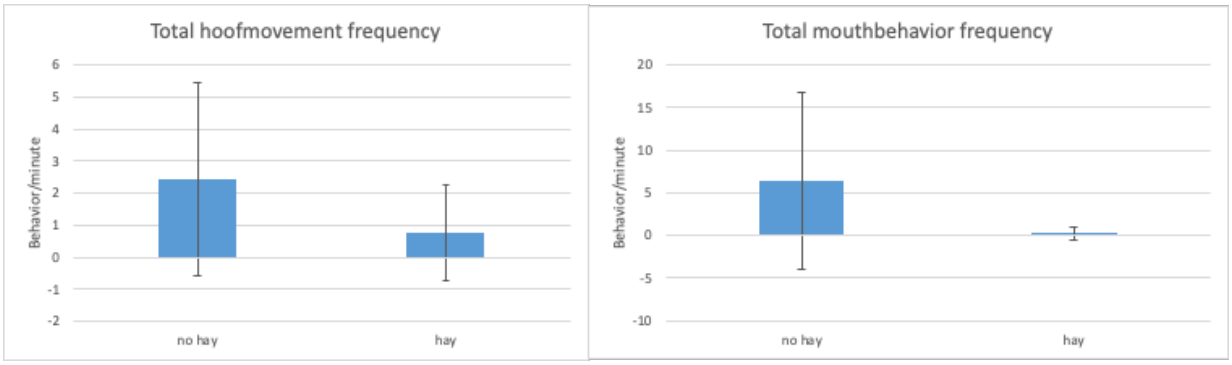

Figure 2: The difference between ten horses hoof movements and mouth related behaviors per minute with or without hay during saddling.

The frequency of mouth related behaviors did decrease when the horses had access to hay, as shown above. The same was found for the percentage of time that the horses were showing their teeth (p=0.014). The horses were showing their teeth at a mean of 1.47±3.99% of the total time when there was no hay present. When the horses had hay this behavior was not seen (0.00±0.00% of the total time).

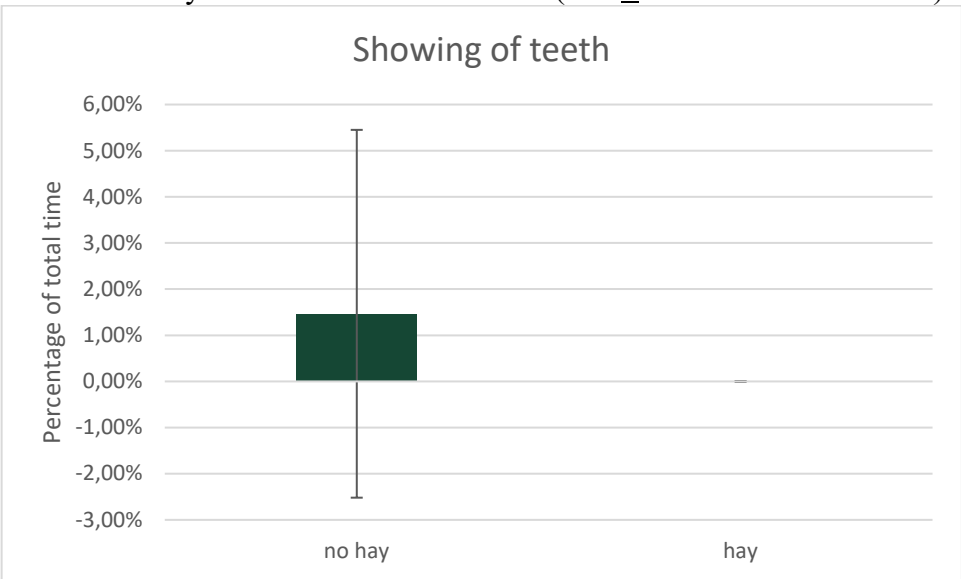

Figure 3: The difference in percentage of the ten horses showing teeth between the treatments during saddling.

Overall, the behaviors indicating a more positive or neutral state did not change in frequency depending on whether there were any hay present. However, when studying the different behaviors included in this category in detail there were two behaviors that was affected by treatment. Those behaviors were *rest standing*, both in frequency and in duration, and *sham chewing*. The horses did sham chew for longer time when there was no hay present (10.73±11.98% of the total time when there was no hay present, compared to 0.21±1.15% of the total time when there were hay present (p=0.00). It shows similar differences as the other mouth related behaviors (p=0.000).

The horses were not resting at all when they had access to and were eating hay, but without hay present they rest 12.16±29.97% of the total time, spread out in bouts, 0.29±0.79 bouts per minute. This means there are a difference in duration (p=0.017) and a difference in frequency (p=0.038).

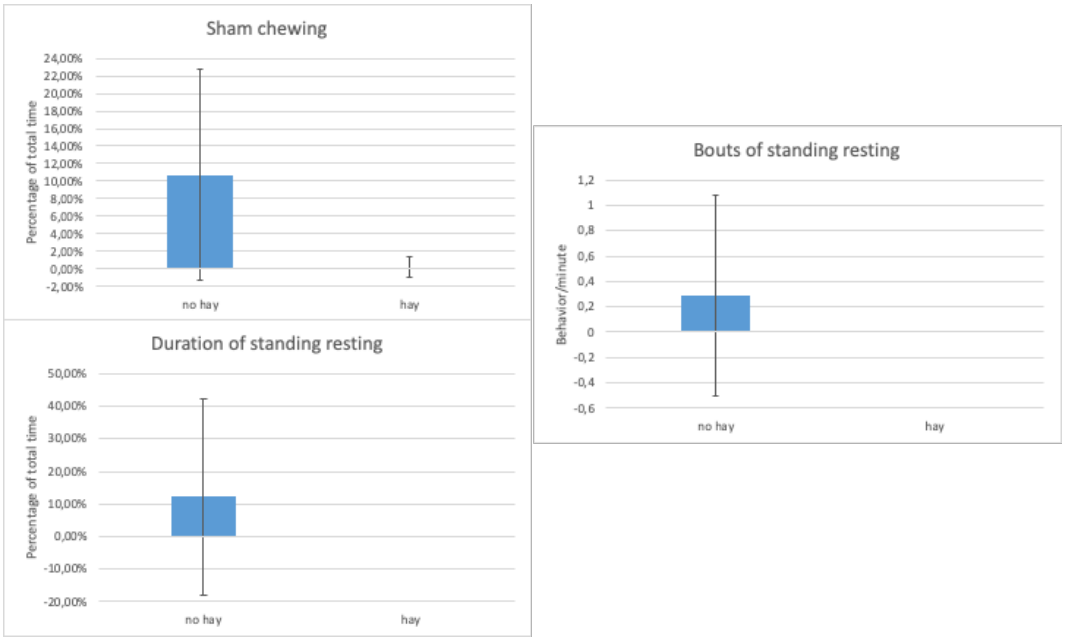

Figure 4: Diagrams showing the differences for ten horses between the treatments for the behaviors rest standing, both bouts and duration, and sham chewing during saddling.

The total time to saddle the horses were not different between the treatments (p=0.854). It took on average 1.32±0.75 minutes to saddle a horse with hay, and 1.38±0.80 minutes to saddle a horse without hay, as shown in figure 5.

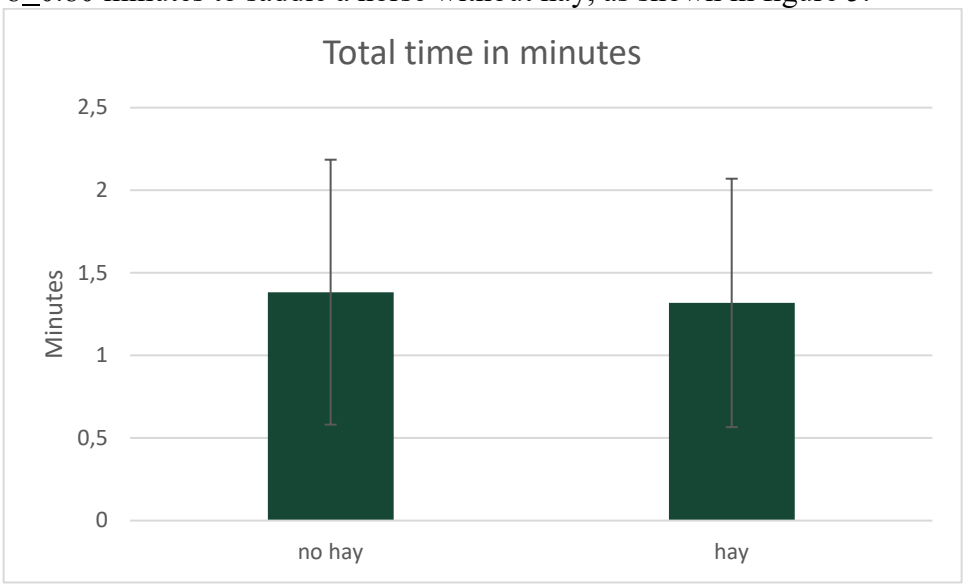

Figure 5: Difference in total minutes it took to saddle the ten horses, with and without hay.

The behaviors that did not differ either in frequency or duration between the treatments are listed in table 3. In conclusion, negative behaviors were reduced when the horse was able to eat hay (p=0.002). There was also a reduction in the frequency of mouth related behaviors and hoof movement with hay present (p=0.000 and p=0.007). Overall, the horses in this study did not use kicking as way to tell the saddler they were not pleased.

Table 3:List of behaviors that did not show a difference or is not included in the specific categories. The table shows the mean of each behavior and for each treatment, as well as the p-value

Behavior	Mean+standard deviation behavior/minute with hay	Mean+standard deviation behavior/minute without hay	P-value
Blinks	17,33±9,18	20,83+7,63	0,198
Stand alert	1,98±6,56%	5,47±11,51%	0,166
Heavy breathing	0,76±4,17%	0,70±3,79%	0,977
Ears flattened (duration)	33,95±32,51%	34,62±33,14%	0,973
Ears flattened (bouts)	2,50±2,34	2,76±2,68	0,731
Autogroom	0,02±0,09	0,02±0,09	0,985
Yawns	0,00±0,00	0,19±0,71	0,112
Sighs	0,02±0,06	0,01±0,06	0,824
Sniffs	0,04±0,24	0,10±0,33	0,424
Muscle shake	0,19±0,75	0,16±0,58	0,781
Showes whites of eyes	0,67±1,47	0,85±1,75	0,565
Freezes	0,00±0,00%	2,84±10,62%	0,159

All the horses choose to eat when the hay was present, all but one ate all the time during the test period. Since the horses were only able to eat when hay was present there is no statistical analyzes made on this data.

4. Discussion

The most important aim of this study was to find out if there was a way to make saddling easier on the horses. The results show that when feeding the horses hay, it has a dramatic effect on the frequency of behaviors categorized as discomfort, aggression or pain in a short term compared to without hay. The hypothesis was that the negative welfare indicators would decrease when the horse had the possibility to eat hay.

The individual behaviors observed in the study were categorized, partly into positive or negative behaviors from a welfare perspective, but also in hoof movements and mouth related behaviors. When categorizing the positive and negative behaviors, the criteria for each category came from previous research (McGreevy 2012; Birt et al. 2015). Behaviors that show up in aggressive or stressed horses, as well as horses in pain were categorized as negative behaviors (McGreevy 2012), while behaviors visible in relaxed, calm and happy horses were categorized as positive behaviors (Birt et al. 2015). With mouth related behavior, every behavior involving the mouth, lips, tongue, and teeth were included, with one exception. The behaviors showed in connection to eating was categorized as a separate behavior since it was only possible for the horses to perform when food was present. Hoof movements includes all behavior where the horse lifts one or more hoofs from the ground, whether it is to move or to kick. The categories described above are not standardized categories, even if there is research stating that the behavior shows during a positive or negative reaction from the horse (McGreevy 2012; Birt et al. 2015). This means that someone else might have categorized it in a different way, making the outcome another than it is now.

With the negative behaviors declining in frequency when the horse could eat hay, one potential explanation could be that the hay helped the horse. Speaking against this, is the fact that the positive behaviors showed no difference in frequency or showed the same decline in frequency as the negative behaviors with hay, compared to without hay. This might indicate that the hay is just masking the behaviors. When the horses were given hay, the horses spent 83.33$\pm$32.25% of the time eating and the mouth related behaviors declined from 6.40$\pm$10.44 behaviors per minute without hay to 0.25$\pm$0.74 behaviors per minute with hay. This could be because the horse was prioritizing the hay and therefore had less time and ability to bite, threaten the saddler or sham chew. The same is true for hoof movement

(declining from 2.34±3.00 hoof movements without hay to 0.78±1.5 hoof movements per minute with hay). If the hay is placed in a fixed position the horse will stand in that place eating and will not be moving around. It is still possible for the horse to kick, wave their front legs and move a bit in a sideways motion. The reason for this might be that the horse was prioritizing the hay and did not put time or effort into moving around. The fact that all the horses ate from the hay when it was present shows either that the situation is not as stressful for the horse as one might think, or that the hay actually had a calming effect on the horse. (Zelazna & Jezierski 2018) has found that horses experiencing stress due to separation does have a lower food intake than before the stress. They also found that horses that watched other horses do calm behaviors became calmer and joined in these behaviors. All but one horse ate all the time when the hay was present. The last horse took a bite of the hay when the girth was being tightened, not in an aggressive way. It chewed it calmly and did not eat any more when the saddle was in place. This might be a way for the horse to help itself relax in a situation that was stressful and uncomfortable.

The hay was put in a position that made it easy for the horse to reach. This meant that all the horses had their head in a position where their eyes were in height with their withers. This ensured that the original head position of the different treatments was the same for all horses.

The standard deviations in the statistical results often ended up being quite high. The explanation for this is the individual differences between the horses. Some horses expressed a lot of or a high frequency of the observed behaviors while others expressed a lower amount or frequency of the behaviors.

An algometer was used in the study to investigate the mechanical nociceptive threshold and the hypothesis was that there would be a change in the mechanical nociceptive threshold, with the pressure applied before reaction being greater with hay than without. The pressure needed on each side was believed to be different as well, with a greater pressure needed on the side where the horses' owners do not tighten the girth or mount. Part of this hypothesis depended on dissociative analgesia, where distractions like treats can make the animals willingly enter a restraint or get a shot (Animals 2009). This was also one of the reasons for developing the test model, comparing the same horses with and without hay. There are some sources of error when working with this equipment and to reduce these all measurements were done by the person and the results were written down by another person to minimize that the results were influenced by the person conduction the tests. The horses were tested in a known environment and interference from other horses or people where limited as much as possible. This was done by informing the people in the stable about the research, asking them not to make sounds or walking around near the horse. To limit the distraction for the test horse other horses were moved to other areas where possible. Since the horses

where their own control, time of day is not recognized as a source of error, every horse did both measurements within the same hour, but not all horses were measured at the same time of day. All the horses were measured in summertime though. Since the measurements were done both with and without hay the tests were balanced in a way the half the horses started off with hay, and the other half started without hay. There were some variations in the measurements, but they were not significant, and could be explained by earlier research that shows a big variation in the measurements of the mechanical nociceptive threshold over time when measuring horses (De Heus et al. 2010). This can also be the reason for the significant differences in some of the individuals.

Earlier research conducted within the area often suggest some kind of pain that is triggering the girthiness or the girth-aversion (van Iwaarden et al. 2012; Bowen et al. 2017; Millares-Ramirez & Le Jeune 2019). All the horses in this study were specified as healthy, checked by a veterinarian and doing well within their discipline. In most cases the horse owners stated that they had tried a lot of things trying to help their horses with aversive behaviors towards the saddle and the girth, including veterinarians or equiterapeuts. There was no veterinarian on site during the tests, neither did the test request any files from the veterinarian. The horses reaction to palpation on muscles was not checked. This means that the horses' reaction could depend on some pain that is not known. van Iwaarden et al. (2012) and Bowen et al. (2017) writes about muscles and myofascial triggerpoints which are located in the area where the saddles are placed. They all mention that an ill-fitting saddle can both cause backpain, and trigger girthiness or girth-aversion. The horses in the study all had their saddle fitted within the last 12 months. What kind of saddle they had on before that is not specified in all cases though. Some declared that the horse had an ill-fitting saddle earlier, some had no knowledge about the saddle before they bought the horse. None of the owners had information about how the horses were broken in. Previous research show by Lansade et al. (2004) show that a horses early experiences are important for how the horse will react in their adult life. Research made by Henry et al. (2005) showed that horses that got to meet humans from a young age were more social than the horses who did not have this upbringing. This shows that the early experiences are important in the training of the horse.

Current or previous experience of pain may be the possible explanation for the horses in this study exhibiting girthiness. The purpose of this study was to find out if there was a way to help decrease the girthiness behavior, not determine why horses experience girthiness. Still the reason behind the girthiness could affect the outcome of the study, therefor this must be regarded as a source of error.

To avoid missing behaviors, all the horses were filmed. That meant the video could be watched several times, making it easy to count both frequency and duration. Unfortunately, since the camera was set up before the study started, it

happened that the owner hung something on the stall covering parts of the horse, for example the ears or the eyes, from the camera view. This meant that these horses could not participate in behaviors including these body parts. Depending on where the horse was tied up, the angle of the camera got a little bit different on some horses, but that should not affect what behaviors were observed. Another source of error during this study is the fact that there was an extra person in the stable that most of the horses had never seen before. There was also a new object, the camera standing close to the horse, and the heart rate monitor on the horse, which sometimes ended up beneath the saddle during tacking up. All these factors could cause the horse to react a bit different than it would normally (Leiner & Fendt 2011). These factors are the same for both behaviors though but could still have an effect on the horses' behaviors and reactions. Maybe the hay would work better or worse if the test would have been done under completely normal circumstances. There is also the possibility that the horse owners were tenser than usual because of the presence of the camera or the thought of being part of a study (Proops et al. 2018).

Since the horses were only saddled once with hay and once without hay, and then observed when standing still, the results registered are only short term. Since girthiness can show when the horse is moving or when being mounted as well (Dyson et al. 2022), this study only covers a part of the girthiness behavior and problems.

Future research might be able to conclude whether this will have a long-term effect. For example, a study where the horses are studied during a longer time period. The importance here is to use horses that are checked thoroughly by a veterinarian to rule out that the behavior is due to pain. Another study could then focus on the theory of overshadowing, getting the saddle to relate to something positive, the hay. For counter conditioning it is important to get the order of the hay and saddle right. To get the effect of overshadowing the horse must connect the saddle to the hay. If the timing is wrong, there is a risk that the horse unintentionally makes the connection that hay will lead to the saddle. Another suggestion to further research is to study the importance of the saddler or the way the saddler is tacking up the horse. Another thought for the future is to find out how the saddle breaking will affect girth-aversion behavior in the future. This could be done by starting off with a small blanket or saddle pad, working your way up to the complete saddle with girth compared to faster ways.

The horses in this study varied in age, size, breed and they showed different behavior connected to saddling, all defining them as girthiness (Bowen et al. 2017; Dyson et al. 2022). This was due to the different and widely including definitions of girthiness or girth-aversion (Bowen et al. 2017; Dyson et al. 2022). This led to a possibility to compare the horses' behavior towards the saddle depending on their aversive behavior. It also opened up the possibilities for a deeper study of the

owners' answers in the interview, data that exceeds this study. The heart-rate monitor might answer other questions than those answered already and might even help define if the horses experience some kind of stress while being saddled.

No horses were harmed in the study, the owners were told to saddle the horse in their usual way. One of the reasons for this was in an attempt to not cause the horses more stress than they already feel towards the saddle. Standing rest was observed on multiple horses during the test, indicating that the test did not cause any unnecessary stress. Since the owners put the saddle on in their usual way, the chances that it was done in the way the horse is most comfortable with are high.

5. Conclusion

The results show that when the horses are fed hay during the tacking up, their negative behaviors, *total head movements*, *moves one hoof, bites surrounding, threatens, tail swish, licks lips, looking at stomach/saddle, walk, back, snort, paws, bites, headbob, kicks front leg* and *kicks back leg,* decreased compared to when there is no hay present. This could be a sign that the hay helps the horses deal with the negative feelings that arise when being saddled. This together with the results from the algometer measurements tell us that the decrease in negative behaviors does not depend on a decrease in sensitivity. More research needs to be done to find out if the hay masks the behaviors or helps the horse cope with the girthiness or girth-aversion.

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Popular science summary

What do we do when the horse does not like its saddle? Usually, the owner tries a lot of different methods to find the one that the horse accepts the most. It could be a different way of putting the saddle on, a special way to tighten the girth or special tack all together. But is there a way that can help the horse feel better, and not just accept what we are doing? Can we train the horse to like something it previously did not like?

By providing hay while putting the saddle on, we try to make the horse think about the positive feeling that the hay gives them, instead of the negative feelings that arise towards the saddle. The hay distracts the horse from biting the saddler, and keeps it from moving away from the saddle, since the hay is kept in one place all the time.

The hay does not keep the horse from feeling what we are doing or stop it from being sensitive to touch. The horse will still feel the saddle on its back and the girth tightening around their belly. This means that if the horse does not like the saddle because it hurts, it will still feel the pain.

To be able to change the way the horse feels about the saddle we have to try this method out for longer periods. Is it possible for the horse to start to like the saddle? We do not know this at present, but with training and lots of positive things around when getting the saddle put on it is possible.

Is there a way to stop the horse from ever feeling negative about the saddle? We do not know that either, but even here there might be a possibility. We have to think about how we introduce the saddle to the horse, how the horses saddle fit, and how we put the saddle on every time. It is important to make sure that the saddle is never a negative experience for the horse.

Putting a saddle on a horse might seem like an easy thing to do, but when you get into the details of the saddle and the horse, it is more complex than that. We need to help the horses feel good about the saddle, which in the long term will make us feel good about it as well.

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Thank you all for making this project this great experience. It has been both fun and educational, giving me a great wish of further developing the research in this area.

Appendix 1

Bakgrund Nedan följer några frågor om din och din hästs bakgrund

Kön?

Valack

Sto
Hingst

Ålder?

6-12 år

13-20 år
>20 år

Hästens ras?

Vilken gren används hästen till?

Hoppning

Dressyr
Allround
Fälttävlan
Islandsridning
Körning
Galopp
Trav
Annat, vad?

Var i Sverige finns hästen?

Hur länge har du ägt hästen?

Vid vilken ålder blev hästen inriden? Med inridning menas att hästen ska kunna gå att rida i alla gångarter samt vara styrbar i alla gångarter.

Vem red in hästen?

Den reds in hemma av ordinarie ryttare

Den reds in hemma av en för hästen okänd ryttare
Den skickades iväg för inridning
Annat

Hur lång tid tog inridningen? Med inridning menas att hästen ska kunna gå att rida i alla gångarter samt vara styrbar i alla gångarter.
Svara så exakt som möjligt.

Hur gick inridningen? Försök få med så mycket detaljer som möjligt.

Fungerar hästen att rida på?

Ja

Oftast
Ibland
Nej
Kommentarer

Hur presterar hästen i vardagen? Tillexempel om det är en hopphäst, uppfyller den rimliga krav och hoppar för det mesta utan att vägra

Är hästen kollad av veterinär någon gång under de senaste 12 månaderna?

Nej

Ja, varför?

Har hästen varit skadad på ett ställe som skulle kunna påverka sadeltvånget, till exempel rygg, sadelgjordsläge osv?

Nej

Ja, var?

När var hästen skadad?

Vilken behandling fick hästen?

Beskrivning av beteendet

Beskriv hur sadeltvång yttrar sig hos din häst. Försök få med så många detaljer som möjligt.

Visste du om att hästen hade problem med sadling när du köpte den?

Ja

Nej

Annat

När visade sig beteendet första gången? Fanns det något som utlöste beteendet?

Har den beteendet just nu eller har det tränats bort?

Beteendet finns kvar

Beteendet är helt borta
Beteendet är borta om jag sadlar på ett specifikt sätt
Annat

Har du tagit hjälp för att komma till rätta med problemet?

Ja

Nej

Blev problemet bättre efter att du tagit hjälp?

Ja, det är helt borta

Ja, det blev bättre men har inte försvunnit
Nej, problemet försvann men har kommit tillbaka igen
Nej, det hjälpte inte alls

Hur tog du hjälp?

Vilka strategier använder du i vardagen för att hantera problemet?

Har hästen alltid haft en utprovad sadel?

Ja

Nej
Annat

Hur ofta kontrolleras sadeln?

Om hästen har mer än en sadel, uppvisar den sadeltvång med alla sadlar?

Hästen har bara en sadel

Hästen har mer än en sadel och uppvisar sadeltvång med alla
Hästen har mer än en sadel, men uppvisar inte sadeltvång med alla
Här kan du beskriva i mer detalj hur beteendet skiljer sig mellan sadlarna

Rids hästen av mer än en ryttare? Uppvisar den isåfall beteendet med alla ryttare?

Hästen rids enbart av en ryttare

Hästen rids av mer än en ryttare och uppvisar beteendet med alla
Hästen rids av mer än en ryttare, men uppvisar inte beteendet med alla
Här kan du beskriva mer i detalj hur beteendet skiljer sig mellan ryttarna

Reagera hästen på något annat än sadeln?

Tömkörnings/longeringsgjord

Sele
Schabrak
Vid borstning
Täcke
Vid beröring
Annat

Hur upplever du att beteendet påverkar din och hästens vardag?

Beteendet påverkar hästens välfärd

Beteendet påverkar ridning och hantering
Beteendet påverkar både hästens välfärd samt ridningen/hanteringen av hästen
Annat

Slutligen

Skulle du vara intresserad av att vara med på nästa del av studien? Hästen kommer då filmas medan sadeln läggs på, en gång med lite hö och en gång utan hö. Jag skulle även vilja veta om det är okej att jag tar lite tagel från din häst för att kunna se om det finns några gener som är desamma för hästar med sadeltvång.

Ja

Nej
Emailadress för vidare kontakt

Appendix 2

Försöksprotokoll ”Projekt sadeltvång”
Namn på djurägare:
Namn på häst:
Datum och tid:

- Informera djurägare, muntligt och skriftligt, signering av djurägarmedgivande.
- Fråga vilken sida de sadlar/sitter upp på.
- Standardisering av försöksställe (ingen matning, klappning, annan distraktion)
- Förberedd höpåse
- Ställ upp hästen
- Montera upp kameran, kameravinkel snett framifrån, från den sidan de sadlar.
- Montera hjärtfrekvensmätaren på hästen. Denna placerades så att mätaren inte hamnade så att sadeln tryckte, men ändå så att remmen gick under sadelgjorden/i sadelgjordsläge.
- Slå på kamera, tala om vilken häst det är och datum.
- Provtryck 3 ggr på varje testställe. Börja på den sida de inte blir sadlade/sitter upp på.
- Registera 3 ggr/ställe, blindat, dvs ngn annan läser av registreringsresultatet:

Börja med höger sida lumbalrygg, sedan hö sida sadelläge, sist hö sida gjord.

Lumbal: 75-80 % av avstånd högsta punkten på manken (th 4) till linje mellan de två tuber coxae (bäckenknöl). 10 cm från spinalutskott, på långa ryggsträckaren.

Sadelläge: 30-40 % av avstånd högsta punkten på manken (th 4) till linje mellan de två tuber coxae (bäckenknöl). 5 cm från spinalutskott, på långa ryggsträckaren.

Gjord: i höjd med armbågsspetsen, 5 cm från frambenet

Algometer höger sida	Reg 1	Reg 2	Reg 3	kommentar
Lumbal				
sadel				

gjord				

Fortsätt med vänster sida, lumbal, sadel, gjord.

Algometer vänster sida	Reg 1	Reg 2	Reg 3	kommentar
Lumbal				
sadel				
gjord				

Gör om allt men med ”behandling”.

Algometer höger sida	Reg 1	Reg 2	Reg 3	kommentar
Lumbal				
sadel				
gjord				

Fortsätt med vänster sida, lumbal, sadel, gjord. (gör en tabell i detta dokument där den oblindade fyller i).

Algometer vänster sida	Reg 1	Reg 2	Reg 3	kommentar
Lumbal				
sadel				
gjord				

Hästen ska tas från provstället och promeneras (50 meter)

- Ägaren sadlar hästen som vanligt, hästens puls registreras när sadel läggs på och när sadelgjorden spänns. Sadeln ligger på i max 5 min. Avbryt om situationen blir farlig för häst eller människor.
- Sadeln kommer från samma håll som den kommer i vanliga fall. Förbered så att sadeln är nära men utom synhåll.
- Sadelgjorden spänns så hårt som de skulle spänt i vanliga fall, innan de lämnar stallet.
- Gå ut ur stallet och promenera. Förbered hö
- Gör om sadlingen igen men med behandling

puls

Inte behandling		
Behandling		

Appendix 3

BEHAVIOR	DESCRIPTION	DURATION/FREQUENCY	BEHAVIOR2	DESCRIPTION3	DURATION/FREQUENCY4
Eats food	With lips and tongue, hay is gathered into mouth, broken down into pieces by chewing, then swallowed.	Duration and maybe frequency of bouts if there are breaks of more than 5 seconds.	Back	At least two legs moves the horse in a backwards motion	Frequency
Head above withers	Head positioned higher than the horse withers, measured from the eyes.	Frequency	Ears flattened	Horse puts ears back, flat against head/neck	Duration and frequency of bouts
Head at withers	Head positioned at the same height as the horse withers, measured from the eyes.	Frequency	Search food	Nose in crib or other place where food was before	Frequency
Head below withers	Head positioned lower than the horse withers, measured from the eyes.	Frequency	Autogroom head	Rubbing head on stable interior/person	Frequency
Blinks	Horse closes eyes completely for a short period of time.	Frequency	Bites food	Bites towards or in hay without eating it	Frequency
Moves one hoof	Picks up one hoof and puts it down in a different place	Frequency	Paws	Horse lifts hoof and scrapes it against the ground/floor	Frequency
Chewing	Horse is chewing without food in mouth, jaws moving from side to side	Duration	Bites	Horse bites in the air or towards the saddler	Frequency
Stand alert	Rigid stance with elevated neck, ears are stiffly upright and forward, eyes oriented at object of focus	Duration	Waves head/head bob	Waves head violently up and down	Frequency
Kicks back leg	Back leg kicks up and out from body	Frequency	Shows teeth	Lips drawn back enough to show teeth	Duration
Bites surrounding	Horse bites crossties, leadrope or other pieces of stable interior	Frequency	Shakes head	Rhythmic rotation of head, rest of the body still	Frequency
Threatens	Ears flat, head turned towards saddler, tenses	Frequency	Yawns	Long, deep inhalation, mouth open, jaws either still opposite eachother or moving side to side	Frequency
Breathing heavily	Breathing showing clearly on stomach	Duration	Sighs	Takes deep breath in and releases at the same time as the horse relaxes his body	Frequency
Tail swish	Tail moving fast from side to side, making a swishing sound.	Frequency	Plays with lips	Opens lips and smacks them together without moving teeth	Frequency
Licks lips	Tongue touches lips without food or water intake	Frequency	Kicks front leg	Picks up front leg and waves it in the air	Frequency
Rest standing	Standing inactive, slightly lowered head, weight on one backleg, the other leg resting on toes	Duration, frequency of bouts when changing backleg	Push hay	Pushes hay with nose, closed mouth, moving head	Frequency
Licks salt	Horse licks the stone of salt	Duration and frequency?	Sniff	Draws air through nostrils with nose close to object of interest	Frequency
Looking at saddle/stomach	Horse turns neck to view saddle or stomach	Frequency	Shakes muscles	Horse vibrates muscles as to get rid of flies or other things irritating	Frequency
Walks	At least two legs moves the horse in a forward motion	Frequency	Shows the whites of the eyes	The whites of the eyes showing	Frequency
Snort	Short powerful exhalation from nostrils	Frequency	Freezes	Stands still, not showing any type of feeling, rigid posture	Duration

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