



## BIBLIOMETRIC ANALYSIS OF SCIENTIFIC STUDIES ON HORSE WELFARE FROM PAST TO PRESENT

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**Abstract:** Animal welfare studies continue to gain importance over the years. Since horses are bred and cared for many different purposes, welfare studies on horses have a wide scope. Detailed information about the research topic can be obtained by determining many changes such as the fields, researchers and countries in the published studies over the years through bibliometric analysis. For the bibliometric analysis of horse welfare studies, the Web of Science database was scanned and a total of 1983 documents were found between 1983 and 2023. The most studies in this field were found in Animals, Applied Animal Welfare Science and Equine Veterinary Journal. Mc Greevy P.D. was determined as the author with the most articles in this field. The highest number of corresponding authors of articles in horse welfare were from the United Kingdom. By the bibliometric analysis, the change in years of the trend research fields of horse welfare, based on keywords made the changes particularly easy to understand. The results of the present study could easily be used in planning further studies in horse welfare, which could save time and costs.

**Keywords:** Bibliometrics, Horse, Welfare, Articles, Authors

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### 1. Introduction

Animal welfare studies could be categorized as a young research field. Animal welfare science is of veterinary origin and has taken a multidisciplinary form covering many fields over time and is now represented in veterinary faculties and animal science departments all over the world (Webster, 2016). The interest in this field has increased with the spread of the emotional approach of the society, political concerns and ethical principles. "Brambell's Five Freedoms" principles, most known and accepted welfare guidelines have been an advisor for those who were in close contact with animals and even for legal regulations (Lesimple, 2020). However, it was criticized that these principles were actually created by centered on environmental factors and that the welfare of the animal in question was not individually considered (Lesimple, 2020). Furthermore, its lack of integrating the concept of positive welfare and need for more appropriate scientific approaches was emphasized (Webster, 2016). Especially the exposure of horses to very different environments, breeding, work, sports, individual hobby and pet care, and the existence of various factors affecting welfare constitute a serious research area. Since there are many factors affecting well-being, it is difficult to evaluate, so studies in scientific fields such as behavior, immunology, physiology, endocrinology, pathology and neurosciences continue and are used (Marchant-Forde, 2015). It is generally accepted by many authors that welfare refers

to the permanent state of the animal concerned over time and depends on the animals' subjective perception of the environment (Lesimple, 2020). Some of the studies carried out in different fields are accepted as an indicator of welfare, like behavioral indicators, considered to be early indicators of improper conditions (Keeling and Jensen, 2009). Behavioral indicators include stereotypic behaviors and are reported to be a disease of domestication in horses (Marsden, 2002). Stereotypic behaviors like box walking (Normando et al., 2011; McGreevy, 2012; Devereux, 2019), wood chewing (Albright et al., 2009; Normando et al., 2011), crib biting (Wickens and Heleski, 2010; Nagy et al., 2010), weaving (Cooper et al., 2000; Clegg et al., 2008) and wind sucking (Normando et al. 2011; Escalona et al., 2014). Especially horses have a close relation and a constant exposure to humans in contrast to farm animals. The interaction with humans and their behavior towards humans are reported as welfare indicators (Rivera et al., 2002; Burghardt et al., 2012; Lesimple, 2020). There are many horse behavioral aspects, which were studied in relation to welfare like aggressiveness (Bourjade et al., 2009; Fureix et al., 2010; Pierard et al., 2019), playing habits (Hausberger et al., 2012; Van Dierendock and Spruijt, 2012) and yawning (Górecka-Bruzda et al., 2016; Lesimple, 2020). The search for quantitative measurements such as analysis performed for health screening like hematology, serum biochemistry, endocrinology and different substances indicating the welfare status of a horse are still ongoing



(Massányi et al., 2022; Scholler et al., 2023). However, it has been reported that associating the measurement results made in this way directly with the welfare of the horse may lead to false results and it is necessary to carefully evaluate whether an abnormal result is due to an acute or chronic condition (Lesimple 2020). Otherwise, there are studies that correlate welfare with the evaluation of the environmental conditions of the horses, such as housing and management (Ruet et al., 2019; Rosselot et al., 2019; Kelemen et al., 2021; Mazzola et al., 2021; Mactaggart et al., 2021; Gehlen et al., 2021; de Oliveira and Aurich, 2021; Baumgartner et al., 2023). Bibliometry also known as bibliometrics is a quantitative method to analyze and measure different features in scientific literature and papers. Bibliometric studies give the chance for researchers how the interested field took shape in a specific time span. Data of which countries, authors and journals were most productive and the most used keywords with time information were shown. All these information could be used for planning a research in the interested field.

Due to the complex fields of study of equine welfare, the aim of this study was to evaluate the development and approaches of this field over time with the use of bibliometric analyzes.

## 2. Material and Methods

### 2.1. Data Collection

The present study included 1983 documents, which were obtained from the Web of Science (WoS) database from the years 1985 to May 2023. To ensure publications about horse welfare, keywords and journals were picked up carefully.

### 2.2. Bibliometric Analysis

This analysis is a sociometric and network analysis method that reveals the social network of scientific studies in a special field with the help of computer technology, thus enabling the determination of the effectiveness of scientific studies (Han et al., 2020; Önder and Tirink, 2022). The analyses provides information in which journals the most articles in the research field were published, which authors studied intensively on this subject, the institutions of the authors and co-authors', also on a country basis. The usage density and distribution over time of the keywords used within the date range included for the bibliometric analysis are shown. It contributes to determining the impact of specific studies on the field by ranking the most cited articles. Therefore, all these results can directly affect many aspects such as trends, policies, areas of collaboration and financial support for current and future research in a field of scientific research (Ergin et al., 2023).

### 2.3. Data Analysis

After the data was obtained from the WoS database, it was made ready for data analysis with the help of the "convert2pdf" package of the R software (R Core Team, 2019). Data obtained from horse welfare studies and

made ready for establishment were analyzed statistically using the "bibliometrics" package and "bibloshiny" application in R software (Aria and Cuccurullo, 2017; Kaplan and Altay, 2023).

## 3. Results and Discussion

The results of the main information about collected data had shown that the greater part was compromised of 1593 articles in this field, including 110 proceedings paper, 14 early accesses, and 13 book chapters and followed by 186 reviews, as seen in Table 1. Since 1985 a peak of articles reported in the year 1996, with 70 articles, pointed out, whereas in year 1997 this number dropped to 4 articles (Figure 1). Generally, a trend to increase was seen till 2022, suggesting the interest and importance of welfare in horses. Since 2016, 100 and above articles were observed with the highest number of 200 in 2022, based on the WoS database (Figure 1).

**Table 1.** Main information of primary data

Document types	Number
Article	1593
Article; Book chapter	13
Article; Early access	14
Article; Proceeding paper	110
Correction	2
Editorial material	33
Letter	6
Note	195
Proceeding paper	24
Review	186
Review; Early access	1

Documents resources were established as 193 and the most relevant source was the journal *Animals* with 305 articles, followed by the journals *Applied Animal Behavior Science*, *Equine Veterinary Journal*, *Journal of Veterinary Behavior- Clinical Applications and Research*, *Pferdeheilkunde* and *Journal of Veterinary Equine Science* with 185, 143, 121, 121 and 112 articles, respectively (Figure 2). A bibliometric study on animal welfare, where documents were scanned in the WoS database between 1968 and 2017, and the most relevant journal was *Animal Welfare and Applied Behavior Science* (Freire and Nicol, 2019). Besides the semimonthly publications of the journal *Animals*, special issues about Welfare including horses were available, which could be related to the high number of articles resulted as the most relevant source. Whereas the most local cited journal, which means only in the field horse welfare, was the *Journal of Applied Animal Behavior Science* (*Appl. Anim. Behav. Sci.*) with a total of 6584 citations and *Equine Veterinary Journal* was resulted as the second one with 5291 citations, shown in Figure 3.

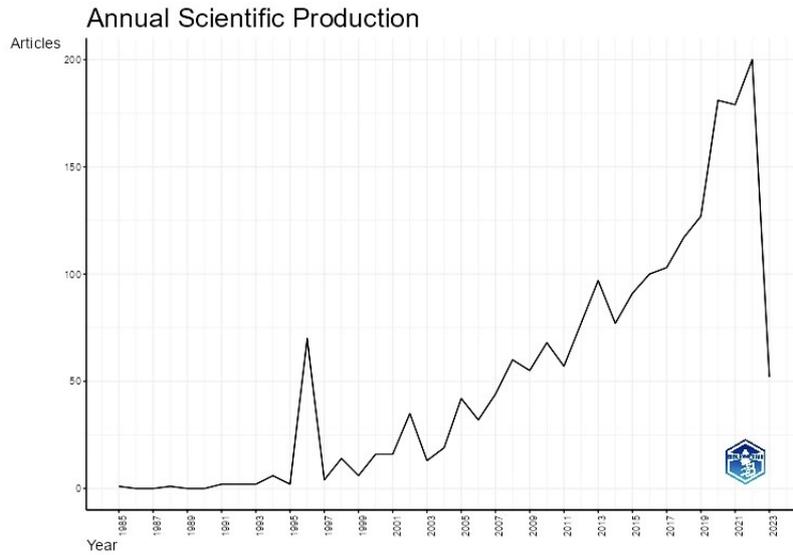


Figure 1. Annual scientific production in horse welfare articles.

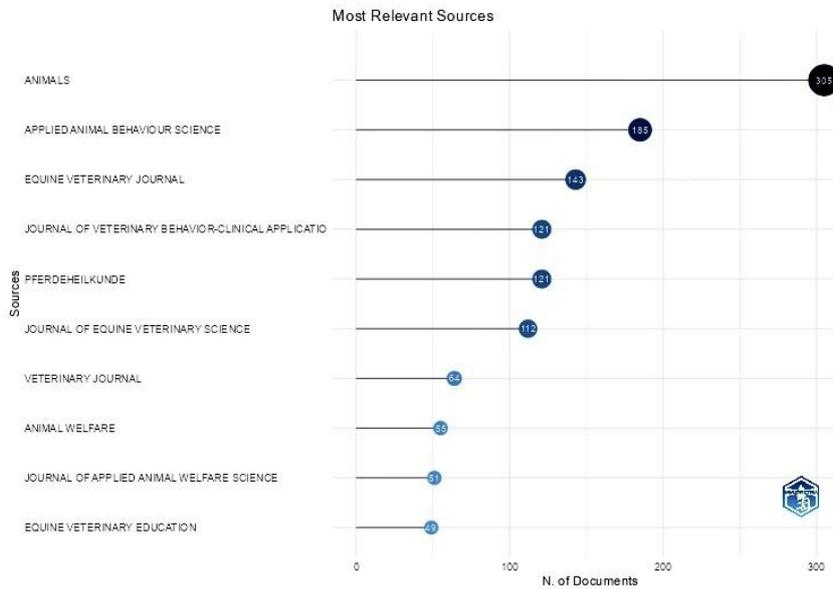


Figure 2. Most relevant sources of articles about horse welfare between the years 1998-2023.

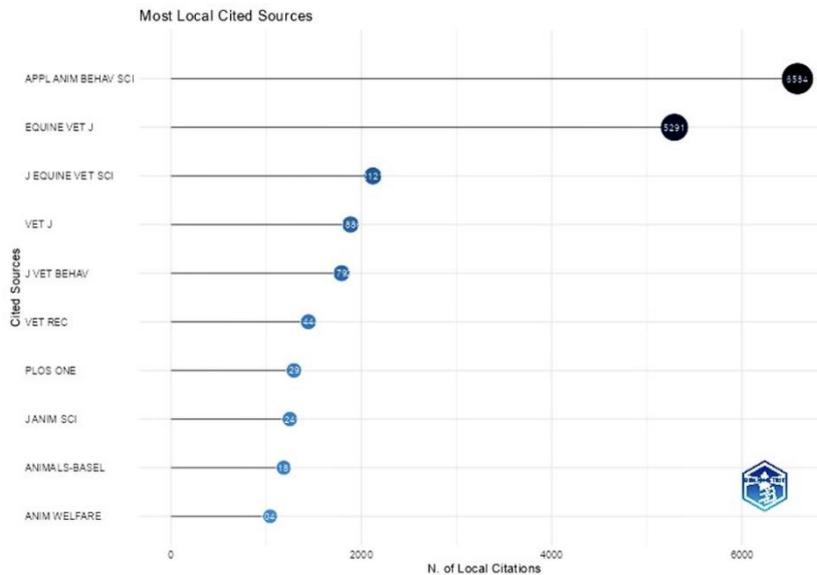


Figure 3. Most cited sources between the years 1998 – 2023.

The most productive authors are rowed in Figure 4. As seen Mc Greevy P.D. and Mc Greevy P. were sorted separately, but as a result of the database review and the examination of the articles, it was revealed that the first two authors were actually the same person. Thus, the author's 73 articles on horse welfare were identified. Padalino B. and Minero M. followed with 34 and 29 articles, respectively, in the field horse welfare.

Documents, which were most cited were represented in Figure 5. The article "Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals -- a review" by Von Borell E., Langbein J., Despres G., Hansen S., Leterrier C.,

Marchant J., Marchant-Forde R., Minero M., Mohr E., Prunier A., Valance D. and Veissier I., in the journal Physiology and Behavior in 2007, was the most global cited with a total citation of 602, which means the documents cited these review were not only from horse behavior studies. In contrast the most local cited article, only in the topic horse welfare, was "Assessment of the welfare of working horses, mules and donkeys, using health and behavior parameters." by Pritchard J.C, Lindberg A.C., Main D.C.J. and Whay H.R. published in Preventive Veterinary Medicine in 2005, as seen in Figure 6.

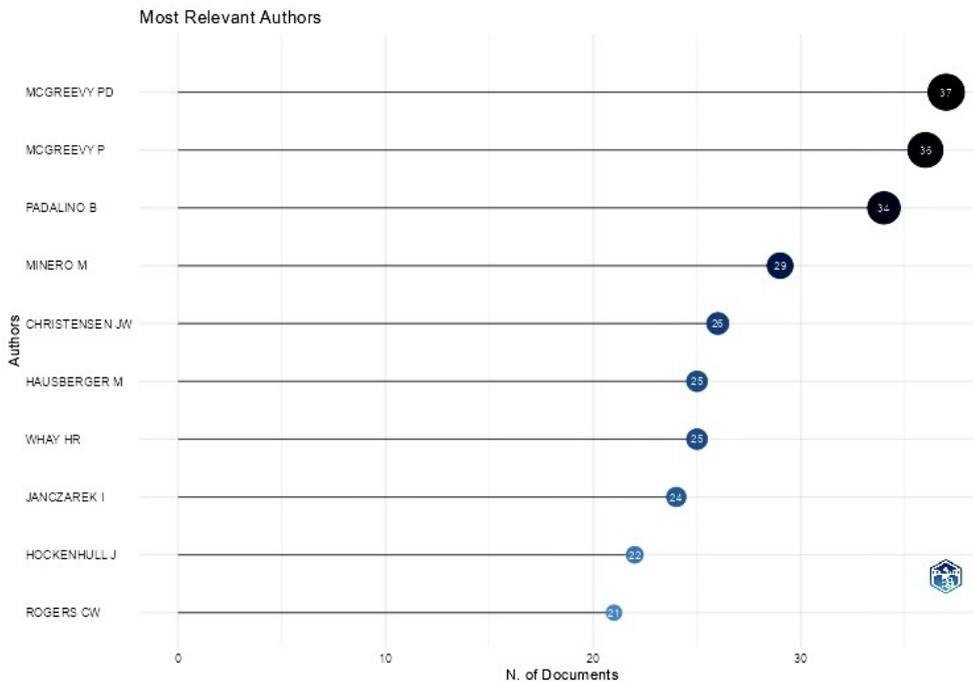


Figure 4. Most relevant authors on horse welfare between the years 1998 – 2023.

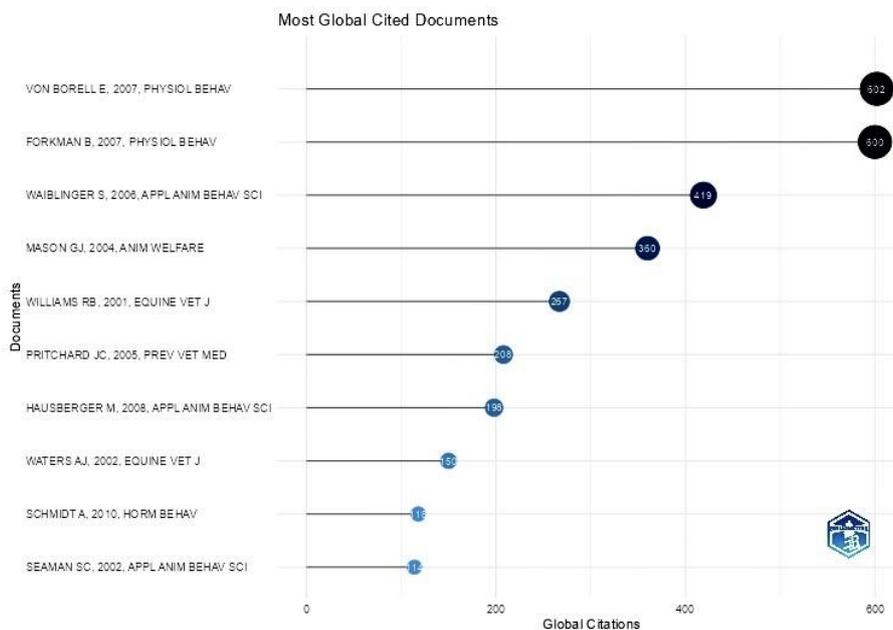


Figure 5. Most global cited documents.

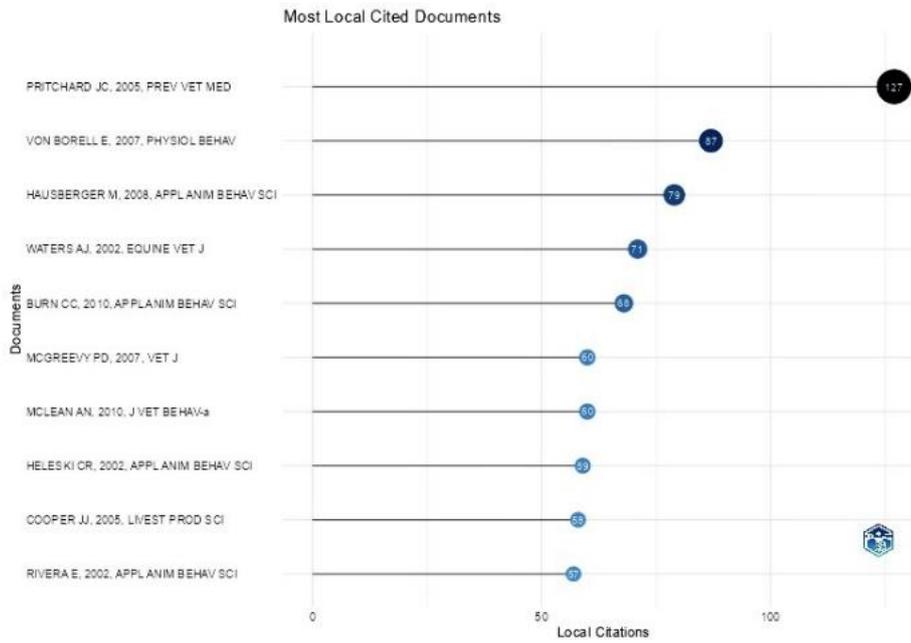


Figure 6. Most local cited documents.

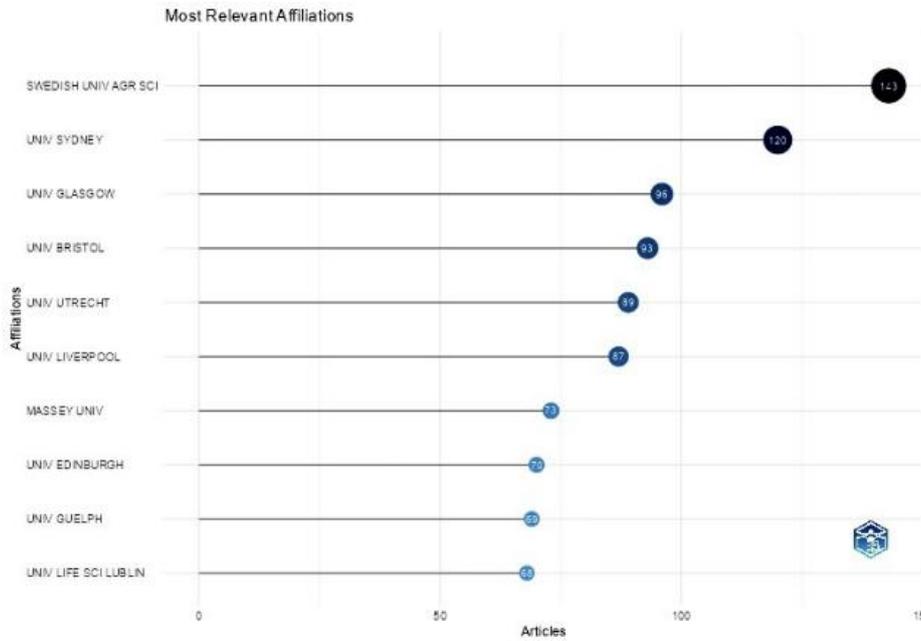


Figure 7. Most relevant affiliations.

The most relevant affiliations on articles themed horse welfare were the Swedish University of Agricultural Science with 143 articles and followed by the University of Sydney with 120 articles, as seen in Figure 7. The 3rd university in the ranking is the University of Glasgow and the number of published articles was determined as 96. Observations on corresponding author’s countries had shown 359 single country publications (SCP) and 85 multiple country publications (MCP) from the United Kingdom, with the highest publications. In Table 2 the first ten countries with SCP above 10 articles were demonstrated. It was reported that the highest total paper amount published in Applied Animal Behavior Science were from the USA, England and Australia with

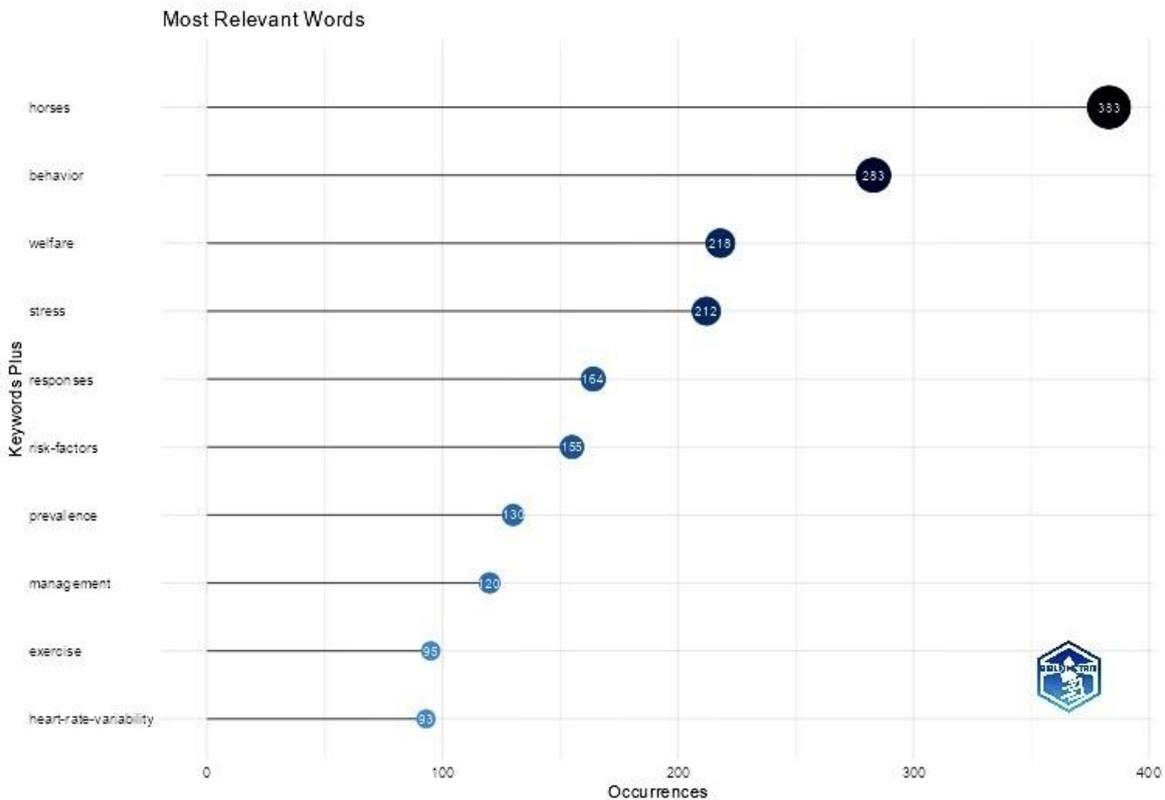
149, 45 and 26 publications, respectively, in a ten year range (2009-2019) (Rousseau and Binfet, 2022). Same countries were the first three ones in the corresponding authors’ countries ranking in the field horse welfare in the present study.

**Table 2.** Corresponding author's countries

Country	Articles	Single Country Publications (SCP)	Multiple Country Publications (MCP)	Frequency	MCP Ratio
United Kingdom	444	359	85	0.22390	0.1914
USA	198	157	41	0.09985	0.2071
Australia	181	119	62	0.09128	0.3425
Italy	133	88	45	0.06707	0.3384
Germany	131	107	24	0.06606	0.1832
Poland	89	73	16	0.04488	0.1798
Sweden	76	44	32	0.03833	0.4211
Netherlands	72	44	28	0.036309	0.3889
Canada	68	44	24	0.03429	0.3529
France	56	41	15	0.02824	0.2679

In the field horse welfare, the ten first most relevant words and their occurrences were as follows; horses 383, behavior 283, welfare 218, stress 212, responses 164, risk-factors 155, prevalence 130, management 120, exercise 95 and heart rate variability 93, which is shown in Figure 8. Beside the mentioned first ten most relevant words, which stand out in the word cloud (Figure 9), the words animal-welfare, physiological responses, donkey, pain and young horses draw attention in the cloud. The mostly used keywords and their distribution over the years is represented in Figure 10. The keyword horses was mentioned 383 times in articles between 2011 and 2021, whereas in 2017 and the following years the occurrence was higher than before 2017. The word behavior and welfare ranked as second and third most used words were shown between 2013-2020 and were mostly seen in 2017 and the years after. The

physiological response term, which stands out in the word cloud but was not in the top ten, appeared 62 times between 2012 and 2019, and was mostly used in 2015 and later. None of the words and terms mentioned in the top ten and stood out in the word cloud were a trend in the last two years. Topics like descriptive epidemiology, riders, communication and therapy, used in different timespans but were mostly seen in 2020 and after were in a trend in the last years. The collaboration world map in Figure 11, had shown that a network between Europe, United Kingdom, USA and Sydney are distinctive. A collaboration frequency of 50 from the United Kingdom to Australia, is the highest one, followed by the collaboration from United Kingdom to USA. Apart from this, working partnerships between the USA and Australia, Sweden and Denmark, and the Netherlands and Belgium are notable.



**Figure 8.** Most relevant words.



Figure 9. Word cloud in the field horse welfare.

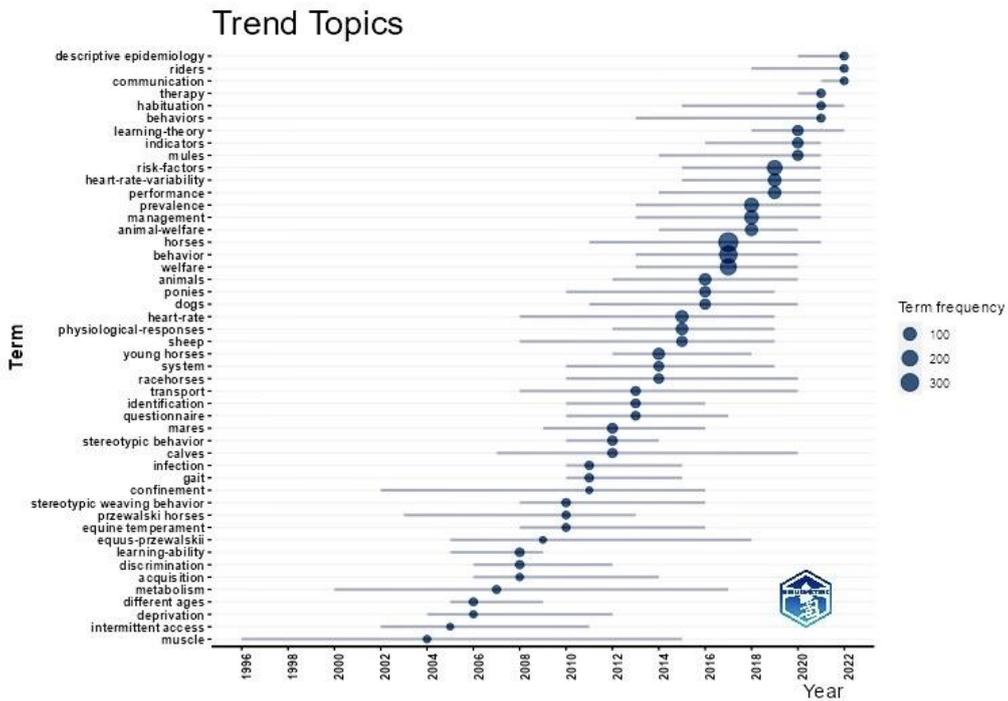


Figure 10. Mostly used keywords and their timespan.

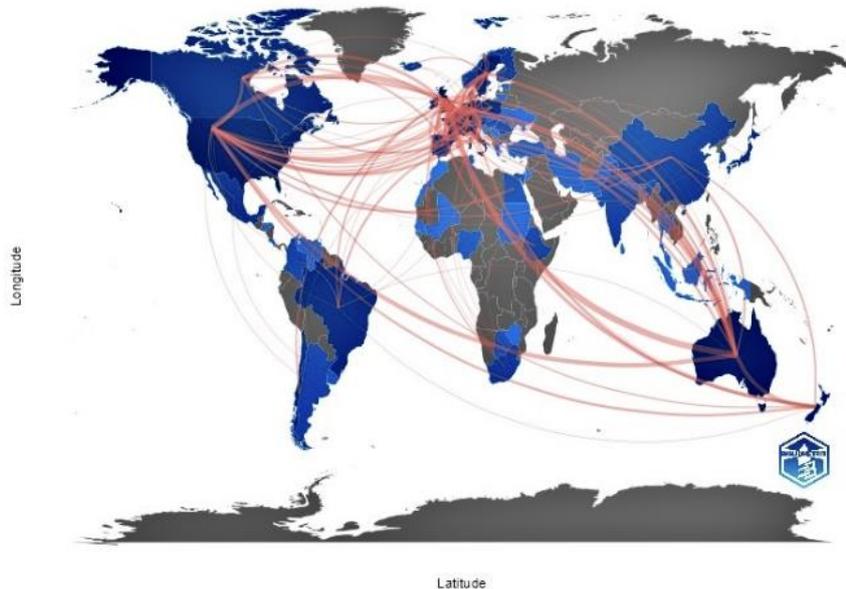


Figure 11. Collaboration world map.

#### 4. Conclusion

Data results had shown an interest in horse welfare including topics like behavior, therapy, communication, riders, habituation and descriptive epidemiology since 2020. Future studies should consider these trends. Thus, scientific studies could have a higher chance to be financed and could lead to new research areas in horse welfare.

#### Author Contributions

The percentage of the author contributions is presented below. The author reviewed and approved the final version of the manuscript.

	O.E.İ.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

#### Conflict of Interest

The author declared that there is no conflict of interest.

#### Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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