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Retrospective study of respiratory diseases in working equids in Morocco: 2018 – 2023

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Very few countries have investigated respiratory diseases in working equids, despite their significant impact on the health and well-being of these animals, and on the income of their owners. The aim of this study was to determine the prevalence of respiratory disorders in working horses, mules and donkeys examined between 2018 and 2023 at the five SPANA centres in Morocco according to species, region and season. The date of consultation, region, species and diagnosis based on the animal's history and clinical examination were collected from 136,692 working equids. A significant difference was found between species regarding the prevalence of infectious respiratory diseases, specifically strangles, and severe equine asthma. Marrakech had the highest rates of total respiratory diseases and specifically non-infectious diseases, with a prevalence of 23.8% and 48.4% respectively. Furthermore, the prevalence of all respiratory diseases and non-infectious respiratory diseases in working equids was higher in Summer (14.1% and 29.1%, respectively), while the prevalence of infectious respiratory diseases was higher in Winter and Autumn (45.5% and 43.8%, respectively). In order to implement preventive measures and good husbandry practices, further investigations are needed to refine the diagnosis of respiratory disorders.

Key words: Donkeys, mules, region, respiratory diseases, season, working horses

INTRODUCTION

In 2022, the global equine population was estimated at around 120 million equids, with approximately 60.5 million horses, 7.6 million mules and 51.6 million donkeys; although it is very likely that these numbers are significantly underestimated (FAO, 2022). These equids are distributed throughout the world, with a total of 44 million equids in the Americas, 41 million in Africa, 28 million in Asia and 5 million in Europe (FAO, 2022). In Morocco, according to the survey conducted by the Strategy and Statistics Department (MAPM) between 2015 and 2016, the Moroccan equine population was estimated at 1,460,702 equines, with 187,029 horses, 324,069 mules and 949,604 donkeys (MAPM, 2016).

The majority of horses, donkeys, and mules in the world are working animals, and many of them are found in poor or underdeveloped countries. They are vital to the survival of almost 600 million people worldwide (Valette, 2015). These animals are particularly important for vulnerable populations and impoverished communities as they are used in revenue-generating activities and

contribute to global rural development, poverty alleviation and food security (Marshall et Ali, 1997; Curran et al., 2005).

Working equids are exposed to a variety of diseases and illnesses all over the world, which can significantly impact their health and ability to work (Sáez et al., 2013). Although a number of diseases have been diagnosed in working equids in countries in Africa, the Middle East, Asia and South America (Djimadoum, 1994; De Aluja, 1998; De Aluja et al., 2000; Pritchard et al., 2005; Tadich et al., 2008; Tadich et al., 2011; Upjohn et al., 2012), only one study has been carried out in Morocco regarding the main diseases affecting working horses (Idbarka, 2006). Among 42,480 equines examined at the SPANA (Société Protectrice des Animaux et de la Nature) centres in Morocco between 2000 and 2005, digestive disorders (intestinal parasites, colic and dental hooks) were the main reason for consultation, followed by wounds and abscesses, respiratory disorders and musculoskeletal disorders (Idbarka, 2006). Other studies showed that respiratory diseases are highly prevalent in working equids and have a significant impact on the health, well-being and productivity of these animals (Laing et al., 2018). Respiratory diseases represent a limiting factor to effort and in most cases lead to a decrease in performance, thus indirectly reducing the income of the people who depend on them (Van Erck, 2006; Burn et al. 2010).

The study of respiratory diseases in working equines enables the collection of data from various geographical regions and environments in order to assess the extent of respiratory diseases by species, region and season, identify potential risk factors and develop effective preventive measures and management strategies aimed at improving their health and well-being (Jaramillo and Gutierrez, 2018). However, very few countries, such as Ethiopia, Senegal, Chile and Mexico, have carried out studies on respiratory diseases in working horses, donkeys and mules (Djimadoum, 1994; De Aluja et al., 2000; Sáez et al., 2013; Laing et al., 2018).

The aim of this study is to determine the prevalence of respiratory diseases in working equids (horses, mules and donkeys) examined between 2018 and 2023 at the five SPANA centres in Morocco, according to species, region and season.

MATERIALS AND METHODS

Study area

This study was carried out at the five SPANA centres in Morocco including Marrakech, Casablanca, Chemaia, Had Oulad Frej and Khémisset. Casablanca and Had Ouled Frej belong to the Casablanca-Settat region and are therefore characterized by a semi-arid Mediterranean climate with a mild, sunny and particularly humid climate (Lachgar et al., 2022). Khémisset is a town in the Rabat-Sale-Kenitra region. It also has a semi-arid Mediterranean climate, with wet, mild and moderate winters and temperate and humid summers with dry and hot days (Elhachimi et al., 2022). Whereas Marrakech has a semi-arid continental climate, with a dry season lasting most of the year and a wet season with low levels of precipitation. It has an average annual temperature of around 20°C and maximum temperatures of around 40°C (Lachir et al., 2016). Similarly, Chemaia has a semi-arid climate, with minimum temperatures of -3.6°C in winter and maximum temperatures of 48°C in summer (Karroum et al., 2014).

Data collection

This study was based on data collected on respiratory diseases of 136,692 working equids (horses, donkeys and mules), such as the date of consultation, region, species, and the type of respiratory disease diagnosed, presented for consultation at the five SPANA centres mentioned above, over a period of five years and seven months, from June 2018 to December 2023.

The diseases reported in this study were diagnosed by different veterinarians depending on regions

on the basis of the animal's history, characteristic clinical signs of each disease, and clinical examination of the upper and deep respiratory tracts. No para-clinical tests were performed. Admission dates were classified according to season, with summer defined as June to August, autumn as September to November, winter as December to February and spring as March to May.

Statistical analysis

The data collected from the clinical records of the patients examined were processed using Microsoft Excel® 2016 spreadsheet software and expressed in the form of percentages and tables. The analysis was carried out using the Statistical Package for Social Sciences (SPSS) (16.0, 2008) for windows software. A three-way ANOVA (Analysis of Variance) followed by Student-Newman-Keuls multiple comparison test were used to test the statistical significance of associations between continuous and categorical variables (species, season and region). For all tests, the significance threshold was set at $p < 0.05$. In cases where an animal had visited the SPANA centres more than once, each visit was treated as an independent measure.

RESULTS

Animals examined

The total number of working equids presented at the five SPANA centres during the study period was 136,692, with 96,383 (70.5%) cases examined in Marrakech, 13,730 (10%) in Casablanca, 9612 (7%) in Chemaia, 7894 (5.8%) in Khémisset and 9073 (6.6%) in Had Ouled Frej. Of the equines presented at the five centres, 53.2% were horses, 22.1% donkeys and 24.7% mules. The percentage of horses, mules and donkeys examined during the study period was, respectively, 46.7%, 28.8% and 24.5% in Marrakech, 72.7%, 10.8% and 16.5% in Casablanca, 44.3%, 24.8% and 30.9% in Chemaia, 70.5%, 20.7% and 8.8% in Had Ouled Frej and 89.7%, 3.6% and 6.7% in Khémisset.

Prevalence of respiratory diseases

The prevalence of the total respiratory diseases in working equids was 12.4%, with a prevalence of 12.9% in horses, 13.4% in mules and 10.8% in donkeys. There were no significant differences between species ($p > 0.05$) (Figure 1).

A prevalence of 23.8% of respiratory cases was observed in Marrakech, 18.7% in Casablanca, 9.6% in Chemaia, 5.6% in Had Ouled Frej and 3.2% in Khémisset, with a significant difference between all regions except between Khémisset and Had Ouled Frej (Figure 1).

The prevalence of respiratory diseases in working equids showed seasonal variations, but without statistical significance ($p > 0.05$) (Figure 1), with 14.1% in Summer, 12.5% in Autumn, 11.8% in Winter and 11.3% in Spring.

Among respiratory cases presented to the five SPANA centres, the prevalence of infectious respiratory diseases was 41.3%, with a prevalence of 9.1% reported for strangles, while the prevalence of non-infectious respiratory diseases was 26.6%, with a prevalence of 9.9% and 0.6% recorded for severe equine asthma (SEA) and parasitic diseases due to Dictyocaulus arnfieldi, respectively.

Prevalence of infectious respiratory diseases

The prevalence of infectious respiratory diseases in working equines was 41.3%, with a higher prevalence in horses (58.4%) compared to mules (37.6%) and donkeys (28.1%); a significant difference was found between the three species ($p < 0.05$) (Figure 2).

A prevalence of 38.9% of infectious respiratory diseases in working equids was noted in Marrakech, 51.1% in Casablanca, 40.4% in Chemaia, 53.9% in Had Ouled Frej and 22.5% in Khémisset, with no significant difference between Marrakech and Chemaia and between Casablanca and Had Ouled Frej ($p > 0.05$) (Figure 2).

The prevalence of infectious respiratory diseases in working equines was 37.4% in Summer, 43.8% in Autumn, 45.5% in Winter and 37.5% in Spring, with no significant difference between Winter and Autumn and between Spring and Summer ($p > 0.05$) (Figure 2).

Strangles

The prevalence of strangles in working equids was 9.1%, with a prevalence of 15.7% in horses, 9.2% in mules and 2.4% in donkeys. A significant difference between the three species was noted ($p < 0.05$) (Figure 3).

The prevalence of strangles in working equis was 3% in Marrakech, 5.5% in Casablanca, 10.9% in Chemaia, 14.6% in Had Ouled Frej and 12.2% in Khémisset, with the highest prevalences in Khémisset, Had Ouled Frej and Chemaia and the lowest in Casablanca and Marrakech ($p < 0.05$) (Figure 3).

The prevalence of strangles in working equids was 9.7% in Summer, 8.2% in Autumn, 9% in Winter and 9.9% in Spring, with no significant seasonal effect.

Prevalence of non-infectious respiratory diseases

The prevalence of non-infectious respiratory diseases in working equids was 26.6%, with a prevalence of 27.6% in horses, 24.8% in mules and 27.2% in donkeys. No significant differences between species were found ($p > 0.05$) (Figure 4).

The majority of cases of non-infectious respiratory diseases were reported in Marrakech (48.4%) and Chemaia (43.4%), followed by Casablanca (22.8%), Had Ouled Frej (8.3%) and Khémisset (6.8%). A significant difference was noted between all regions ($p < 0.05$) except between Khémisset and Had Ouled Frej ($p > 0.05$) (Figure 4).

The prevalence of non-infectious respiratory diseases in working equines was 29.1% in Summer, 25.7% in Autumn, 26.5% in Winter and 25.2% in Spring, with no significant seasonal effect ($p > 0.05$) (Figure 4).

Severe equine asthma (SEA)

The prevalence of SEA in working equines was 9.9%, with a prevalence of 6.8% in horses, 11.6% in mules and 11.3% in donkeys. There was a significant difference between horses and donkeys, and between horses and mules ($p < 0.05$) (Figure 5).

The majority of cases of SEA in working equids were noted in Chemaia (39.8%), followed by Marrakech (7.1%), Casablanca (1.1%), Had Ouled Frej (0.2%) and Khémisset (0%), with a significant difference between all regions ($p < 0.05$) except between Casablanca, Had Ouled Frej and Khémisset ($p > 0.05$) (Figure 5).

The prevalence of SEA was 9.6% in Summer, 9% in Autumn, 12% in Winter and 9% in Spring. A significant difference between seasons was noted ($p < 0.05$) but was not detected by the post hoc test used (Figure 5).

Respiratory parasite (Dictyocaulus arnfieldi)

The prevalence of Dictyocaulus arnfieldi in working equids was 0.6%, with a prevalence of 0.6% in horses, 0.6% in mules and 0.5% in donkeys. No significant differences between species were found ($p > 0.05$) (Figure 6).

A prevalence of 0.5% of Dictyocaulus arnfieldi in working equines was noted in Marrakech, 1.7% in Casablanca, 0.6% in Chemaia, 0% in Had Ouled Frej and 0% in Khémisset, with a significant difference between Casablanca and the rest of the regions ($p < 0.05$) (Figure 6).

The prevalence of Dictyocaulus arnfieldi in working equids was 0.6% in Summer, 0.7% in Autumn, 0.6% in Winter and 0.3% in Spring. No seasonal effect was observed ($p > 0.05$) (Figure 6).

DISCUSSION

This study showed a prevalence of total respiratory cases of 12.4% in working equids between 2018 and 2023, with slight variations according to species (12.9% in horses, 13.4% in mules and 10.8% in donkeys). In Chile, a similar prevalence of respiratory diseases (13.9%) was found in a study of urban working horses following a free care program over a 13-year period (1997-2009) (Sáez et al., 2013). The study was based on symptoms reported in the horses, such as nasal discharge and positive cough reflex, but no specific diagnosis was made (Sáez et al., 2013). However, a lower prevalence was observed in Pakistan, where a survey aiming to determine the prevalence of different equine pathologies was carried out on 450 equines, including 147 horses, 230 donkeys and 73 mules from urban and peri-urban areas (Goraya et al., 2013). The results were also based on a clinical examination and revealed a prevalence of respiratory diseases of 7.3% (Goraya et al., 2013). This could be due to the meteorological difference as well as the difference in living and housing conditions for horses between the two countries. In Morocco, a previous study carried out between 2000 and 2005 investigating the most common pathologies in working equids presented to the nine former SPANA centres noted a lower prevalence of respiratory diseases (7%), with a prevalence of 7.59 % in horses, 6.95% in mules and 6.83 % in donkeys (Idbarka, 2006). These results showed a predominance of cough-related conditions for which a differential diagnosis was not made (50 %), followed by strangles and sinusitis (25%) and severe equine asthma (19%) (Idbarka, 2006). A smaller number of investigated equids and the difference in climate due to the study being carried out in four additional SPANA centres (Tangier, Rabat, Khenifra and Midelt) could explain the difference in the prevalence of respiratory diseases found with the present study.

On the other hand, no significant variation between species was observed for total respiratory diseases, nor for non-infectious respiratory diseases. These results may be attributed to the nature of the equines' activity, the degree of their tenacity, and the fact that SPANA centres relied mainly on the history and clinical signs observed during consultations to establish the diagnosis.

A significant difference in the prevalence of infectious respiratory diseases between horses (58,4%), mules (37,6%) and donkeys (28,1%) was observed, with a higher prevalence described in horses. Similar to horses, donkeys and mules can suffer from a variety of viral and bacterial respiratory diseases. However, prompt identification of diseases in donkeys can be more difficult than in horses, as their susceptibility to certain pathogens is different; anorexia, depression and dullness may be the only clinical signs observed (Barrandeguy and Carossino, 2018; Thiemann, 2012). In addition, donkeys can live to an advanced age and may therefore suffer from concomitant age-related illnesses, which can modify the clinical presentation of respiratory conditions (Thiemann, 2012). Similar to other respiratory diseases, strangles is under-reported in donkeys and mules (Barrandeguy and Carossino, 2018), which may account for the disparity in strangles prevalence found in our study between horses (15,7%), mules (9,2%), and donkeys (2,4%).

Regarding severe equine asthma (SEA), the present study revealed a prevalence of 11.6% in mules, 11.3% in donkeys and 6.8% in horses. There was a significant difference between the different species, with no difference between donkeys and mules. In horses, studies have demonstrated the

role of genetic predisposition in the development and exacerbation of SEA (Gerber 1989; Marti et al. 1991; Gerber et al. 2015). In Lippizans and Warmbloods, the offspring of affected horses were more likely to develop the disease, with a higher susceptibility when both parents were affected (Gerber 1989; Marti et al. 1991; Gerber et al. 2015). Therefore, the genetic predisposition to SEA might be extrapolated to donkeys and mules and may therefore explain the results obtained in this study. In addition, a significant difference between all regions except between Casablanca, Had Ouled Frej and Khémisset was observed for this condition. The lack of difference between these three regions may be due to the fact that they are all characterized by a humid climate, unlike Chemaia and Marrakech, which are known for their dry climate. These results contradict studies by Davis and Sheats (2019), who have shown that humid areas are predisposed to mold proliferation in straw and hay, thus promoting inflammation of the deep respiratory tract. As a result, the high prevalence of SEA in Chemaia may be due to bias arising from the diagnosis, based solely on clinical signs, carried out by different veterinarians depending on the region.

No significant seasonal differences were observed regarding total respiratory diseases; 14.1% of all respiratory cases occurred in summer, 12.5% in autumn, 11.8% in winter and 11.3% in spring. Similarly, no seasonal differences were noted for non-infectious respiratory diseases, and more specifically for SEA. This lack of seasonal variation is perhaps not surprising when the complex interaction between the presence of allergens, pollution and respiratory viruses is taken into consideration. An increase in the frequency of recurrent airway obstruction has been observed in some geographical areas in summer when pollen and fungal spores are present in large amounts in the environment (Mair 1996; Costa et al., 2000; Costa et al., 2006). However, a study evaluating inflammation markers in the respiratory tract of horses by season showed an increase in the percentage of neutrophils in bronchoalveolar lavage samples in winter (Riihimäki et al., 2008). A second study by Hansen et al. (2018), using bronchoalveolar lavage, showed a higher tracheal mucus score and neutrophil percentage in November compared with May. Furthermore, pollution has also been associated with airway inflammation in horses (Ivester et al., 2014) in a similar way to humans, where the association between pollution levels and increased frequency and severity of asthma attacks has been demonstrated (Peters et al., 1996; Choudhury et al., 1997; Brønnum-Hansen et al., 2018).

In this study, the prevalence of strangles in working equids was 9.1%, with a prevalence of 15.7% in horses, 9.2% in mules and 2.4% in donkeys. A limited number of studies conducted in Canada, Brazil, Ireland, Ethiopia, Egypt, Saudi Arabia, and South Africa reported prevalences of strangles in horses ranging from 2.3% to 42% (Clark et al., 2008; Ling et al., 2011; Al-Ghamdi, 2012; Walshe et al., 2012; Libardoni et al., 2016; Neamat-Allah and El Damaty, 2016 and Laing et al., 2018). In working horses, studies in Ethiopia and Lesotho demonstrated a Streptococcus equi seroprevalence of 8% and 10.1%, respectively, using serological tests (Ling et al., 2011; Laing et al., 2018). In different Iraqi provinces, indirect-ELISA was used to test the presence of strangles in 154 donkeys; the results showed that 7.14% of donkeys were seropositive (Al-Gharban, 2017). In our case, the diagnosis of strangles was based solely on characteristic clinical signs that may not be present in a subclinical or milder form of the disease (Slater 2007). Furthermore, the variation in prevalence between this study and ours might be due to the difference in sample size and the epidemiological status of the countries where the studies were carried out. There were no statistical differences in this disease between the different seasons. To the authors' knowledge, very few studies have investigated the seasonality of strangles in equids. The results of an epidemiological study on strangles conducted in Egypt showed that the spring and autumn seasons had a significantly higher incidence of strangles in Arabian horses (33.3% and 18.6%, respectively) than the summer and winter seasons (17% and 9%, respectively) (Neamat-Allah and El Damaty, 2016). In the USA, a study investigated possible correlations between strangles outbreaks and meteorological factors such as temperature and precipitation (Thomas et al., 2023). The results showed that the maximum and minimum frequencies of strangles outbreaks coincided with periods when temperature was rising or falling at the fastest rate; when temperatures were at their highest, lowest, or shift at a slower rate, outbreak frequency likewise stayed rather stable. However, precipitation had no discernible impact on the frequency of strangles outbreaks (Thomas et al., 2023). Therefore, the

lack of statistical difference between the seasons in our study might be due to the characteristics of the climate conditions in Morocco, where temperatures usually do not decrease or increase rapidly. In addition, the prevalence of strangles was higher in Khémisset (32.5%), Had Ouled Frej (14.1%) and Chemaia (10.7%). This might be explained by the increased exposure of working equids to stress conditions, poor hygiene and malnutrition in these regions given that these areas are known to have poorer and underdeveloped communities. Furthermore, unlike sport horses, which participate in shows and competitions, the lack of gatherings for working equids significantly reduces their risk of contamination.

No significant difference in the prevalence of Dictyocaulus arnfieldi was observed between horses (0.6%), donkeys (0.6%) and mules (0.5%). In Morocco, a study carried out over the course of a year on 423 autopsied donkeys from Settat, Casablanca and Rabat revealed the presence of Dictyocaulus arnfieldi in 47.8% of cases (Pandey, 1980). A second study carried out by Mahboub (1991) on 150 autopsied donkeys showed an infection rate of 50.3%. In Iran, a Dictyocaulus arnfieldi infection rate of 31.8%, 24.3% and 15.7% was determined using the Baermann technique in donkeys, mules and working horses respectively (Saadi et al., 2018). The low prevalence found in our study could be explained by the lack of use of diagnostic methods, as well as the ability of equids not to show clinical signs during the infection (Matthews and Burden, 2013). For illustration, a mare excreting 1520 L1/g of faeces and containing 20,000 adult worms at necropsy showed no clinical symptoms of the disease (Round, 1976).

The prevalence of Dictyocaulus arnfieldi was highest in autumn (0.7%), but no significant difference was found between seasons. An epidemiological study of Dictyocaulus arnfieldi carried out in Morocco observed peaks of infection in donkeys in autumn, winter and late spring (Pandey, 1980). These results might be explained by the fact that the infectious larvae can difficultly survive in hot and dry seasons and require optimal temperature and humidity levels for their development. Lastly, our study showed that the highest prevalence of the parasite was recorded in Casablanca (1.7%), which has a milder climate and higher humidity than the other regions studied.

CONCLUSION

In conclusion, this study shows that working equids suffer from major respiratory diseases that affect not only their health and performance but also their owner’s income. Therefore, equine owners should be informed of the study’s findings, and programs for education and training on preventative measures and appropriate husbandry practices should be implemented. In addition, diagnostic methods should be used not only in SPANA centres but also in veterinary practices and clinics in order to improve the diagnosis, determine the best course of action for treatment and follow-up and implement the appropriate preventive measures, all with the aim of playing an active part in improving the health and well-being of working equines.

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