Health status in riding school horses

– housed individual or in group housing

Hälsa hos ridskolehästar - i individuell inhysning eller grupphållning

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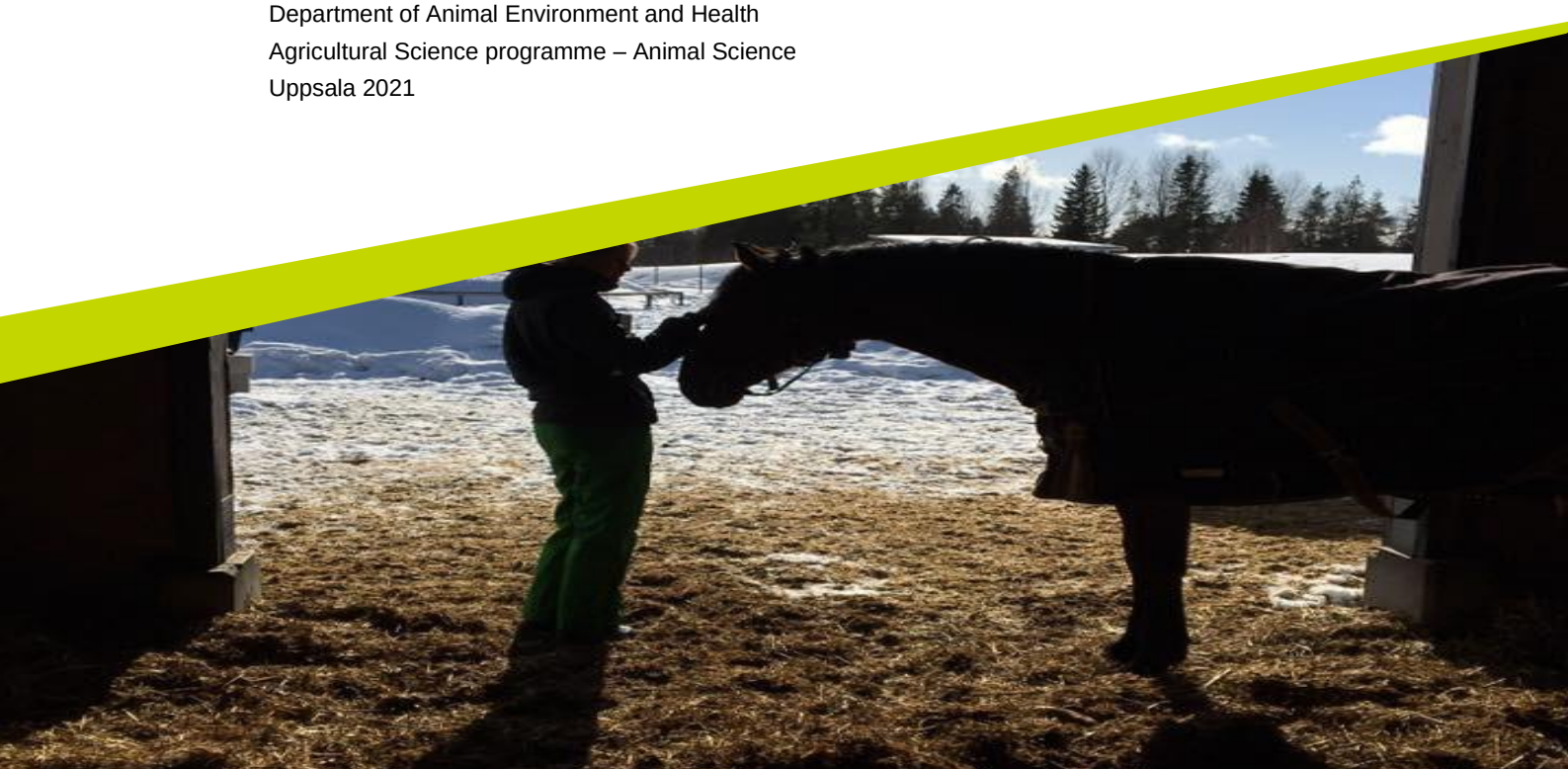

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Sammanfattning

Det finns begränsat med forskning om hur olika inhysningssystem påverkar hästens hälsa. Då hästarna spenderar en stor del av dygnet i inhysningssystemen borde dessa vara väl anpassade och främja en god hästvälfärd. Hos svenska ridskolor är individuell inhysning det vanligaste systemet och endast 10% av ridskolorna håller sina hästar i grupp i lösdriftssystem. Ett vanligt argument för individuell inhysning är att risken för att hästarna skadar sig är lägre jämfört med i lössdriftssystem. Uppsatsens syfte har varit att få en överblick av ridskolehästarnas (RH) hälsa i två olika inhysningssystem, individuell inhysning och lösdriftssystem, genom att notera deras hälsostatus och även kartlägga förekomsten av skador samt typ av skaderisker i systemen. Åtta ridskolor runt om i Sverige har använts för datainsamling. Genom intervjuer med ridskolornas verksamhetschefer samt annan personal, ansvarig för hästarnas hälsa, samlades data in över hästarnas tidigare skador. Data över skaderisker samlades in genom observationer på anläggningarna och hästarnas hälsostatus bedömdes av veterinär. Underlaget för data över hästarnas skador var 171 hästar och underlaget för data över hästarnas hälsostatus var 80 hästar (10 hästar från vardera ridskola). Studien gav en överblick av specifika problem och utmaningar inom de olika inhysningssystemen. I båda inhysningssystemen saknades tidigare journalföring över hästarnas hälsostatus. Studien visade att det är vanligt med skaderisker i stallar även då vissa stallar var relativt nybyggda. Inga signifikanta skillnader fanns i varken skadestatistik eller antalet skaderisker mellan systemen. Typ av skaderisker skiljde sig åt mellan de olika systemen. De typer av skaderisker som var vanligast i ridskolor med individuell inhysning var olika föremål samt dåligt uppsatta stängsel. I lösdriftssystem var de vanligaste typerna av skaderisker hönät och olika föremål. Dåligt designade stängsel och hala stallgångar registrerades endast på ridskolor med individuell inhysning.

Abstract

There is a limited amount of research on how different housing systems affect the health of the horse. The horses spend most of their time in these systems and they should be thoroughly evaluated and adjusted to promote a good horse welfare. The most common housing system in Swedish riding schools is individual housing and only 10% have group housing systems. One argument commonly used for individual housing is that it comprehends a lower risk of injuries compared to group housing. The aim of this study is to give an overview of the horses' health in the different housing systems by noting health status and mapping prevalence of injury and type of risk of injuries in the systems. Eight riding schools located around Sweden were visited for data collection. Retrospective health data was collected through interviews with riding school managers or other staff responsible for the health of the horses, data of risks of injuries was collected by observations and the health status was assessed by clinical examinations. Health data from 171 horses was collected and 80 horses were examined and assessed by a veterinarian. This study highlights some problems and challenges specific for each housing system that needs to be better addressed to lower the number of injuries. It also highlights the fact that risk of injuries are common in riding schools even though the stables are relatively newly built. There were no significant differences in health data or numbers of risk of injuries between the two housing systems. The risk of injuries differed between the housing systems. The most common risk factor in individual housing was objects that pose a risk of injury and poorly maintained fences. In group housing hay nets and objects that pose a risk of injury was the most common risk of injuries. Poorly designed fences and slippery aisle ways in stable was only registered in riding schools with individual housing.

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Introduction

An increased knowledge about management factors that affect horses' health can be used for improvement of the horses' welfare. If it is possible to reduce the number of injured horses, it is also possible to reduce the veterinary costs. In a thorough study of Swedish riding schools Egenvall et al., (2009) found that riding schools use their veterinary care and life insurance more than other horse owners with horses in the same age category in the same insurance company. Reducing the number of days horses are "out of work" at riding schools because of bad health could strengthen the economy. Running a riding school and achieving a positive economic result can often be difficult with large expenses (Egenvall et al., 2009).

There is only limited research on how the health of the horse is affected by its housing system. The most common housing system in Swedish riding schools is individual housing and only 10% use group housing systems (Hallman & Öqvist, 2011). A study based on interviews showed that a common argument for using an individual housing system instead of a group housing system is that it entails a lower risk of horses' obtaining injuries (Svala, 2008). Researchers have studied bite and kick injuries of horses kept in group housed systems (Christensen *et al*., 2011; Lehman *et al*., 2006; Keeling *et al*., 2016; Knübben *et al*., 2008 a; Jørgensen *et al*., 2009) but there is a lack of available research that studies horses' health and comparisons between different housing systems. There is also a lack of studies about different risk factors for injuries in the two systems. The most frequent injuries in Swedish horses are lameness, colic, trauma wounds, laminitis and hoof abscess (Agria, 2015). According to Owen et al., (2012) 62% of the cases of wounds occur out on pasture, 13% under riding and 11% in the stable. Stable interiors are most likely to pose a risk of wounds when they have sharp details or sharp edges (Owen *et al*., 2012).

This thesis aims to get an overview of health differences between riding school horses in group housing and individual housing and to investigate if there are differences in risk of injuries in the two housing systems. This study is a part of a larger interdisciplinary study that compares riding schools with individual housing and group housing systems in different ways. The different areas are work environment, safety, ethical aspects, pedagogics and horse welfare. This thesis aims to contribute to the area of horse welfare. The study is conducted in cooperation between the Swedish University of Agricultural Sciences (SLU), the University of Gothenburg and Flyinge Equestrian Centre.

Background

Horse welfare legislation

The Swedish animal welfare act (2018:1192) is supposed to work preventively and protect animals from unnecessary suffering and disease. The act states that animals must be kept in a good environment and be kept in a way that supports good health and a natural behavior. The animal welfare ordinance (2019:66) also state that interior and furniture in stables or where animals are kept must be designed not to endanger animals or entail a risk for their health. To ensure that the law is complied to, the County Administrative Board performs animal welfare inspections. These inspections are performed by using nationally developed checklists available for different species (Jordbruksverket, 2021). All environments where animals are kept are controlled during these inspections.

Housing system

The most common housing system for horses is individual boxes (Bachmann & Stauffacher, 2002; Petersen *et al*., 2006; Søndergaard *et al*., 2004). Studies show that the minority (16.5% - 24.1%) of the horses is held in group housing systems (Bachmann & Stauffacher, 2002; Søndergaard *et al*., 2004). Turnout is generally a few hours daily in small paddocks (Henderson, 2007). According to Henderson (2007) owners can be protective of their horses and fear that their horses are going to injure themselves if they are allowed access to a larger paddock as it would give the horse more liberty to move around. Owners fear that the horse liberty to move in a larger paddock could increase the risk of self-injury. Owners also fear that group housing of horses could lead to injuries caused by other horses (Henderson, 2007). Keeling *et al*., (2016) argue that the concerns of horses getting injuries in a group house system probably are exaggerated. Knübben *et al*., (2008 a) could not find any significant differences in health data between horses in a group housed system compared with horses that are stabled individually with access to pasture in daytime with other horses.

Health data

Riding schools in Sweden utilizes their veterinary care and life insurance more compared to other horse owners in the same insurance company, with horses in the same age categories. Veterinary care is used 22% more in riding schools and life insurance 79% more than by other horse owners. Riding school horses can be expected to work a higher number of hours per day compared to the average privately owned riding horse (Egenvall *et al*., 2009). The most common cause of veterinary care and death or euthanasia in Swedish horses is lameness (Egenvall *et al*, 2006; Penell *et al*., 2005).

There is a large variation in health data of riding school horses between different riding schools in Sweden. This variation can be seen in injury rates, veterinary claims and mortality of the riding school horses (Egenvall *et al*., 2009). As early as in the 1970s it was found that competence and education amongst the riding school staff were a crucial factor for the health of the riding school horses (Magnusson, 1973). Staff with a high level of education and/or experience of competition decreases the levels of injuries in the riding school horses (Egenvall *et al*., 2009; Egenvall *et al*., 2010; Lönnell *et al*., 2012; Lönnell, 2012). Riding schools with managers that had at least 11 years of experience and 18.5 years (median) of professional experience have lower levels of injuries in the horses. The riding instructors' levels of education varied between riding schools with low and high injury prevalence. In the riding schools with low injury prevalence seven out of ten riding instructors had a level 3 exam and/or had competed advanced level while one of ten riding instructors had the same level of degree in

riding schools with high injury prevalence. The education degree of those working in the stables was not registered in the study (Lönnell *et al*., 2012).

In northwest England, Midlands and north Wales a postal questionnaire about horse injuries was distributed to randomly selected horse owners. The aim with the questionnaire was to assess the frequency of injuries. Wounds were the most frequent type of injury reported. Most of the injuries, 62%, occurred during turnout to grass, 13% occurred during riding and 11% of the injuries occurred in the stable. The questionnaire showed that 47% of the injuries required treatment by a veterinarian, 67% of the injuries were treated by the owner or a friend and 33% of the injuries did not require any treatment (Owen *et al*., 2012). Knübben *et al*., (2008 a) found that the type of housing system and the use of the horse did not remarkably affect the risk of bite and kick injuries. In comparison with other injuries, bites and kicks were more often proceeded by changes in the housing environment, such as structural changes or changes in the group. Another study found that recorded injuries in group-housed horses were only superficial. Variation in sex and age composition of the group had a minor effect on the injury level (Keeling *et al*., 2016). Horses kept stabled during nights and turned out in the days during autumn and winter months were similarly found to be at increased risk of injury (Owen *et al*., 2012).

Gastrointestinal disease/disorder

Colic is the fifth most frequent occurring problem in Swedish horses insured at Agria (Agria, 2015). The term colic includes all form of gastrointestinal diseases/disorders that causes pain in the abdomen of the horse (Bland, 2015) but authors use different definitions of the term. USDA (2001) found that 11% of the colic cases are fatal. There are numerous factors that have been found affecting the risk of colic, among them feeding practices, change in housing system, change in activity level and history of colic (Gonçalves *et al.,* 2002). Feeding practices appear to be one of the most crucial risk factors for colic (Gonçalves *et al.,* 2002). Changes in feed strategy with aspects of quality and quantity result in an increased risk of colic (Cohen *et al.,* 1999 & Reeves *et al.,* 1996). The two following weeks after a change of feed strategy are the period with highest risk for colic. The type of forage remains the most significant risk factor and changing between different forages increase the risk of colic with 9.8 times compared to no change of forage (Cohen *et al.,* 1995 & Cohen *et al.,* 1999). Feeding the horse with a high or increased level of concentrates is also considered as a risk. A feeding strategy that include more than 2.5 kg or 5 kg concentrates per day multiplies the risk of colic with 4.8 respectively 6.3 times compared with horses that are not fed any concentrates or are out on pasture (Tinker *et al.,* 1997).

The activity level of the horse can affect the risk of colic and especially if the activity level decreases in frequency, intensity or duration. A reduction of motility in the colon, like an effect of change in activity can predispose the development of simple colonic obstruction and distension (SCOD) that causes colic (Hillyer *et al.,* 2002). A change in housing system also predisposes horses for colic (Cohen *et al.,* 1995 & Cohen *et al.,* 1999). The two following weeks after a change in housing system (Tinker *et al.,* 1997) and increasing numbers of hours spent stabled increases the risk of SCOD (Hillyer *et al.,* 2002). Several of the risk factors can be correlated when a horse change housing system, for example a change in diet (Tinker *et al.,* 1997) and a change in activity if the horse change housing from pasture in to stabling (Cohen *et al.,* 1999). Ingestion of sand can cause sand colic, which is common in areas with loose sandy soils (Ragle *et al.,* 1989). Soil type in the paddock or pasture, the quality of the pasture and feeding practices are factors that affect the ingestion of sand (Husted *et al.,* 2005). The water

supply has also been seen to affect the risk of colic. Horses without continuous access to water during turnout are more than twice likely to get colic compared to horses that always have access to water during turnout (Reeves *et al.,* 1996). In every appearance, to take the horse away from its natural grazing environment seems to be strongly associated with a higher risk of SCOD (Hillyer *et al.,* 2002).

Airway disease

Stabling of horses has been associated with both upper and lower airway inflammation in young horses. By using bronchoalveolar lavage (BAL) it has been found that stabling can contribute to airway inflammation. The percentage of neutrophils found in the BAL fluid (BALF) were in stabled horses 10,8% and amongst horses on pasture 3.6% (Holcombe *et al.,* 2001).

The total airborne endotoxin concentrations in conventional stables (using hay + straw) have been found to exceed levels that induce pulmonary inflammation and bronchial hyper-responsiveness in humans. The airborne endotoxin exceeded levels that can induce bronchoconstriction in humans with pre-existing pulmonary inflammation. There is no minimum level of airborne endotoxin concentration that can be said to cause airway inflammation and dysfunction in horses published. Until these levels are known it is not accurate to determine what the effect of the reported endotoxin levels are in the respiratory tract of the horse. Since some horses are stabled up to 24 hours per day the exposure is much more intense for them than for humans working around 8 hours a day (McGorum *et al.,* 1998).

Differences in hygiene quality of hay and straw and the quality of the ventilation in the stable are probably factors that affect the airborne endotoxin concentration. Pasture system and low dust stables (using shavings and silage) compared to conventional stables (using hay and straw), had significantly lower levels of airborne endotoxins which makes the system suitable for maintaining chronic obstructive pulmonary disease (COPD) affected horses (McGorum *et al.,* 1998). A relatively mild degree of inflammation in the airways can go undetected in pleasure horses but may be sufficient to impair a racehorses' performance (Holcombe *et al.,* 2001).

Bite and kick injuries

Grogan and McDonnell (2005) and Jørgensen *et al.* (2009) have reported low levels of bite and kick injuries in stable groups, however unstable groups have a tendency to show more agonistic behaviours than stable groups (Christensen *et al.,* 2011). To avoid serious kick injuries one can advantageously take off the back shoes while new horses are let into the group and the group are stabilizing (Henderson, 2007). Horses with fewer social experiences are likely to show more aggression, which increases the risk of injury. It is up to the horse handler to ensure that the group is composed of individuals who function well together (Christensen *et al.,* 2011). If horses are group housed over a longer period of time the risk of getting injuries are small even if changes in hierarchy take place (Lehman *et al.,* 2006).

The gender composition of the group does not seem to affect the amount of injuries or aggressive behaviors (Jørgensen *et al.,* 2009) but the aggressive behaviour is affected by the access of food and water (Grogan & McDonnell 2005). If there are limited sources of food and water, competition is created among horses, which increases the level of aggressiveness in the group (Grogan & McDonnell, 2005). Automatic systems with individual feed stations where only one horse at time can eat seem to trigger more aggressions than feeding booths where several horses can eat together. Horses in automatic systems with individual feed stations show particularly high levels of aggressions which may lead to injuries (Zeitler-Feicht *et al.,* 2010).

In both individual housing with temporary group housing and permanent group housing the risk of injuries is greatly affected by housing management regimes. There are preventive measures like a well-composed stable group, enough space in both lying areas and the turn-out area and several water and feeding areas to avoid competition among the horses (Knübben *et al.,* 2008a).

Lameness

Lameness is the most frequent reported injury in Swedish riding school horses (Egenvall *et al.,* 2009). The orthopaedic health in riding school horses is significantly different between riding schools (Egenvall *et al.,* 2010). In Swedish Warmbloods, diseases of the musculoskeletal system, lameness, are the predominant cause of death and count for about 55% (Wallin et *al.,* 2000). It was found that 41.5% of the injuries were lameness and half of these were caused by injuries that happened out in the paddock. More than half of bite and kick injuries were associated with lameness even if the anatomical location of the wound/lesion were rarely reported (Knübben *et al.,* 2008 b). In a master thesis by Odlander (2010) it was found that the size of the paddock, if the horse has company in the paddock by another horse and the hours spent outside in a paddock, affected the risk of fetlock inflammations. A small paddock without company of another horse was found to be a risk factor of fetlock inflammation compared to a "big paddock with company of another horse". It was also found that turn out over ten hours per day worked protective against fetlock inflammation compared to turn out in six to ten hours per day.

The orthopaedic health in riding school horses was studied in eight Swedish riding schools by doing clinical examinations and data of the riding schools' insurance claims. The variations in orthopaedic injury data, between the eight riding schools, was most likely due to multifactorial management strategies which can influence the prevention of orthopaedic injuries (Egenvall *et al.,* 2010).

Risk of injuries

A significant number of injuries that occur in the stable are affecting the head and eye (Owen *et al.,* 2012). These kind of injuries could be related to the number of hazardous objects such as automatic waterer, hayracks and feed troughs within the stable. By avoiding hay nets, hayracks, hooks, sharp objects and protect the horse from sharp edges could help protect from injuries. Rugs are a significant risk factor for injuries, both when horses wear them in the stable and during turnout (Owen *et al.,* 2012). As part of a master thesis, stable related injuries were assessed through a survey. Of 391 respondents 20% had horses that injured themselves on stable interior. Fittings and equipment that caused injuries in horses was bars, rug racks and windows. Bars have mainly caused injuries on hoofs, but also on the head and jaw. Windows were mainly a cause of injuries on hoofs or legs but also on heads and jaws (Carlsson, 2015).

According to the Swedish Animal Welfare Agency, objects in the stable that can cause injuries should be kept protected and be placed inaccessible for horses, but it is not specified which objects that are hazardous in the regulations (DFS 2019:17 Saknr L 101). In the guidance for animal welfare inspections it is stated that objects that could pose a risk of injury is kept away from the horses, and be inaccessible if the horses come loose. Objects mentioned, that pose a risk of injury, are large amounts of concentrates, pitchforks and similar tools, medicines and chemicals. It also states that electric installations and windows must be protected or placed inaccessible (Jordbruksverket, 2009). According to the insurance company Agria it is mostly

inappropriate furnishing and narrow spaces that causes wounds in stable environments (Dahlkvist, 2010).

Aim

The aim of this thesis is to evaluate differences in the health of the horse and risk of injuries between riding schools with individual housing and riding schools with group housing. By evaluating this area and highlight differences new knowledge can be used for pointing out weaknesses in each housing system. The knowledge of weaknesses can be used for improvements of each housing system and improvement of the horse's welfare.

Research questions

- Does the health data, over the past six months, differ between riding schools with individual housing and riding schools with group housing?
- Do the riding schools keep journals of the horses' injuries and health status?
- Does the health of the horses, at actual time of the clinical examination, differ between riding schools with individual housing and riding schools with group housing?
- Does the risk of injuries, in number and type, differ between riding schools with individual housing and riding schools with group housing?

Methods

Selection

The data was collected from eight riding schools, four with group housing and four with individual housing, located in different geographical parts of Sweden. The selection of riding schools was based on finding matching schools. The riding schools were matched based on geographic location, the type of riding school, the type of housing system and the size of the riding school. The goal was to have two riding schools with each housing system, in the same geographical area in similar size with both ponies and horses to get a representative selection. Riding schools with Icelandic horses were not selected because they are not considered to be representative for the general riding school horse population in Sweden and because Icelandic horses were assumed to mainly be housed in group housing. The riding schools' willingness to participate and their ability to receive a visit did affect the selection. Riding schools with group housing were limited which also affected the selection. Riding schools were found through internet and Swedish Equestrian Federation's (SvRF) list of members. The riding schools were contacted by telephone and email.

Health data

Injury and disease data from the riding school horses was collected through interviews with staff responsible for the horses' health at each riding school. The interviews were semi-structured by using a questionnaire (Appendix. 1). Injuries/diseases that riding school horses suffered from in the last six months, that required care/treatment by either a veterinarian or someone working at the riding school, were registered as injuries/diseases. One of the riding schools had been running for just one year. To give the horses and staff enough time to acclimatize to the system (six months) the time frame of six months were determined. Injury/disease data from interviews were analysed like quantitative data.

Clinical examination

Five ponies and five horses in different ages were randomly selected in each riding school by the research team for clinical examinations. In total 80 horses were examined. Horses recovering from injuries/diseases and therefore "out of work" were excluded and horses that showed aggression were not examined further. Clinical examinations were performed in each riding school. Horses examined were photographed from both sides and registered deviations was documented by photography.

Clinical examinations were done by using a protocol (Appendix 3.) which was developed out of a horse welfare assessment protocol (Viksten, 2016) and modified by veterinarian Astrid Borg and the research team to fit the study. Clinical examinations were done by the same veterinarian in six out of eight riding schools. Horses in two out of eight riding schools were examined by another trained person in the research team since the veterinarian could not be present.

Locomotion test

The horses clinically examined were also graded for lameness by the same veterinarian. Horses in one of the riding schools were graded by the veterinarian for lameness afterwards by looking at videos recorded at site. The grading was done by observing the horses trotting up and down a straight line two times. The line was approximately 20 meters and four cones were placed out the line to mark where the horse was supposed to slow down and walk, turn around the last cone and respectively where it was supposed to speed up and trot (Appendix 1, picture 1). The

veterinarian evaluated each horse and graded each limb on a 0-5 scale, where 5 is equivalent to non-weight-bearing and 0 equivalent to no lameness.

The goal was to do locomotion tests on hard surfaces with all horses. Since this was depending on riding school's resources it was not possible to achieve. Riding halls, aisle ways in stables and roads were used as surfaces during the locomotion tests.

All horses were led by using either a halter and lead rein or a bridle depending on what the manager at each riding school thought was appropriate. A rod was used depending on the horses' willingness to trot but not used on the horse, only to wave with in the air. All locomotion tests were filmed. All 80 tested horses were led by the same person.

In two of the riding schools horses were graded for lameness by the veterinarian afterwards by looking at the recorded videos.

Risk of injury

Risk of injuries data was collected through inspections at the facilities where the horses were kept. The inspection was made by using a checklist (Appendix 2.) with different types of risk of injuries, objects or furnishing, that could pose a risk of injury to the horses. By using the checklist types of risk of injuries observed at the facility were registered. All risk of injuries were photographed. Automatic individual feeding stations was not inspected/observed from the inside of the station because there were horses in the stations at all times.

The checklist was based on other checklists and protocols (Viksten, 2016; Swedish Board of Agriculture, 2017; SvRF) and developed by reading literature and by consulting Agneta Sandberg (Swedish Trotting Association) and Jenny Yngvesson (SLU). Before the data collection began two pilot visits were carried out to learn to see and detect different types of risk of injuries. During these pilot visits the checklist was adjusted and tested.

Statistical analyses

In the cases where differences between housing systems were found to be large tests for statistical significance was made. As riding schools were chosen to match each other we used the paired t-test in Minitab-18. In cases where there were only registrations in one housing system no statistical tests were performed.

Discussion

T-tests were used as this is a robust test, and even though data was not tested for distribution the risk of type 2 errors is small. It turned out we could not reject the null-hypothesis that there were no difference between the horses in the two housing systems.

Results

- There were no significant differences in health data between riding schools with individual housing and riding schools with group housing.
- No riding school kept a journal of the horses' injuries/diseases and health status.
- The health of the horses did not significantly differ between riding schools with individual housing and riding schools with group housing.
- The risk of injuries, in number and type, did not significantly differ between riding schools with individual housing and riding schools with group housing.

Health data

Health data was collected from 8 riding schools with a total of 171 horses, 43 ponies and 38 horses from group housing and 40 ponies and 50 horses from individual housing. The horses were working in riding school lessons 13 hours/week in individual housing and 12 hours/ week in group housing (median values).

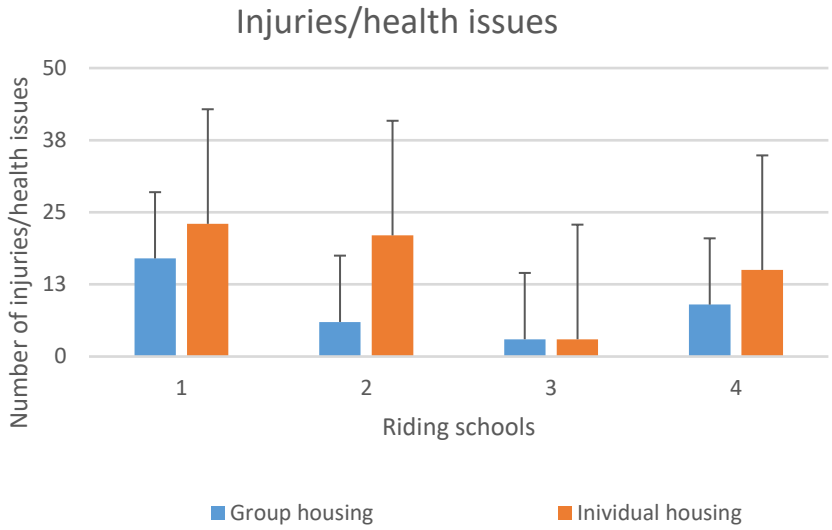

Figure 1. The distribution of injuries/health issues from health data between the riding schools n=8.

Injuries/health issues registered occurred the last six months and were in total 97. Of these 97 injuries/health issues 35 were registered in riding schools with group housing and 62 registered in riding schools with individual housing. Number of injuries/health issues+ SD in respectively riding school are shown in Figure 1.

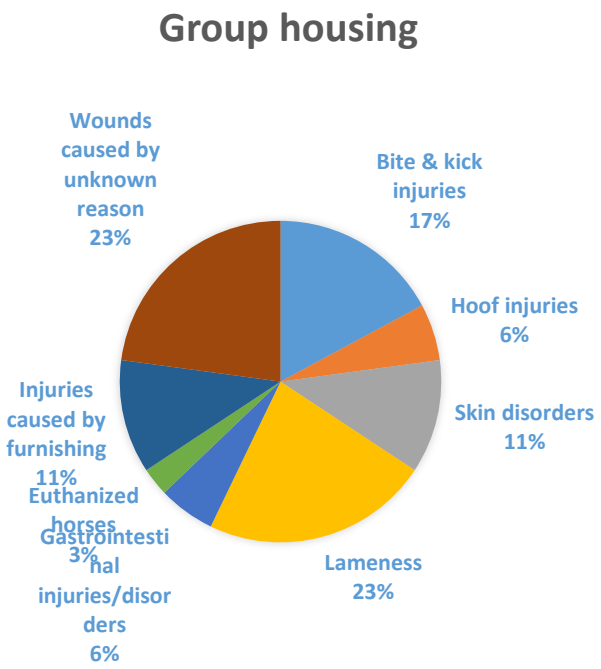

Figure 2. The distribution of health data registered in group housing. Group housing n=4.

A total of 35 injuries/health issues were registered in riding schools with group housing. The distribution of the different types of injuries/health issues are shown in Figure 2. The two most frequent occurring injuries were lameness and wounds caused by unknown reason where both accounted for 23% each.

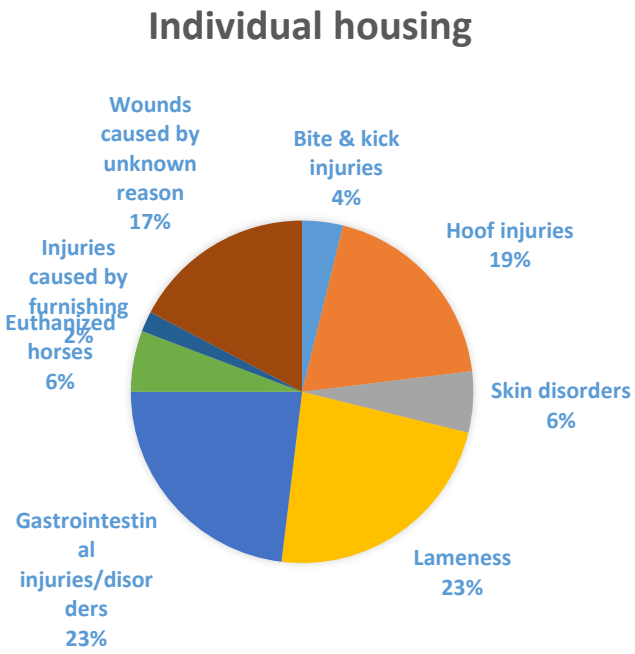

Figure 3. The distribution of health data registered in individual housing. Individual housing n=4.

A total of 62 injuries/health issues were registered in riding schools with individual housing. The distribution of the different types of injuries/health issues is shown in Figure 3. The two most frequent injuries/health issues occurring were gastrointestinal injuries/disorders and lameness which both accounted for 23% each. Gastrointestinal injuries/disorders registered were colic disorders and in the category of lameness were different types of injuries registered that caused lameness. The least frequent injuries/health issues occurring were injuries caused by furnishing and bite & kick injuries, which accounted for 2% respectively 4% of registered injuries/health issues.

The mean number of airway diseases registered in riding schools with individual housing were 1.25 ± 0.5 meanwhile there were no airway diseases registered in riding schools with group housing. There were five airway diseases registered from riding schools with individual housing.

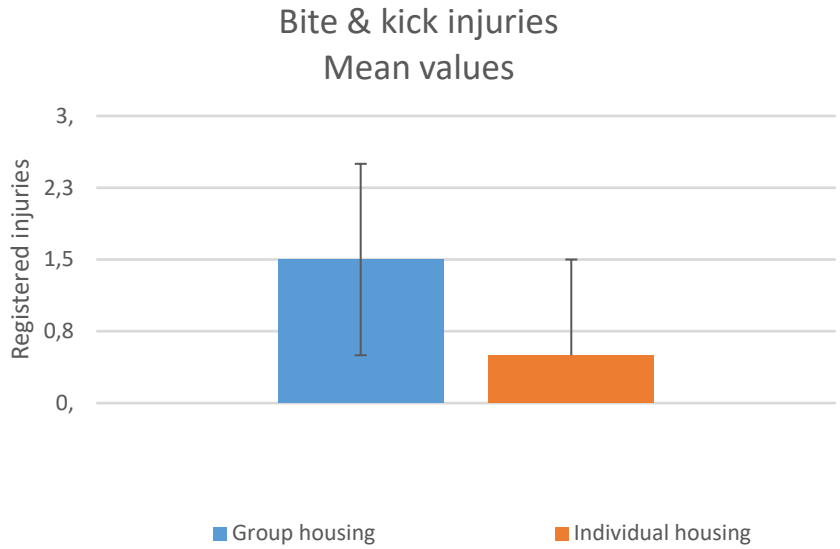

Figure 4. Mean values ±SD of cases of bite and kick injuries registered. Group housing n=4, individual housing n=4.

The mean number of bite and kick injuries ±SD registered in the two different groups of riding schools are shown in Figure 4. Bite and kick injuries in the riding schools with group housing had a mean of 1.5 ± 1.7 injuries registered and the riding schools with individual housing had a mean of 0.5 ± 0.6 injuries registered ($T=2.26$, $P>0.05$). There were two bite and kick injuries in total registered in riding schools with individual housing and six bite and kick injuries registered in riding schools with group housing.

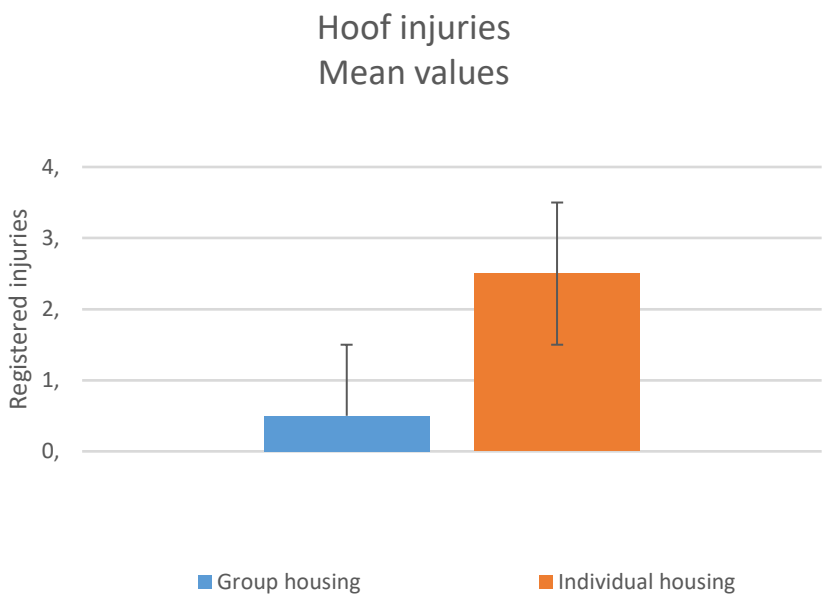

Figure 5. Mean numbers ± SD of hoof injuries registered. Group housing n=4, individual housing n=4.

The mean number of hoof injuries ± SD registered in the two different groups of riding schools are shown in Figure 5. The mean of hoof injuries in the riding schools with group housing had a mean of 0.5 ± 0.6 injuries registered and the riding schools with individual housing had a mean of 2.5 ± 2.4 injuries registered (T=2.0, P>0.05). In total 10 hoof injuries registered in riding schools with individual housing and 2 hoof injuries registered in riding schools with group housing. Injuries that have been registered are injuries like hoof abscesses, thrushes and hoof cracks (see Appendix 3. Picture 4.).

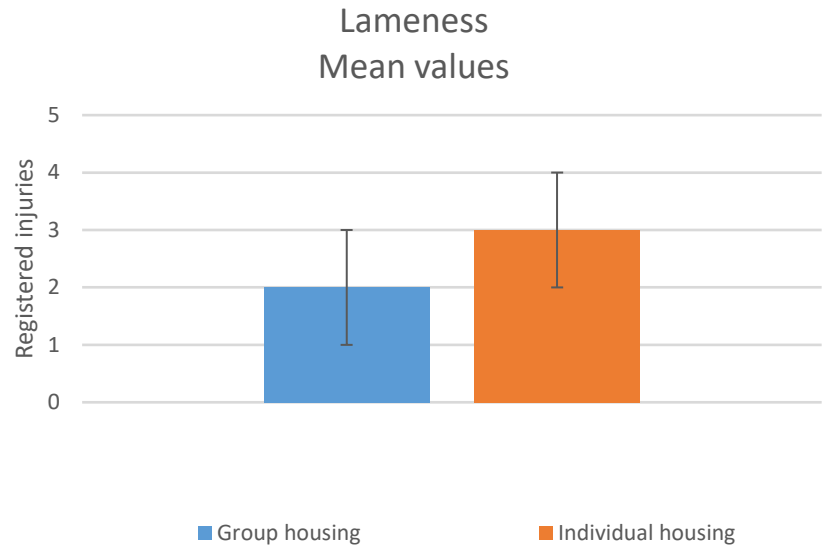

Figure 6. Mean numbers ± SD of cases of lameness registered. Group housing n=4, individual housing n=4.

The mean number of registered cases of lameness ± SD in the two different groups of riding schools are shown in Figure 6. The mean of lameness in the riding schools with group housing had a mean of 2 ± 1.8 injuries registered and the riding schools with individual housing had a mean of 3 ± 2.2 lameness registered injuries. In total 12 cases of lameness were registered in riding schools with individual housing and 8 cases registered in riding schools with group housing.

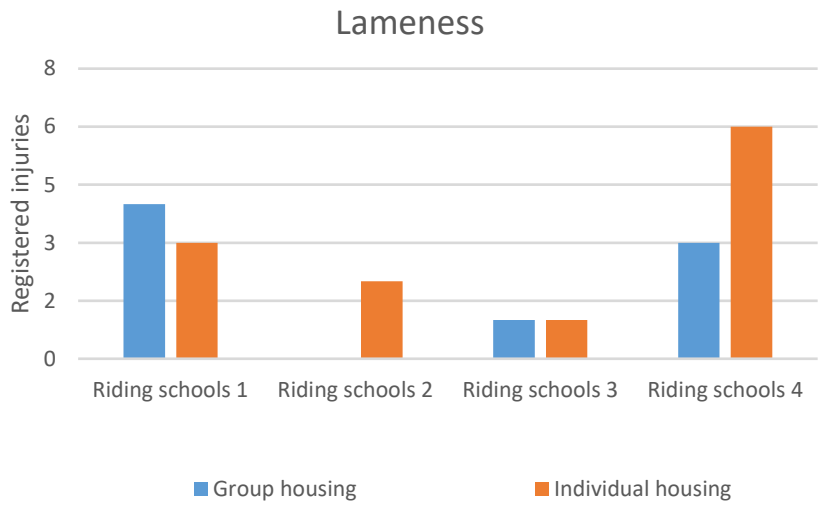

Figure 7. Lameness cases in each riding school.

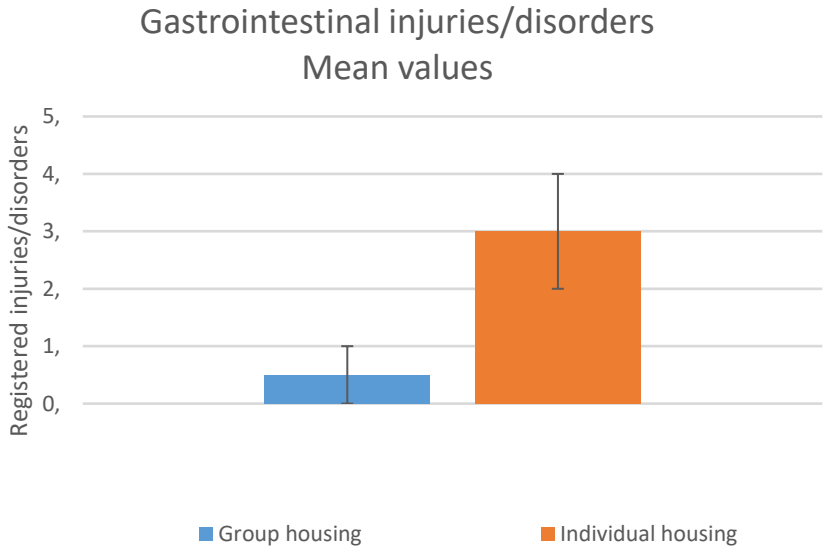

Figure 8. Mean numbers ± SD of cases of gastrointestinal injuries/disorders registered. Group housing n=4, individual housing n=4.

The mean number of gastrointestinal injuries/disorders ±SD registered in the two different groups of riding schools are shown in Figure 8. The gastrointestinal injuries/disorders (i.e. colic) tended to be more frequent occurring in riding schools with individual housing. Group housing riding schools had a mean of 0.5 ± 1 injuries/disorders registered and the riding schools with individual housing had a mean of 3 ± 2.2 injuries/disorders registered (T=2.4, 0.1<P>0.05). In total 12 gastrointestinal injury/disorders cases registered in riding schools with individual housing and 2 cases registered in riding schools with group housing.

Three of the riding schools with individual housing kept journals/binders where they saved receipt from or noted horses' veterinary treatments. Health issues not treated by a veterinarian were not noted in these journals/binders. One of the riding schools with group housing kept a journal with veterinary treatments and/or receipt but no notes of health issues that did not require veterinary care. One of the riding schools with individual housing kept a journal where horses BCS and feed ratio were noted.

Clinical examinations

The results of the clinical examinations of 80 riding school horses.

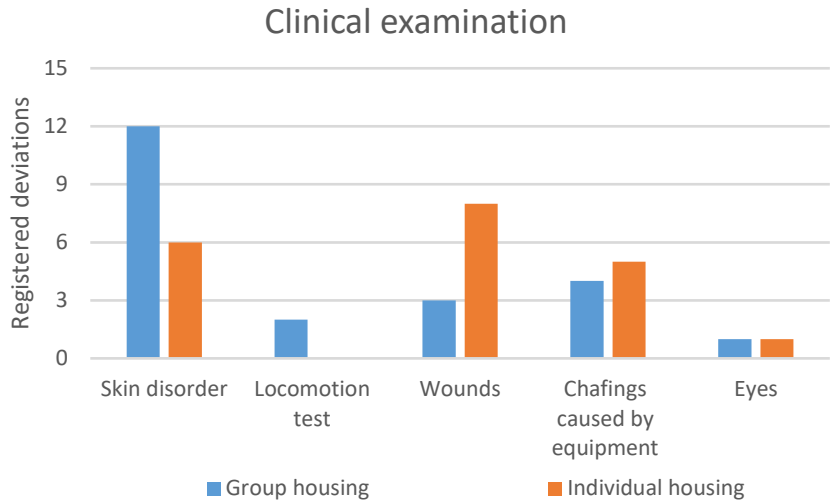

Figure 9. The distribution of deviations registered from clinical examinations of the horses. Group housing n=4, individual housing n=4.

Ten horses were examined from each riding school with a total of 80 horses. In the riding schools with individual housing 20 deviations were registered and in the riding schools with group housing 24 deviations were registered. The number of deviations in the two groups of riding schools are shown in Figure 9. There were 12 cases of skin disorders in riding school horses from group housing and 6 cases in horses from individual housing ($T=0.29$, $P>0.05$). There were 2 cases of lameness in horses from group housing and no cases in horses from individual housing. There were 3 cases of wounds in horses from group housing and 8 cases in horses from individual housing. There were 4 cases of chafing caused by equipment in horses from group housing and 5 cases in horses from individual housing. There were 1 registered case of runny/irritated eyes in each system.

Risk of injuries

The results of the assessment of risk of injuries in the riding schools.

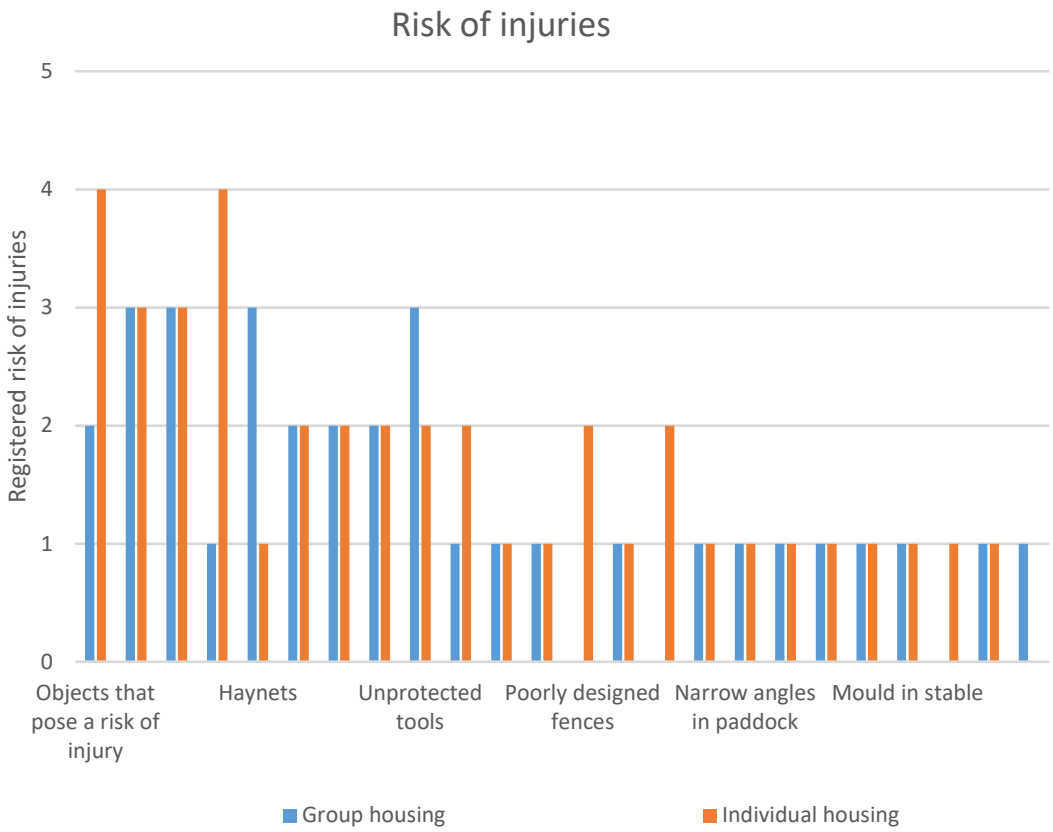

Figure 10. Number of risk of injuries and types of risk of injuries registered.

Registered risk of injuries and types of risk of injuries in the two groups of riding schools are shown in Figure10. In total, 71 risks of injuries were registered at the eight riding schools. In riding schools with individual housing and riding schools with group housing were 40 respectively 31 risks registered. The biggest differences in risk of injuries between the two types of riding schools are shown in Figure 11. The most frequently occurring risk of injuries in riding schools with individual housing were “Objects that pose a risk of injury” and “Poorly maintained fences”. Poorly maintained fences, the risk of a badly put up electric fence, with loose wires, tended to be higher in individual housing than in group housing (T=3.0, 0.1<P>0.05). The most frequent occurring risk factor in group housing were “Hay net” which was registered 3 times in group housing and 1 time in individual housing. “Slippery aisleways in stable” and “Poorly designed fences” were both registered 2 times in individual housing and none in group housing. “Not approved ceiling height” were registered 2 times in individual housing and 1 in group housing. “Mould in feed storage” were registered 2 times in individual housing and 1 time in group housing.

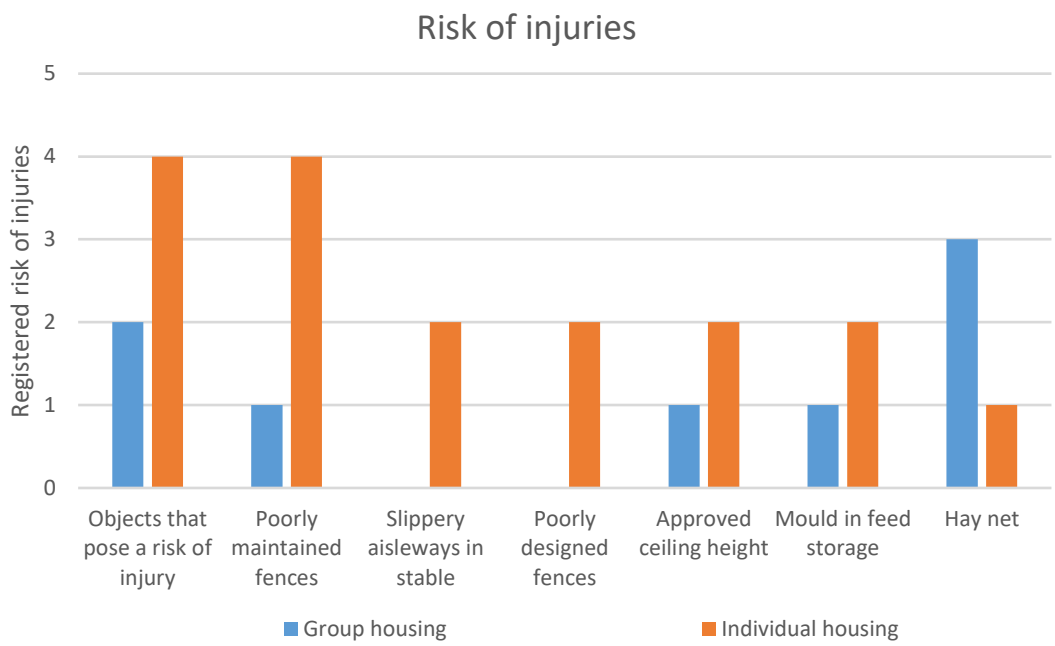

Figure 11. Number of risk of injuries and type of risk of injuries registered.

Discussion

Health data

The three most frequent occurring injuries in Swedish horses are lameness, colic and trauma wounds according to Agria (2015). In this thesis, the collected health data show that horses in riding schools with individual housing most common injuries were lameness, gastrointestinal injuries/disorders (i.e. colic), hoof injuries and wounds. Horses in riding schools with group housing most common injuries were lameness, wounds, bite & kick injuries and skin disorders. Collected health data seem to be consistent with the statistics of Agria (Agria, 2015). The health data showed that riding schools with individual housing had 28% more registered injuries than riding schools with group housing. The majority of registered injuries were not of a serious nature, but a part of the injuries was serious and required long periods of recovering and treatments. In further research it would be valuable to register the severity of the injuries and the number of recovery days.

Twelve occasions of gastrointestinal injuries/disorders occurred in riding schools with individual housing and two occasions in riding schools with group housing. The two cases of gastrointestinal injury/disorder registered at one riding school with group housing were according to the riding school manager, caused by bad hygienic straw. Why colic tends to occur more often in riding schools with individual housing is unknown. There are several reasons that can affect the occurrence of gastrointestinal injuries/disorders. More hours spent stabled (Hillyer *et al.,* 2002) and no access to water during turnout (Reeves *et al.,* 1996) are two factors that could be affecting the occurrence. I found that horses kept in riding schools with individual housing did not have access to water at all times compared to horses kept in riding schools with group housing which had water at all times, and this was also confirmed by Lindholm (2019). Horses without access to water during turnout are more than twice likely to get colic than horses with access to water during turnout (Reeves *et al.,* 1996). The absence of water can therefore be a contributing factor why colic tends to occur more often in riding schools with individual housing. Occasions of gastrointestinal injuries/disorders impact the welfare of the horse negatively because it implies suffering from pain and can be fatal therefore it is important to prevent.

Earlier research found that education and experience of riding school staff was a crucial factor for the health of the riding school horses (Magnusson, 1973; Egenvall *et al.,* 2009; Egenvall *et al.,* 2010; Lönnell *et al.,* 2012; Lönnell, 2012). In this thesis seven out of eight riding school managers had both years of experience and a riding instructor education. The riding instructor education was level 1, 2 and 3 and trainer level C. No conclusion could be drawn between the level of education and cases of injuries. It would be interesting to know which education or experience the staff working in the stable has and if that could influence the level of injuries.

Airway disease was only found in riding schools with individual housing. Differences in airborne endotoxin concentration may be reflected by the quality of hay, straw and ventilation (McGorum *et al.,* 1998). During visits it was noticed that two horses were coughing in individual housing which can be an indication that more horses may have a mild degree of inflammation that goes undetected since these two horses was not diagnosed or "sick" according to the staff. A relatively mild degree of inflammation in the airways can go undetected in pleasure horses but may be sufficient to impair a race horses' performance (Holcombe *et al.,* 2001). In group housed systems horses are outside most of the day which implies that they have an excellent ventilation compared to horses that are stabled and may have an under dimensioned ventilation.

The stability of the group, both in group housing and individual housing could affect the risk of injuries. Three out of four riding schools with group housing had a small welcoming paddock within the group housing for "pre-exposing" the horses to each other before entering the group which are recommended by Hartmann *et al.* (2011). Knübben *et al.* (2008a) found that bite and kick injuries were more often proceeded by changes in housing environment such as when a new horse enters the group. It can be hard to avoid taking in new horses in a riding school since the workload balance between horses must be maintained which means that sick horses must be replaced with new ones. One riding school with group housing had only been running for six months which may affect the slightly higher number of bite and kick injuries since the group were newly established.

Keeling *et al.* (2016) found that the breed of the horse affects the incidents of injury. Icelandic horses had fewer injuries following regrouping compared to warmblood horses. If certain breeds are more prone to get injured is not clear. Grogan & McDonnell (2005) discuss if the physical proportions of different breeds may be one factor that affects the risk of getting injuries. A Shetland pony that often have a higher Body Condition Score (BCS) allow them to cushion bites and kicks (Grogan & McDonnell, 2005). Horses of cob-types and ponies have a lower risk of getting bite or kick injuries (Owen *et al.,* 2012) and breeds like Thoroughbreds, Arabian horses and Warmbloods have 4.3 times higher risk of getting bite and kick injuries (Knübben *et al.,* 2008a). However, housing and rearing environment for young horses could also be factors that contribute to these differences between breeds. This still remains to be investigated.

In two of the riding schools with group housing, riding school 1 and 4, automatic individual feeding stations was used which may affect the level of bite & kick injuries and lameness cases (See Figure.3,5 and 6). One riding school had an automatic individual feeding station with concentrates and the other with forage. If there is limited access of food, competition is created among the horses which increases the level of aggressiveness in the group (Grogan *et al.,* 2005). This can be applied in both riding school systems since the riding school horses from individual housing turn out in groups. Zeitler-Feicht *et al.* (2010) found that automatic systems with individual feed stations, with either forage or concentrates, where only one horse at a time can eat seems to trigger more aggressions. By using automatic individual feed stations, you limit the access of food for the horses and by doing this the aggressiveness of the horse is increased. Particularly high-level aggressions may lead to injuries (Zeitler-Feicht *et al.,* 2010) which mean that use of an automatic individual feed stations could be a factor that increase the risk of bite and kick injuries in riding schools with group housing. Obvious aggression is most likely to be a consequence of inappropriate management (Fureix *et al.,* 2012) and if individual feeding stations could be an inappropriate management that may increase the level of injuries could be discussed further.

Automatic feed stations can be designed with sharp edges and protruding details which can pose a higher risk of injuries compared to low technical feed systems. Automatic feed stations should be tested and evaluated to make sure details and design that can pose a risk for the horses can be detected and eliminated before they come out on the market. One group housed riding school had an automatic system, manufactured by a well-established fabricate, with both group and individual feed stations that been running for six months. The managers found sharp edges in one of the feed stations which they suspected was the cause of two horses' severe head injuries. The incident indicates that there is a need for further evaluation before systems come out on the market.

Four out of eight riding schools kept a journal where they noted/saved receipt from veterinarian treatments. Several of the riding schools meant that they were not in a need of a journal to keep track of the health of the horses because of their low number of staffs. The unrecorded number of injuries in the riding schools are not known but since Owen *et al.* (2012) found that 67% of the injuries did not require veterinary treatment it can be assumed to be a large number. Because none of the riding schools noted injuries that did not require veterinary treatment and since it is easy to forget old injuries it is difficult to find the true number of injuries. Two of the riding schools did use a computer program where injuries that kept the horse "out of work" were registered which also could keep track of the individual economic result of each horse. If these types of computer programs become more common, it would be a great tool for registering injuries and keep track of the individual horse costs. From an economic point of view, riding school horses' days "out of work"/period of recovery is valuable information since these days implies costs and no incomes. The severity of an injury could possibly be measured in numbers of days recovering from the injury. Health data in these computer programs would be valuable for further research. The systematic preventative work at each individual riding school could be improved by registering injuries and using the information to analyze how risks can be prevented.

Clinical examination

The clinical examination of the horses showed that there were slightly more wounds in riding school horses in individual housing and twice as much skin disorders in riding school horses in group housing. The skin disorders were almost exclusively folliculitis and common in one riding school with group housing. Two riding school horses were lame in the locomotion test from the same riding school with group housing. The veterinarian assessed that both horses were lame with a level of one, which is the lowest level of lameness. The veterinarian general impression of the horses was that horses in individual housing had more accumulated subcutaneous adipose tissue and more injuries from aggressive behavior than the horses in group housing, however this was not verified by the actual figures. Since only fresh injuries were registered, old injuries like scars did not influence the data but may have affected the general impression of the horses.

Risk of injuries

The types of risk of injuries found in the two groups of riding schools seems to differ. The risk factor that were most registered in individual housing were "objects that pose a risk of horse getting stuck" and "poorly maintained fences". Poorly maintained fences, the risk of a badly put up electric fence, with loose wires, tended to be higher in individual housing than in group housing. In riding schools with group housing "hay nets" seems to be common. Hay nets are used as a feeding strategy to keep the forage from the ground and increase the feeding time. Even though horses can get stuck with their teeth and shoes in these hay nets it seems to be common to use them. Maybe staff at the riding schools did not know about the risks with hay nets. The staffs' experience of objects and furnishing that can pose a risk of injury may affect the types of risk of injuries and the numbers of risk of injuries. Most of the risks of injuries are easy to detect and eliminate if the staff have knowledge about them. The knowledge of risks of injuries are clearly lacking since several of these risks are easy to remove. The information of risk of injuries should be spread to riding schools to increase the knowledge of risks. One potential way of increasing knowledge is the Swedish Equestrian Federation, which could spread this knowledge to the riding schools that are connected to the federation.

Old stables often have insufficient ventilation because the building was not built for housing of horses. Even new stables that are built without calculating the ventilation needed can end up with insufficient ventilation. The insufficient ventilation makes a favorable environment for mould to grow which was found in riding schools.

Almost half of the riding school managers mentioned that their horses did have frost nails in their shoes because they did not want injuries due to slipping. They also mentioned that these frost nails caused many small wounds, which did not need any treatment, (not registered in the health data) when the horses kicked each other during the turn out or stepped on themselves. One riding school manager mentioned that she though these small wounds could be an underlying reason for several lameness occasions. It seems that frost nails are a risk factor for wounds but protect horses from injuries due to slipping. It would be interesting to study if the number of injuries would be lower or higher between horses with or without frost nails in similar turn out conditions.

Conclusion

- We cannot conclude if there are any differences in health data between riding schools with individual housing and group housing. As the number of riding schools was low more data is needed to be able to conclude if there are or are no differences. With this collected health data it tends to be more frequently occurring with gastrointestinal injuries/disorders (i.e. colic) in riding schools with individual housing.
- Surprisingly none of the riding schools kept any journal where they noted injuries or signs of forthcoming injuries, like abnormal behaviors, that were not treated/investigated by a veterinarian. Half of the riding schools kept journals/binders where they noted or saved receipt from veterinarian treatments.
- The clinical examinations showed no significant health differences between horses in riding schools with individual housing and group housing.
- The risk of injuries did not differ between riding schools with individual housing and group housing, but the risk of poorly maintained fences tends to be higher in riding schools with individual housing.

This research has given an overview of health data, and health status in riding school horses in individual and group housing. This overview highlights some problems and challenges that each housing system need to work on to lower the number of injuries. It also highlights the fact that risk of injuries is common in riding schools even though the stables are relatively newly built. The health of horses is an area that need more research in order to make conclusions about differences between riding schools with individual housing and group housing in Sweden. Since horses spend most of their time in housing systems further research are important in this area to improve the welfare of the horses.

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Appendix

Appendix 1.

Question	**Answer**
How many horses (>148 cm) do you have on the riding school?	
How many ponies (≤148 cm) do you have on the riding school?	
How many hours do the horses work per week?	
Do the horses have a period on pasture and rest in the summer?	
What education or/and experience do the riding school manager have?	
Do you keep journals of the horses?	
Do you record veterinary treatments?	
Do you record the horses' abnormal behaviors? Signs of injuries/diseases?	
Do you record injuries/diseases that does not require veterinarian treatment?	
Have you euthanized any horse?	
Occurrence of wounds caused by unknown reason?	
Occurrence of injuries caused by furnishing?	
Occurrence of bite and kick injuries?	
Occurrence of gastrointestinal injuries/disorders?	
Occurrence of airway diseases or problems with airways?	
Occurrence of lameness?	
Occurrence of hoof injuries?	
Occurrence of laminitis?	
Occurrence of Equine metabolic syndrome (EMS)?	
Occurrence of Equine Cushing's Disease or other hormonal disorder?	
Occurrence of skin problems?	

Picture 1. The photo shows the locomotion test.

Appendix 2.

Risk of injury	**Occurrence**
Ceiling height according to regulations?	0 = no 1 = yes
Recommended width of aisleways?	0 = no 1 = yes
Recommended width of gates?	0 = no 1 = yes
Slippery aisleways in stable?	0 = no 1 = yes
Weak bars in boxes/pens?	0 = no 1 = yes
Sharp / hard hooks?	0 = no 1 = yes
Weak walls (holes in walls) in boxes?	0 = no 1 = yes
Unprotected windows?	0 = no 1 = yes
Hay nets? [3]	0 = no 1 = yes
Water buckets / drinkers with sharp details?	0 = no 1 = yes
Concentrate troughs with sharp details?	0 = no 1 = yes
Rug racks placed inappropriately?	0 = no 1 = yes
No fire protection? No extinguishers?	0 = no 1 = yes
Unprotected electronics?	0 = no 1 = yes
Unprotected feeds?	0 = no 1 = yes
Plastic from bales in paddock?	0 = no 1 = yes
Objects that pose a risk of injury? [1]	0 = no 1 = yes
Tools, brooms, wheelbarrows unprotected?	0 = no 1 = yes
Poorly designed fences?	0 = no 1 = yes
Poorly maintained fences? [2]	0 = no 1 = yes
Slippery paddock surfaces or/and aisle leading to the paddock?	0 = no 1 = yes
Occurrence of mould in feed storage?	0 = no 1 = yes
Occurrence of mould in stable?	0 = no 1 = yes
Narrow angles in paddocks?	0 = no 1 = yes

Rugs during turn out?	0 = no 1 = yes
Halter during turn out?	0 = no 1 = yes

[1] See Picture 1.
[2] See Picture 2.
[3] See Picture 3.

Picture 1. The photo shows a chain lying on the floor which pose a risk of injury.

Picture 2. The photo shows a fence poorly maintained were the electric wires are widely apart.

Picture 3. The photo shows a hay net around a bale with holes in it.

Appendix 3.

Clinical examination	**Score**	**Scale**	**Other**
General impression under examination		-1= avoiding/aggressive 0 = neutral	Aggressive horses will not be examined
General condition		0 = normal 1 = affected	
Rug		No / yes	**If yes:** fitting, clean, whole? yes/no
Thermal comfort		-1= shivering 0= neutral 1= sweating	
Cough provocation		0=negative 1=positive	
Eyes		0= no fluid 1= some fluid 2=pus	Picture
Nasal discharge		0=cone 1= clear fluid 2= colored or thick fluid	Picture
Injuries from bit		0= none 1= shafing 2= wound	Picture
Bars		0 = normal 1= Old scar 2= wound	
Lymph nodes		0= no deviation 1= deviation	Comment
Cleanliness body		0 = clean 1 = contaminated with manure	Manure or mud
Cleanliness legs		0= clean 1=up to fetlock 2=up to cannon	Manure or mud
Temperature		0 = normal 1= deviation	
Pulse		0=28-40, 1= >40 (beats per minute)	Comment
Breathing		0= 8-16, 1= >16 (breath per minute)	Comment
Legs (below Carpus/tarsus)		0 = normal 1 = deviation	Picture and comment
Hoof quality [4]		0 = normal 1= abnormal shape, or severe cracks	Picture and comment
Shoes		0 = normal 1 = worn shoes	Picture
Faeces		0 = normal 1 = loose	Picture
Mane and tail condition		0 = normal 1 = sign of scratching	Picture

Coat condition		0 = normal 1= matte or partially/abnormal long	Picture
Skin condition		0 = normal 1= flaking, crusts etc.	Picture
Wounds (not scars)		0 = no wound 1 = fresh wound	Picture
Equipment chafing		0 = no chafing 1 = Hair loss, wound	Picture
Henneke BCS		1-9	Picture
Exterior anomaly		0 = normal 1= severe deviation	Picture
Locomotion test		0 = normal 1 = lame (scale 1-5)	Movie

[4] See picture 4.

Picture 4. The photo shows a hoof crack.