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Frequency and nature of health issues among horses housed in an active open barn compared to single boxes—A field study

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Abstract

Background: Keeping horses in open barns has positive effects on social interaction and free movement, which may improve horse welfare. However, many horse owners fear that housing in open barns leads to more injuries.

Objective: To compare health events among horses housed in an active open barn (AOB) or in single boxes (BOX).

Study design: A prospective study during 9 months and a 2-year retrospective study.

Methods: Two housing systems in one farm were investigated: AOB and BOX in pairs or alone in paddock (2–4 h/day) using 66 and 69 horses in the prospective respectively retrospective study. Lameness, wounds, colic and days lost from training were recorded.

Results: There were lower prevalences of lameness and colic in AOB than in BOX (18% vs. 26% and 0% vs. 5%; $p < 0.001$). Overall, there was a larger proportion of individuals with health events in AOB (83%) compared with BOX (52%) ($p < 0.01$). However, number of days lost to training did not differ between AOB (10 ± 15 days) and BOX (15 ± 34 days) ($p = 0.36$). There were no significant differences between the housing systems in number of health events/horse in the retrospective study: AOB 1.54 ± 1.51 versus BOX 1.14 ± 1.20 ($p = 0.22$).

Main limitations: The different, not standardised, housing systems varied in size and number of horses with no individual consideration in this descriptive field study with no possibility to cross-over. A convenience sample was used.

Conclusions: Lameness and colic were less frequent in the AOB system compared to single boxes, probably because the horses in the open barn could move freely day and night. Horses in AOB had a higher prevalence of wounds due to interactions between horses, but this did not lead to more days lost from training.

KEYWORDS

colic, group housing, health, horse, lameness, loose housing, welfare

1 | INTRODUCTION

Keeping horses in groups is becoming increasingly common, as it gives the horses more social contact[1] and possibilities for increased movement.[2] Yngvesson et al.[3] found that horses kept in open barns had fewer respiratory problems and colic than those housed in tie-stall or single boxes, likely due to more outdoor time, more movement and free access to water day and night. Horses showed increased locomotor activity in an open barn compared with single boxes.[4] Group housing also had a positive effect on learning in young horses during training.[5] However, some horse owners are concerned about the risk of injuries among horses when housed in larger groups.[6] Agonistic behaviour among domesticated horses can increase due to lack of space, restricted feeding and sub-optimal group composition,[7–9] while agonistic behaviour is generally rare in free-ranging horses.[10] Severe injuries among horses as a result from being kicked by other horses have been reported,[11,12] but incidents of severe injuries in established groups of horses seem to be rare, indicating that a stabilised group composition is important.[13]

Lameness not caused by trauma is a common diagnosis in equine veterinary practice.[14] Studies have identified risk factors for lameness as surface in training areas, training regime and age.[15–18] Moving freely stimulates the hoof mechanism and thereby blood circulation,[19] improving bone density.[20] Holding horses in an open barn may therefore reduce the risk of lameness.

Housing horses in open barns could improve their welfare in terms of social behaviour, moving freely and fewer colic, but can also impair welfare due to a higher risk of injuries from kicks and bites. For horses used in riding schools, number of days lost from training due to injury is also an economic issue. This study compared the prevalence of health events such as wounds, lameness and colic among horses housed in an open barn or in single boxes. Our research question was: Does housing horses in an active open barn system affect the frequency and categories of health events including wound, lameness and colic?

2 | MATERIALS AND METHODS

2.1 | Horses

The study was conducted at the Swedish National Equestrian Centre Strömsholm, Sweden. All horses in the study were Swedish Warmblood, and school horses used in an undergraduate programme in equine studies at the Swedish University of Agricultural Sciences. The older horses (6–20 years) were trained to compete either in dressage (advanced M-level) or showjumping (1.2–1.3 m), while the younger horses (3–5 years) were being trained in both dressage and showjumping. All horses were exercised 5–6 times a week. In the prospective study the horses' level of competition and discipline were 23 horses in dressage (advanced M-level), 26 in showjumping (1.2–1.3 m) and 13 young horses (novice and 1.0 m) and the median age of the horses was 7.5 years for AOB and 8.0 years for BOX ($p > 0.05$). In the retrospective study the horses' level of competition and discipline were 31 horses in dressage (advanced M-level), 21 in showjumping (1.2–1.3 m) and 13 young horses (novice and 1.0 m) and the median age of the horses was 9.5 years for AOB and 10.0 years for BOX ($p > 0.05$). No respiratory diseases were detected.

2.2 | Housing systems

Two housing systems were studied: active open barn (AOB) and outdoor single boxes (BOX). The horses were housed in either an AOB system designed for 24 horses or in outdoor single boxes (3 m × 3.5 m) and were distributed in the different systems according to Table 1. A smaller proportion of the BOX horses were kept individually in the paddock (BOX-ind) both in the prospective study and in the retrospective study 2014 respective 2015 but most of the BOX horses were kept in pairs in the paddock (BOX_pair) during all studies. An active open barn is an open barn with haylage and concentrate delivered individually to each horse by automatic computer-controlled feeding stations, as described by Kjellberg and Morgan.[21] The AOB (HIT Active Stable®) consisted of one paddock and four straw-bedded lying halls and three double forage stations with a total of six feeding stalls respectively one concentrate station. In addition, there were three automatic watering bowls. In the prospective study the paddock mean size ± standard deviation was 218 m^2 ± 11 m^2 per horse and the mean lying area ± standard deviation was 27 m^2 ± 1.3 m^2 per horse. In the retrospective study, the paddock mean size ± standard deviation was 176 m^2 ± 14.9 m^2 per horse and the mean lying area ± standard deviation was 22 m^2 ± 1.9 m^2 per horse. Only geldings were kept in the AOB, but both geldings and mares in the single boxes. Horses in single boxes were fed manually four times a day (at 6:30, 11:30, 16.00 and 20:00 h), with free access to water in the boxes, bedded with shavings, and spent 2–4 h in a paddock (approximately 225 m^2 per horse) without feed or water.

2.3 | Data collection

The data were collected from one farm in a field study design and comprised two parts: a prospective study from 15 September 2018 to 24 May 2019 (9 months) and a retrospective study using data from 2 years, 2014 and 2015. In the prospective study, data were collected

TABLE 1 Mean number and percentages of horses in the housing systems.

	AOB[a]	Box_pair[b]	Box_ind[c]
Prospective 2018–2019	16.5 (30%)	30.8 (55%)	8.3 (15%)
Retrospective 2015	20.5 (41%)	20.5 (41%)	9 (18%)
Retrospective 2014	20.5 (49%)	15 (36%)	6.5 (15%)

[a]Active open barn.
[b]Stabled in single boxes and paddock in pairs.
[c]Stabled in single boxes and alone in paddock.

from a total of 66 individual horses (49 geldings and 17 mares), and 20 of them (14 geldings and 6 mares), were also included in the retrospective study. An individual horse could be stabled either in AOB or a single box during different periods, or in only one of these housing systems throughout the study due to practical reasons decided by the stable manager. Seven horses were housed in both the AOB and in single boxes in the prospective study. The equine students responsible for the horses helped to collect the data. In the event of an injury or disease, the students used a form to report housing system, category of health event (Table 2), days lost from training (no. of days, <1 week, 1–3 weeks or >3 weeks) and where the injury arose (in paddock/AOB, in box, during riding, or not documented). A researcher followed up on the reports on the horses every week and categorised the injury or disease for all traumas or diseases that occurred during the study period. Infectious diseases, congenital effects and injuries related to shoeing were excluded, since they were not relevant for the research question. The injuries or diseases were categorised by type and also by whether the wounds were presumed to be caused in interactions by other horses or not (Table 2).

In the retrospective study, data from a total of 69 individual horses (52 geldings and 17 mares) were analysed. The horses were kept in the same housing system during the retrospective study with two exceptions (two geldings relocated from AOB to Box-ind) and were categorised according to information provided by the stable manager. The veterinary records for each horse were documented in a computerised veterinary record and horse data archive and in paper form in the school veterinarian's files. Some of the health events were not described in the database, which resulted in a blank regarding diagnosis or development. The categories of health events were defined by type in the veterinary records and the parameters documented were housing system and category of health event (Table 2).

TABLE 2 Schematic overview of categories of injuries or diseases and their definitions used in the study.

Category	Definition
Wound from interaction	Wound assessed as caused by another horse (i.e., a kick or a bite) due to location of the wound such as in front of the foreleg, outside of either fore- or hindleg, on the neck.
Wound from unclear cause	Wound assessed as may not be caused by another horse due to location of the wound such as inside of fore- or hindleg, heel, pastern, head or due to a fall or stumbling and therefore could be considered as self-inflicted.
Lameness	Lameness treated with intra-articular treatment or lameness in joints, muscles and tendons detected during riding or flexion test, excluding traumatic events. These were due to sprain, over-stretching, overtraining or sore back.
Colic	Gastro-intestinal tract problem needing veterinary care.

Note: A wound was specified as either penetrating the skin and, in some cases, needing stitching and/or bandages or was superficial with signs of swelling and/or lame and/or sore and/or blood. Only hair loss was not considered as a wound. Wounds and lameness not needing veterinary care and colic were not considered in the retrospective study.

2.4 | Data analyses

The data were entered in spreadsheets (MicroSoft™ Excel for Microsoft 365 Version 2309). The datasets from the retrospective (Data S2) and prospective study (Data S1) were analysed separately. The study was conducted as a descriptive field study using convenience sampling at an equestrian centre. A Chi^2 test was performed (in Excel) to determine whether the proportions of the following parameters differed significantly between the housing systems: category of health event, days lost from training and location where the injury or disease arose (only in prospective study). In the retrospective study, the data from 2 years (2014 and 2015) were analysed separately, so the period for 'number of health events per horse' was equivalent to that in the prospective study. Non-parametric statistics were used since the data were not normally distributed. A Mann–Whitney Rank Sum Test was performed on two treatments (AOB vs. BOX), while analysis of variance (ANOVA) on Ranks was performed on three treatments (AOB, Box_pair, Box_ind) to check for any significant differences. The ANOVA was followed up with a post-hoc test (Dunn's method) where appropriate. The ANOVA was performed in SigmaPlot 13 (SysStat Software, Inc., 2014), with the level of significance set to $p < 0.05$.

3 | RESULTS

3.1 | Prospective study

Overall, there were 87 recorded health events in the 66 horses over the 1-year study period. There was a significantly larger proportion of individuals with health events in AOB (83%) compared with BOX (52%) ($p < 0.05$). The distribution of categories of health events also differed significantly between the housing systems ($p < 0.001$) (Figure 1). The most common health event in AOB horses was wound from interaction (51%), followed by wound from unclear cause (31%)

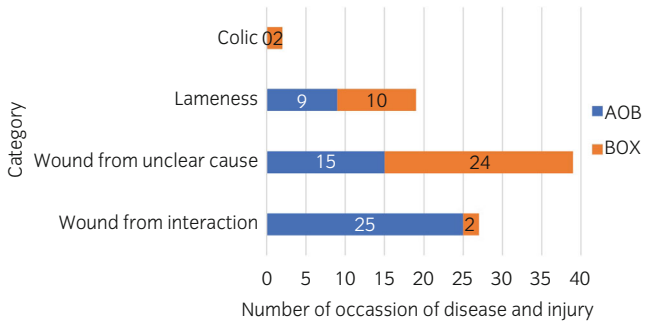

FIGURE 1 Numbers of events involving different categories of health event in horses in the active open barn (AOB) housing system and in individual boxes (BOX) in the prospective study.

and lameness (18%). The most common health event in BOX horses was wound from unclear cause (63%), followed by lameness (26%) and colic (5%). Notable findings were when comparing the proportion of lameness that lameness seemed to be less frequent among AOB horses (18%, 9 out of 49 horses) compared to horses stabled in BOX (26%, 10 out of 38 horses), and that only horses in BOX suffered from colic (5%, 2 out of 38 horses). The analysis also revealed that there were no significant differences in the frequency of health events between horses housed in single boxes whether they spent time in the paddock in pairs or alone.

The number of days lost from training did not differ significantly between the housing systems ($p > 0.05$) (Figure 2). The overall distribution of days lost to training was: 47% no days, 18% <1 week, 17% 1–3 weeks and 28% >3 weeks. The mean ± standard deviation number of days lost to training was 10 ± 15 for AOB and 15 ± 34 for BOX ($p > 0.05$). The location where health events arose differed significantly ($p < 0.001$) between AOB and BOX (AOB-area/paddock: 82% vs. 36%; during riding: 16% vs. 22%; not documented: 0% vs. 8%). A third of the health events (33%) among horses housed in single boxes occurred in the box.

Most of the horses had 0–3 health events during the study period, while three horses had 4–5 health events and one horse had 9. There were higher numbers of horses with health events in all housing systems at the beginning of autumn, but especially in AOB (Figure 3). The proportion of horses with a health event then showed a downward trend in all housing systems until regrouping in AOB in March (Week 12), when the proportion of horses with health events was similar in both housing systems. After regrouping, the proportion of horses with health events, mostly wounds, in AOB rose again to the peak seen in the previous autumn. The number of health event per horse differed significantly between the AOB and BOX housing systems ($p < 0.001$), with mean ± standard deviation (min-median-max) of 2.08 ± 2.02 (0-2-9) in AOB and 0.73 ± 0.99 (0-0-4) in BOX.

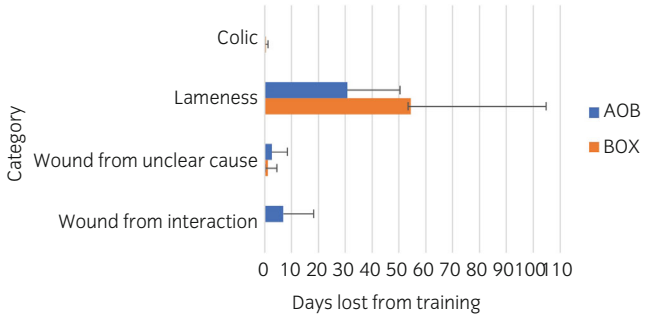

FIGURE 2 Number (mean and standard deviation) of days lost to training due to different categories of health event in horses in the active open barn (AOB) housing system and in individual boxes (BOX).

3.2 | Retrospective study

In the retrospective study, there were a total of 157 health events in the 69 horses over the 2-year-period (2014, $n = 76$ and 2015, $n = 81$). The results revealed no significant differences in the proportion of individuals with health events between AOB (71%) and BOX (73%), or in the categories of health event ($p > 0.05$) (Figure 4). The health events consisted of lameness in 81 cases (52%) ($n = 37$ in AOB, $n = 44$ in BOX), wound from unclear cause in 58 cases (29%) ($n = 34$ in AOB, $n = 24$ in BOX), and wound from interaction in 18 cases (11%) ($n = 12$ in AOB, $n = 6$ in BOX). There were no significant differences ($p > 0.05$) between the groups in number of health events per horse, with mean ± standard deviation (min-median-max) of 1.5 ± 1.6 (0-1.0-5) in AOB and 1.1 ± 1.2 (0-1-4) in BOX.

4 | DISCUSSION

4.1 | Distribution of health events

The prospective study revealed a significantly ($p < 0.05$) larger proportion of individuals with a health event in the AOB system (83%) compared with single boxes (52%). However, almost half (45%) of the health events recorded in the AOB system did not lead to days lost from training, suggesting that these were minor health events. The types of health events differed significantly ($p < 0.001$) between the housing systems in the prospective study, where the most common health event in AOB horses was wound from interaction (51%) and that in BOX horses was wound from unclear cause (53%).

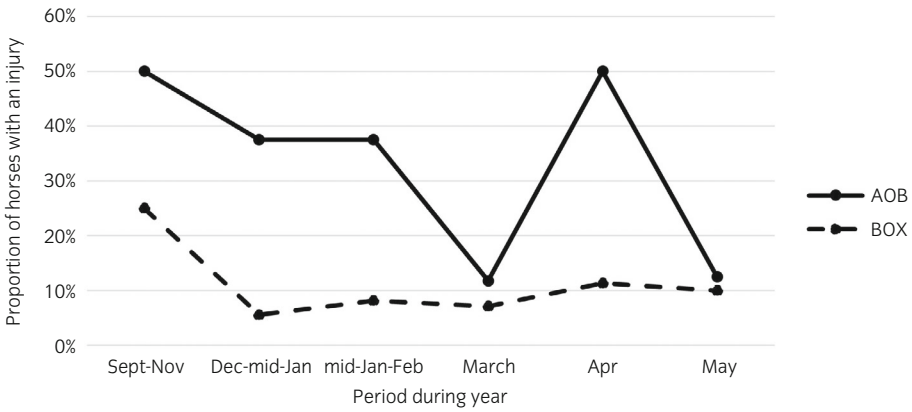

FIGURE 3 Proportion of horses with a health event, mostly wounds, in the active open barn (AOB) and individual box (BOX) housing systems during the prospective study. The AOB system showed a downward trend until regrouping in March.

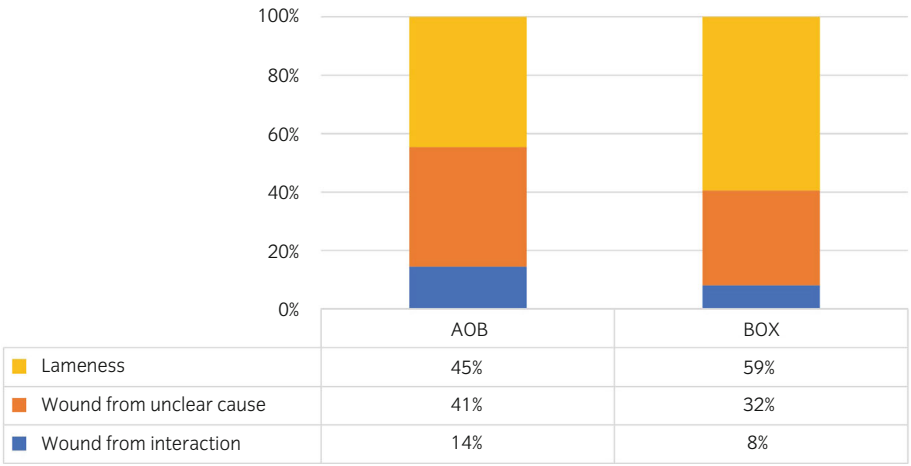

FIGURE 4 Proportions of different categories of health event to horses in the active open barn (AOB) and individual box (BOX) housing systems in the retrospective study (AOB vs. BOX: $p > 0.05$).

Moreover, the proportion of lameness was lower among horses in the AOB system (18%) than in horses in BOX (26%). Another interesting finding was that only horses in single boxes suffered from colic. The AOB horses lost fewer days from training (mean 10 days) than the BOX horses (mean 15 days), however, there were no differences in distribution of days lost to training between the housing systems in the prospective study. In both the prospective and retrospective study, there were similarities in the frequency or nature of health events between horses housed in single boxes and kept in pairs (Box_pair) or alone (Box_ind) in the paddock, indicating that keeping horses in stable pairs who know each other in the paddock does not increase the number of health events.

The differences seen in number of individuals with health events between the housing systems in the prospective study might be due to group composition,[22] regrouping,[8,12] restricted feeding[23,24] or space availability in the paddock.[9] In the prospective study, the AOB horses displayed no colic, while the prevalence of colic in BOX horses was 5%. This is consistent with findings by Yngvesson et al.[3] of lower frequency of colic among group-housed horses than among horses housed in tie-stall or single boxes.

4.2 | Free movement

Lameness resulted in significantly more days lost from training than the other categories of health events, which means it had a greater impact on both horse welfare and equestrian business finances. Lameness was numerically less frequent among horses stabled in AOB in both the prospective and retrospective study, possibly due to more opportunities for free movement in AOB compared with single boxes, as observed by Gulbrandsen and Herlin.[4] Other studies have observed benefits in terms of bone density from increased movement daily[20] and fewer motion asymmetries after a long period on pasture,[25] confirming the benefits of free movement.

Penell et al.[14] identified lameness not caused by trauma as the most common diagnosis in equine veterinary practice. Other studies have identified training surface, training regime and age as risk factors for lameness in sport horses.[15,17,18] In the present study, all horses included in both housing systems had access to the same training arenas, were ridden by students with the same level of skill and trained in dressage and/or showjumping by the same riding teachers. Therefore, the observed differences in categories of health events indicate that the AOB housing system might lead to lower frequency of colic and of lameness, probably due to greater possibilities for free moment. However, further research is needed to confirm that to be able to walk around 24 h per day is beneficial.

4.3 | Group composition and stability

In the retrospective study, there was a larger proportion of health events, mostly wounds, during 2014 than during 2015, possibly because two groups were brought together in the AOB when the system started in February 2014. According to the stable manager, regrouping and introduction of new horses during 2014 in the AOB resulted in that the group did not stabilise. Christensen et al.[8] found that regrouping can lead to more aggressive behaviour and that horses do not habituate to constant regrouping, while Knubben et al.[12] found that mixing and changing can increase the risk of kicks. An effect of regrouping was also seen in the prospective study, where the herd was uniform from September to mid-March. There was then a regrouping leading to a rapid increase in health events, mostly wounds (Figure 3). Hartmann et al.[26] concluded that the frequency of injuries increases when one or several new individuals enter a group, due to regrouping and interactions to establish rank order. This behaviour could be a reason to the rise of health events in this study when new horses entered the group during spring.

According to Hartman et al.,[26] the risk of injury decreases, if horses are placed in boxes next to each other to familiarise, before entering the paddock together. Horses entering the AOB during the housing period are released into a paddock next to the AOB, with opportunities for close contact, and released thereafter when many horse are away for riding. Grouping of the horses on pasture is used to decide how to pair the horses in the paddock housed in the single

boxes, which could be the reason for the relatively low frequency of health events needing veterinary care in that system. The horses in the present study were separated according to sex, but there are reported to be no differences in agonistic behaviour in herds with mixed sexes compared with same-sex herds[7] or in all-mare and all-gelding herds of Icelandic horses.[27] Nevertheless, housing only geldings in the AOB-system may have affected the results according to findings with higher agonistic levels in groups with only mares compared to geldings.[28] Even though personality may be more important than sex in horses, since Majecka and Klawe[22] observed differences in social interactions in different herds, indicating that the individual behaviour of each horse in each herd is important for the level of aggression. This could be one explanation why three horses had 4–5 health events and one horse had 9 health events in this study, while most horses had 0–3 health events during the study period.

4.4 | Feeding

Restricted feeding has been found to lead to more aggression in horses.[23,24] In the AOB, the horses are offered a restricted ration of haylage and concentrate in the automatic feeding stations and have free access to straw in the lying halls, but that might not be sufficient to lower the aggression level. Horses in single boxes are only offered feed in the boxes, which might reduce aggression levels in the paddock. When starting up the AOB, the areas around the feeding stations were paved and became somewhat slippery during use, possibly leading to health events. To minimise the risk, the stable manager gritted the paved surfaces. The health events observed might also be related to competition for feed, due to more agonistic behaviour.[23,24]

4.5 | Paddock size

The actual AOB in our study was designed according to the AOB manufacturer's recommendation of 150 m^2 per horse with a full number of horses ($n = 24$), which may have affected the rate of health events. Flauger and Krueger[9] found that an available area of 106 m^2 per horse or less increased the level of aggression in the herd and that the level did not plateau until the space allocation was 331 m^2 per horse or more. Majecka and Klawe[22] also found that increasing paddock area decreased aggressive behaviour. During the retrospective study, there was scanty documentation on whether the number of horses in the AOB was complete ($n = 24$) or not, which hampered evaluation of whether the number of health events was related to available paddock area. The available AOB paddock area was on average larger in the prospective study (218 m^2 per horse) than in the retrospective study (176 m^2 per horse). Despite the larger paddock area, the frequency of health events in AOB was slightly higher in the prospective study (median 2) than in the retrospective study (median 1.5). The explanation can be that the 'wounds without lameness' were reported in the prospective study and not documented in the veterinary records on which the retrospective study was based. Horses housed in single boxes and going out in pairs (Box_pair) had access to 225 m^2 per horse, which may have led to fewer in health events juries among those horses. However, this indicate that sufficient available area had to be combined with socially experienced individuals, as pointed out by Flauger and Krueger[9] and Majecka and Klawe.[22]

4.6 | Limitations

The study was conducted as a descriptive field study with no possibility for a cross-over design and therefore the individual horse could not be considered in the statistics. Also, we used convenience sampling and therefore the results may not be generalisable for another group of horses. Even though the housing system for each horse was not randomised, median age in years of the horses did not differ between the AOB and single boxes. The proportion of horses in Box_ind was similar (15–18%) in the two studies, but the proportion of horses in AOB was larger in the retrospective study (45%) than in the prospective study (30%).

In the retrospective study, only veterinary records were available for the horses, whereas in the prospective study all injuries were recorded whether or not they needed veterinary attention. This probably led to the higher number of health events recorded in the prospective study, as confirmed by the fact that almost half of these health events did not lead to days lost from training.

5 | CONCLUSIONS

Lameness seemed to be less frequent in the AOB system compared to single boxes. Horses in AOB system had a higher prevalence of wounds from interaction with other horses, but this did not lead to more days lost from training. Based on the results obtained in this study, we recommend horses to be group-housed when using correct management with limited regrouping of horses and sufficient available paddock area. Further studies over a longer period and in different AOB designs are needed to confirm this recommendation.

AUTHOR CONTRIBUTIONS

Linda Kjellberg: Conceptualization; data curation; investigation; methodology; validation; visualization; writing – original draft; writing – review and editing. **Kristina Dahlborn:** Conceptualization; methodology; supervision; validation; writing – review and editing. **Lars Roepstorff:** Conceptualization; methodology; supervision. **Karin Morgan:** Conceptualization; formal analysis; funding acquisition; methodology; project administration; resources; supervision; validation; visualization; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

No competing interests have been declared.

PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/evj.14054.

DATA AVAILABILITY STATEMENT

The data supporting these findings of this study are available in Supporting information: Data S1 and S2.

DATA INTEGRITY STATEMENT

Linda Kjellberg had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

ETHICAL ANIMAL RESEARCH

All experimental procedures involving animals were approved by the local ethics committee, according to Swedish legislation (SJVFS 2019:9), dnr C 80/15.

INFORMED CONSENT

Not applicable.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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