

TITLE: Assessing the impact of housing on the welfare of horses: A Scoping Review Protocol[#]

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[#]This protocol is based on PRIMA-ScR – Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (Tricco *et al.*, 2018)

ABSTRACT

Domestic horses are commonly housed in individual box stalls, often without access to paddocks or contact with other animals. This is very different from the natural environment of wild and feral horses that may roam many kilometres in a day and form complex social relationships with herd mates. A growing body of research has assessed the effects of housing on domestic horse welfare. Our aim is to review this literature, addressing four related research questions: 1) what types of variation between and within housing systems have been considered, and how might these types of variation limit comparisons between these systems, 2) what categories of horses have been studied and how the categories might limit the comparison between studies, 3) what outcome measures have been used to assess the impact of housing on the welfare, and 4) what conclusions do these studies draw about welfare in different housing conditions. We will critically discuss treatment conditions, categories studied, measures and conclusions, and identify knowledge gaps for future research. Our review will include all types of peer-reviewed articles, short reports and conference abstracts on electronic databases (Web of Science, CAB Direct, PubMed, Scopus).

INTRODUCTION

Housing systems are intended to keep animals safe, clean and comfortable, but inappropriate housing can result in abnormal behaviours, such as crib-biting, weaving and even unpredictable behaviours that can be dangerous for humans (Mills and Clarke, 2007; Lesimple *et al.*, 2011; Lesimple, Poissonnet and Hausberger, 2016). Free exercise, social interaction, and interaction with the environment are some of the important activities for the health and well-being of any social animal. Restricting these activities can impair various aspects of welfare (Cooper, McDonald and Mills, 2000; Rivera *et al.*, 2002; Popescu *et al.*, 2019)

Horses can be housed in a variety of systems, from shelters with access to pastures or dry lots, that provide protection from inclement weather and opportunities to social contact, to barns that house horses in groups in an open space or barns that allocate tie-stalls or several individual box stalls that allow some physical and visual contact, and to the isolated individual box stalls that limit both visual and physical contact (Mills and Clarke, 2007). Preferred systems vary regionally, as does provision of some period of exercise and social contact. In Europe, for example, approximately 75% of horses are kept around 18h/day in box stalls (Christensen *et al.*, 2002; Mills and Clarke, 2007; Visser, Ellis and Van Reenen, 2008; Popescu *et al.*, 2019). Considering that feral and wild horses range predominantly on grasslands, one might expect that keeping domestic horses in pastures would be the norm,

but this method is associated with concerns regarding aggressive social interactions and the risk of injuries (Benhajali *et al.*, 2008; Hartmann, Søndergaard and Keeling, 2012).

Research assessing the effects of housing conditions can be confounded by differences within systems, and also differences among horses including breeding condition (Popescu *et al.*, 2019), training condition (Rivera *et al.*, 2002), previous experience with the housing system and age (Visser, Ellis and Van Reenen, 2008). Moreover, the idea of modifying 'housing' typically conflates how the physical space limits social and non-social behaviours of horses (Hartmann, Søndergaard and Keeling, 2012; Ruet *et al.*, 2019).

Each of these studies uses different outcome measures to assess the impact of housing on the welfare, such as welfare scores (Popescu *et al.*, 2019), cortisol (Rivera *et al.*, 2002; Visser, Ellis and Van Reenen, 2008), and behaviour (Lesimple *et al.*, 2011) including stereotypies (Cooper, McDonald and Mills, 2000; Ruet *et al.*, 2019). Some studies have also considered covariates that may affect these outcome measures, including sex, age, housing (with windows, grills between boxes and bedding), feeding (number of meals/day), equitation (discipline and level) and physical activity (competition events, riding and automatic walker) (Ruet *et al.*, 2019).

Across studies there appear to be some evidence of the impact of housing conditions on horse welfare. For example, tie-stalls limit free movement and access to water, and are related to respiratory and locomotor disorders (Popescu *et al.*, 2019), box stalls affect horse reactivity, increasing the risk of unpredictable behaviours (Lesimple *et al.*, 2011), the prevalence of stereotypical and abnormal behaviours (Cooper, McDonald and Mills, 2000; Visser, Ellis and Van Reenen, 2008), and the expression of a persistent unresponsive states (Ruet *et al.*, 2019).

This scoping review will describe research on the effects of housing on the welfare of horses, considering the type of housing system, the category of horses, the outcome measures and conclusions. We will assess four related research questions: 1) what types of variation between and within housing systems have been considered, and how might these types of variation limit comparisons between these systems, 2) what categories of horses have been studied and how the categories might limit the comparison between studies, 3) what outcome measures have been used to assess the impact of housing on the welfare, and 4) what conclusions do these studies draw about welfare in different housing conditions. We expect that the results from our review will help researchers to identify knowledge gaps, design new studies and may inspire future reviews to answer more specific questions about housing and welfare of horses.

METHODS

Eligibility criteria: The Population-Concept-Context (PCC) tool was considered for this protocol: Population – Domestic horses of all ages and categories; Concept - Housing Systems for horses may affect different aspects of their welfare; and, Context – studies comparing different housing treatments and measuring responses that they use to draw welfare related inferences.

Sources of evidence: All types of peer-reviewed papers, short reports, conference abstracts about housing and keeping horses available on electronic databases (Web of Science, CAB Direct, PubMed and Scopus). Only literature in English will be considered. There will be no limit for time period, nor geographical limitation.

Search strategy: Search will be performed on Web of Science (Core Collection, MEDLINE, SciELO and Zoological Records), CAB direct, PubMed and Scopus (Elsevier) using the advanced search tool. The keywords were chosen based on papers about housing and welfare of horses. Search will be performed independently for population, concept and context retrieving the number of articles for each item using Boolean operators. Then a combined search will be performed retrieving the final search. All indexes and the maximum period allowed was used. Examples of search on Web of Science and CAB direct are displayed below (Tables 1-4).

Table 1. Advanced search history from Web of Science* (1900-2021) using keywords for concept (1), context (2), population (3), combined search (4) and results (number of articles retrieved).

| Set | Results | Search |
|-----|-----------|---|
| 1 | 2,208,497 | TS=(housing OR keeping OR pasture* OR paddock* OR stall* OR box* OR barn* OR stable*) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i> |
| 2 | 4,960,647 | TI=(welfare OR stress OR stereotyp* OR behav*) OR AB=(welfare OR stress OR stereotyp* OR behav*) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i> |
| 3 | 159,504 | TI=(horse* OR equine* OR foal* OR mare* OR stallion*) OR AB=(horse* OR equine* OR foal* OR mare* OR stallion*) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i> |
| 4 | 1,794 | #3 AND #2 AND #1 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i> |

* Web of Science Core Collection. TS=Topic (Web of Science Field Tag).

Table 2. First five results from the combined search (Table1) on Web of Science, sorted by relevance.

| Order | Result |
|-------|--|
| 1 | Welfare Quality of Breeding Horses Under Different Housing Conditions By: Popescu, Silvana; Lazar, Eva A.; Borda, Cristin; et al. ANIMALS Volume: 9 Issue: 3 Article Number: 81 Published: MAR 5 2019 |
| 2 | Animal welfare in equine keeping: Evaluation and implementability of animal welfare measures By: Drittler, Lara; Heise, H.; Theuvsen, L. ZUCHTUNGSKUNDE Volume: 89 Issue: 3 Pages: 219-230 Published: MAY-JUN 2017 |
| 3 | Important considerations regarding the guidelines, horse keeping with respect to animal welfare" and winter housing of horses. |

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| | By: Zeitler-Feicht, MH DEUTSCHE TIERARZTLICHE WOCHENSCHRIFT Volume: 111 Issue: 3 Pages: 120-123 Published: MAR 2004 |
| 4 | Influence of housing on weanling horse behavior and subsequent welfare By: Heleski, CR; Shelle, AC; Nielsen, BD; et al. APPLIED ANIMAL BEHAVIOUR SCIENCE Volume: 78 Issue: 2-4 Pages: 291-302 Article Number: PII S0168-1591(02)00108-9 Published: SEP 10 2002 |
| 5 | Housing Horses in Individual Boxes Is a Challenge with Regard to Welfare By: Ruet, Alice; Lemarchand, Julie; Parias, Celine; et al. ANIMALS Volume: 9 Issue: 9 Article Number: 621 Published: SEP 2019 |

Table 3. Advanced search history from CAB direct (1920-2021) using keywords for concept (1), context (2), population (3), combined search (4) and results (number of articles retrieved).

| Order | Results | Search |
|-------|-----------|--|
| 1 | 1,345,669 | (housing OR keeping OR pasture* OR paddock* OR stall* OR box* OR barn* OR stable*) Refinements: |
| 2 | 922,499 | title:(welfare OR stress OR stereotyp* OR behav*) OR ab:(welfare OR stress OR stereotyp* OR behav*) Refinements: |
| 3 | 179,581 | title:(horse* OR equine* OR foal* OR mare* OR stallion*) OR ab:(horse* OR equine* OR foal* OR mare* OR stallion*) Refinements: |
| 4 | 2,854 | title:(horse* OR equine* OR foal* OR mare* OR stallion*) OR ab:(horse* OR equine* OR foal* OR mare* OR stallion*) AND title:(welfare OR stress OR stereotyp* OR behav*) OR ab:(welfare OR stress OR stereotyp* OR behav*) AND (housing OR keeping OR pasture* OR paddock* OR stall* OR box* OR barn* OR stable*) Refinements: |

Table 4. First five results from the combined search (Table3) on CAB direct, sorted by relevance.

| Order | Result |
|-------|--|
| 1 | Factors influencing the development of stereotypic and redirected behaviours in young horses: findings of a four-year prospective epidemiological study. Stereotypies are invariant and repetitive behaviour patterns that seemingly have no function, which tend to develop in captive animals faced with insoluble problems and may be indicative of reduced welfare. A 4-year prospective study of the factors influencing the development of stereotypic and... Author(s) : Waters, A. J.; Nicol, C. J.; French, N. P. Publisher : Equine Veterinary Journal Ltd, Newmarket, UK Journal article : Equine Veterinary Journal 2002 Vol.34 No.6 pp.572-579 ref.27 |
| 2 | An analysis of horse stereotypies during social isolation. It was assumed that social isolation intensifies the manifestation of stereotypies in horses. The aim of the study was to compare the frequency and duration of some stereotypies in socially isolated and nonisolated horses. Seven saddle horses participated in the test. During the experiment a horse... Foreign Title :Analiza stereotypii koni podczas izolacji socjalnej. Author(s) : Tkaczyk, E.; Kaczmarek, B.; Mierzicka, M.; Fraczak, M.; Dybczynska, M. |

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- Publisher : Instytut Zootechniki, Kraków, Poland
Journal article : Roczniki Naukowe Zootechniki 2020 Vol.47 No.2 pp.257-265 ref.15
- 3 Stereotypes among domestic horses: the unexpected correlation with breeding, cognitive abilities and working conditions.
Stereotypic behaviors are an intriguing part of the behavioural repertoire of captive/domestic animals and their relation with welfare issues is still highly debated. Although this phenomenon has received particular attention in domestic horses, many aspects are still under question in this...
Foreign Title :Stéréotypies chez les chevaux domestiques: des corrélats inattendus avec la reproduction, les capacités cognitives et les conditions de travail.
Author(s) : Benhajali, H.; Richard-Yris, M. A.; Ezzaouia, M.; Charfi, F.; Gautier, E.; Hausberger, M.
Publisher : Les Haras Nationaux, Le Pin au Haras, France
Conference paper : 36e Journée de la recherche équine, Le Pin au Haras, France, jeudi 4 mars 2010 2010 pp.133-139 ref.15
- 4 Equine stereotypic behaviors: causation, occurrence, and prevention.
There are strong suggestions that equine stereotypies are connected to poor welfare and a suboptimal management and/or stabling environment. Different forms of equine stereotypic behaviors have been described. Crib biting, weaving, and box walking are considered the most prevalent. Several studies...
Author(s) : Sarrafchi, A.; Blokhuis, H. J.
Publisher : Elsevier, New York, USA
Journal article : Journal of Veterinary Behavior: Clinical Applications and Research 2013 Vol.8 No.5 pp.386-394 ref.many
- 5 Free movement: a key for welfare improvement in sport horses?
Horses, and in particular sport horses, remain housed predominantly in single stalls. One of the main reported reasons is the fear that they will become agitated and injure themselves and thereby impair their performance if released in paddocks. The hour spent daily at work is also assumed to be...
Author(s) : Lesimple, C.; Reverchon-Billot, L.; Galloux, P.; Stomp, M.; Boichot, L.; Coste, C.; Henry, S.; Hausberger, M.
Publisher : Elsevier, Amsterdam, Netherlands
Journal article : Applied Animal Behaviour Science 2020 Vol.225
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RESULTS

Selection and characteristics of sources of evidence:

Screening process will happen in two stages: 'Titles and Abstracts' and 'Full Texts'.

1. Screening for titles and abstracts will be made and assessed for eligibility by two reviewers using Covidence® platform. Before independent screening, pilot tests will be made to ensure consistency between reviewers with 20 articles and discussion meetings. When both reviewers agree with the results from the pilot tests, titles and abstracts will be assessed independently, using the following questions:

- a) "Is the title and abstract available in English?"
- b) "Does the title or abstract describe housing conditions for horses?"
- c) "Does the title or abstract describe welfare outcomes for horses?"

Possible answers for these questions are Yes, No and Uncertain. A reference will be excluded when both reviewers answer “No” to any of the above questions. Conflicts will be discussed and in case of no-agreement, a third reviewer may be consulted.

2. Screening for full text will be made by assessing for eligibility by two reviewers independently using Covidence® platform. Eligible references from the title/abstract screening will be retrieved in the platform. Before independent screening, pilot tests will be performed to ensure consistency between reviewers with 10 full-text articles and discussion meetings. When reviewers agree with the results from the pilot tests, full texts will be assessed independently using the following questions:

- a) “Is the article available in English?”
- b) “Does the study draw inferences about the welfare of horses related to housing conditions?”

Procedures for exclusion or inclusion will be the same as the ‘Title and Abstract’ screening.

Data charting process: data will be organized in spreadsheets by author, title, year, type of publication and information about housing and outcome measures.

Data items:

- a) General information about the study: year, location, type (review, short communication);
- b) Objectives/hypothesis;
- c) Population: number of animals, age, category;
- d) Housing system: boxes, stalls, paddocks; etc
- e) Outcomes measures;
- f) Conclusions.

Critical appraisal of individual sources of evidence: the quality of evidence will be performed by two reviewers independently using the tools: Critical Appraisal Skills Program (CASP) and Scottish Intercollegiate Guidelines Network (SIGN).

Results of individual sources of evidence will be charted with relevant data that related to the question and objectives.

Synthesis of results: Descriptive analysis of the published data focusing on housing conditions and welfare of horses will be plotted in tables and charts with information about the approach of research, objectives, sample size, location, animal category, results and outcome measures. Charts will be used to summarize the results of the scoping review.

DISCUSSION

Discussion will be focused on the four research questions about treatment conditions, categories studied, outcome measures and conclusions, bringing recommendations for researchers about possible new studies.

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