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Major hoof and musculoskeletal disorders of cart pulling mules with special reference to lameness in Bahir Dar town, northwestern Ethiopia

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A cross-sectional study was conducted in Bahir Dar town, Northwestern Ethiopia, to quantify the major hoof and musculoskeletal disorders of cart mules and identify their predisposing factors. Both physical examinations of 250 cart mules and a questionnaire survey of 174 volunteer cart owners or drivers were used. The overall prevalence of gait problems was 18.8%, of which 83% were lameness, 6.3% staggering gait, and 10.6% stiffness. There was no statistically significant difference (p>0.05) in the proportions of lameness between age groups, sexes and body conditions. In contrast, epizootic lymphangitis (10.3%), trauma (4.6%), and harness injury (0.57%) were the major complaints of the respondents as the causes of lameness. The prevalence of wounds on the chest and back region was 23.2%. Only 8.6% of the respondents paid attention to the feet of their mules; they washed, picked foreign material from the hooves, and trimmed the hoof wall. Lameness caused by hoof problems was the most frequent gait abnormality encountered in the study area. Therefore, for feasible and prompt intervention of musculoskeletal problems, the provision of proper shoeing and regular checkup and treatment of the foot, joint, and back should be instituted as routine activities. Further training should also be implemented to change the owners' awareness, particularly their practices.

Key words: Musculoskeletal, lameness, mule, cart pulling, Bahir Dar, Northwestern Ethiopia

INTRODUCTION

Ethiopia hosts a total of about 11 million equines, of which 8.44 million are donkeys, 2.16 million are horses, and 0.41 million are mules. Approximately 185,186 mules reside in the Amhara region, with more than 14% of the working mules in this area involved in cart pulling (CSA, 2017). Over 300 mules are present in Bahir Dar town, upon which the livelihoods of the same number of households depend (BDHWP, 2008: unpublished report; Meselu et al., 2018). In the town, cart mules serve the community by transporting commodities at a relatively affordable price to and from marketplaces, construction sites, and mill houses. Like any other animals, equines are vulnerable to various diseases of biological origin, nutritional disorders, and other miscellaneous causes

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that lead to ill health, suffering, a considerable loss of efficiency, and reduced longevity (Ashley et al., 2005; Gebreab and Fanta, 2006). Problems involving the musculoskeletal system are among the reasons for veterinary attention to equines (Hadgson and Rose, 2000). The major and common clinical manifestations of diseases affecting the musculoskeletal system include lameness, failure of support, insufficiency of movement, and deformity (Radostits et al., 2007). The majority of conditions causing lameness occur in the distal part of all limbs, especially the foot. Despite the invaluable service equines provide to the national economy, they, particularly mules, have not been given the attention they deserve (Gebreab and Fanta, 2006). Moreover, information concerning musculoskeletal and hoof disorders is lacking in the study area and in the country at large. Therefore, this study was conducted to identify the major hoof and musculoskeletal disorders and to evaluate the associated risk factors in cart-pulling mules.

MATERIALS AND METHODS

Description of the study area

The study was conducted from November 2013 to May 2014 in Bahir Dar town and its surroundings. Bahir Dar, the capital of the Amhara Regional State, is located 570 km away from Addis Ababa at 11' 29'' N and 37' 29'' E, at an altitude ranging from 1500 to 2300 m above sea level. The climate of the town conforms to the Ethiopian 'woynadega,' with an average annual rainfall of 1,434 mm, humidity at 57.88%, and an average annual temperature of 23°C. The rainy season extends from early June to late September (BZWARD, 2004: Unpublished report). The area practices a mixed crop-livestock production farming system (Asaye and Alemneh, 2015).

Study animals and management

The study involved 250 cart-pulling mules encountered at various sites where cart mules are commonly found, such as flour mill houses, construction sites, and marketplaces. During sampling, mules of all age groups, body condition scores, and both sexes were considered. Although the estimated number of mules in the town is around 300 (BDHWP, 2008), only 250 mules (that is, 83.3%) could physically diagnose. To prevent sampling bias, especially re-sampling, maximum effort was made to identify each mule by color, owner's name, and cart number.

The mules were housed in stone-paved houses or on soil ground without bedding, and their manure and wasted feed were occasionally cleaned. The mules were primarily fed natural pasture, crop residue, and hay, with occasional provision of concentrates like wheat bran and other food industry byproducts. None of the cart mules were shoed. The majority of the mules (73%) worked 6 days per week and usually pulled over 1,000 kg of goods. In nearly 50% of the cases, a single mule worked 8 hours per day without any shift.

Data collection

Both physical examination and a questionnaire survey were employed to gather valuable information for the study. The age and body condition score of the animals were estimated following the guidelines set by Crane (1997) and Svendsen (1997), respectively. For simplicity, the examined mules were categorized into three age groups: young (≤5 years), adult (5 - 15 years), and old (≥15 years). Similarly, the body condition scores were categorized into poor (score 1), moderate (score 2), and good (score 3 and 4).

Physical examination

The mules underwent a thorough examination for abnormalities in gait, posture, back, neck, chest, limbs, muscles, joints, hooves, and bones. The examination included assessing for lameness, wounds, back sores, stiffness or paralysis, pain, heat, swelling, and other abnormalities in the joints. Lameness cases were diagnosed by observing changes in stride length, the duration of weight-bearing on the affected and unaffected limbs, the symmetry of head and hip movements, and the angle of joint flexion (Stashak, 1987). Back abnormalities were examined by applying pressure and pricking with a pen (Hadgson and Rose, 2000). Limbs were tested by overstretching and flexion of the joints and firm palpation. Similarly, all structures of the foot were visualized by removing dirt from the sole and frog (Hadrill, 2002), and then checked for pain by applying a hoof tester.

Questionnaire

One hundred seventy-four (174) volunteer cart drivers/owners were interviewed using a semi-structured questionnaire to gather relevant information regarding the health, welfare, and general management system of their mules. Additionally, their knowledge about possible predisposing factors and corrective measures for major hoof and musculoskeletal disorders was also explored.

Data management and analysis

Information obtained from the physical examination and interviews was entered into a Microsoft Excel spreadsheet and analyzed using STATA software (Windows version 14.2, Stata Corporation, College Station, TX). Chi-square analysis and multivariable logistic regression were employed to examine the presence of significant associations between the dependent variables (such as gait abnormality, lameness, and hoof problems) and the considered risk factors. In all analyses, a significance level of $P \leq 0.05$ was set.

RESULTS

Physical examination

Out of the total 250 cart mules examined, 47 (18.8%) exhibited various types of gait defects. Among these, 3 (6.4%) showed staggering, 5 (10.6%) displayed stiffness, and 39 (83%) demonstrated lameness. The causes of lameness were primarily joint and hoof defects, with relative frequencies of 20 (51.3%) and 23 (59%), respectively. Four lame mules suffered from both foot and joint problems. Lameness was more commonly observed in the front limbs (27, 69.2%) compared to the hind limbs (12, 30.8%). Seedy toe was the most common cause of hoof-related lameness, followed by imbalance, overgrowth, crack, laminitis, and abscess. Among joint-

Table 1. Prevalence of the major gait abnormalities encountered in working mules in Bahir Dar.

Types of defects	Number affected	Percent	Relative %
Gait problems	47	18.8	
Staggering	3	1.2	6.4
Stiffness	5	2	10.6
Lameness	39	15.6	83
Joint problems	20	8	3.4
Dislocation	6	2.2	15.4
Acute arthritis	12	4.8	30.8
Open wound	12	4.8	30.7
Hoof problems	23	9.2	59
Seedy toe	14	5.6	35.9
Imbalance	10	4	25.6
Over growth	9	3.6	23.1
Crack	8	3.2	20.5
Laminitis	4	1.6	10.3
Abscess	3	1.2	7.7

Table 2. The result of multivariable logistic regression analysis of different risk factors associated with gait problems.

Risk factors	No. examined	No. (%) affected	OR ($CI^{95\%}$)	P-value
Age (years)				
>16	45	6(13.3)	1	
6-15	179	37(20.7)	1.29(0.32,5.14)	0.30, 0.72
<5	26	4 (15.4)	1.65(0.64,4.23)	
Body condition				
Good	28	4(14.3)	1	
Moderate	155	25(16.1)	1.11(0.35,3.51)	0.86, 0.24
Poor	67	18(26.9)	2.07(0.62,6.85)	
Sex				
Male	127	22(17.3)	1	
Female	123	25(20.3)	1.28 (0.67, 2.46)	0.455

OR=odds ratio, CI= confidence interval.

related lameness, acute arthritis and open wounds, both with a frequency of 12 (30.7%) each, were more common compared to dislocation (6, 15.4%) (Table 1).

The hypothesized risk factors for the study's outcome (gait problem), including age ($\chi2=0.23$, $p = 0.89$), sex ($\chi2=0.32$, $p=0.54$), and body condition ($\chi2=3.99$, $p=0.14$), showed no statistically significant association with the occurrence of gait problems (Table 2).

There was no statistically significant difference in the occurrence of hoof and joint problems and lameness among the different categories of the hypothesized risk factors, namely age, sex, and body condition score (Table 3).

The prevalence of open wounds and swelling on the back and chest region of mules in the study area was 23.2%. The risk factors including age, sex, and body condition, showed no statistically significant association with the prevalence of wounds and swelling on the back and chest region (Table 4).

Result for questionnaire survey

Lameness (n=104, 59.22%), epizootic lymphangitis (n=92, 52.9%), colic (n=71, 40.8%), and wounds at the back (back sore) and chest region (n=51, 29.3%) were

Table 3. Prevalence and Chi square analysis of hoof and joint problems and lameness in mule with the considered risk factors.

Risk factors		No. examined	Hoof problem		Joint problem		Lameness	
			No. (%)	χ^2, p-value	No. (%)	χ^2, p-value	No. (%)	χ^2, p-value
Age (years)	<5	26	19(73)	5.72, 0.06	2(7.69)	0.18, 0.914	4 (15.4)	0.68,0.71
	6-15	179	94(52.5)		18(10.06)		29(16.2)	
	>16	45	21(46.6)		4(8.9)		6(13.3)	
Sex	Male	127	69(54.3)	0.06, 0.81	12(9.5)	0.01,0.934	16(12.6)	0.17,0.23
	Female	123	65(52.8		12(9.8)		23(18.7)	
BCS	Poor	67	38(56.7)	0.38, 0.83	9(13.4)	1.59, 0.452	16(23.9)	0.88,0.19
	Moderate	155	81(52.2)		13(8.4)		20(12.9)	
	Good	28	15(53.6)		2(7.1)		3(10.7)	

Table 4. Prevalence and chi-square analysis of open wound and swellingon the back and chest region associated with risk factors sex, age and body condition.

Risk factors		No. examined	Frequency	Prevalence (%)	χ^2	P-value
Age	<5 year	26	4	15.4	1.73	0.42
	6-15 year	179	41	22.9		
	>16 year	45	13	28.9		
Sex	Male	127	31	24.4	0.21	0.65
	Female	123	27	22.0		
Body condition	Poor	67	18	26.9	2.65	0.266
	Moderate	155	31	20		
	good	28	9	32.1		

the most common complaints of the respondents, followed by African horse sickness (n=23, 13.2%) and tetanus (n=2, 1.2%). Moreover, the majority of respondents (n=115, 66.1%) indicated that hoof problems, more frequently observed on gravel roads and during the rainy season, were the major cause of lameness. This was followed by epizootic lymphangitis (n=18, 10.3%), trauma (n=9, 4.6%), and harness injury (n=1, 0.8%). Only 15 (8.6%) respondents provided care for the feet of their mules through washing and picking stones or gravel from the hooves once a week or a month, depending on the workload. In contrast, 66 (37.9%) owners washed the feet and trimmed the hoof wall only when there was a problem with the foot. Only 5 (2.9%) respondents had taken their mules to a veterinary clinic, and 54 (31.0%) of them had given rest to their mules when they were suffering from lameness.

DISCUSSION

Gait defects, the common manifestation of musculoskeletal disorders and nervous problems and the leading owner's complaint in the area, were observed with an overall prevalence of 18.8%. This prevalence in the area could be attributed to different causes. Lameness, accounting for 83% of the gait defects, was the major manifestation observed during the study period. In a previous study, Morgan (2007) reported a lower prevalence of lameness (3.1%) in working donkeys in and around Debre Zeit, including Addis Ababa, compared to the prevalence in the current study (15.6%). This difference might be associated with variations in study types, species of animals studied, geographical location, owners' awareness, management practices, and the type of work the animals perform. Morgan sampled donkeys brought to veterinary clinics, where only those with severe lameness are typically presented.

According to Aver (2005), inciting factors in lameness include direct or indirect trauma, incoordination of muscle action following fatigue, or inflammation of joints, tendons, and ligaments. In this study, observed lameness cases were solely caused by joint and hoof problems. Hoof wounds are common causes of lameness (Lane and Litchfield, 2010). As observed in this study, a high prevalence of hoof problems is expected in most equine

populations during the wet season and as they walk on gravel roads, where their hooves soften, and debris packs into their hooves. Wet and humid ground affects the integrity of hooves and exposes them to serious complications such as hoof abscess and thrush (Hadgson and Rose, 2000; Coombs, 2002; Bowker, 2003). Moreover, some observed hoof problems such as seedy toe (5.6%), hoof imbalance (4%), and overgrown hooves (3.6%) could be the cause or effect of lameness. According to Dyson (2011), these and other conditions on the hoof induce severe pain, excessive degeneration, and other complications, posing an excessive load on the other limbs. Similarly, seedy toe (35.9%), arthritis (30.8%), and open wounds (30.7%) were common causes of lameness in the study area. The results of this study regarding the causes of lameness differ from those of Morgan (2007), who reported trauma and ulcerated wounds due to car accidents in urban and hyena bites in rural areas as the commonest causes of lameness in donkeys. This difference could be partly explained by variations in the management activities between the study sites. Unlike in the current study area, donkeys in and around Addis Ababa are usually left outside at night and spend most of their time on the road, where attacks by hyenas and car accidents are more frequent.

The more frequent forelimb lameness (69.2%) observed in this study aligns with the previous report by Morgan (2007), who found that most lameness (61%) occurs in the forelimb, with approximately three cases of lameness in the forelimb for every case in the hind limb. This can be partly explained by the fact that the forelimbs bear 60 to 65% of the animal's weight and are thus subjected to much greater concussion than the hind limbs.

The prevalence of open wounds on the back and chest region (23.2%) recorded in the current study is significantly lower than the prevalence of external harness-related injuries (31.2%) reported by Fentie et al. (2014) in the same study area. This variation may be partly associated with improvements in harnessing materials and increased awareness in society about the health care and management system of equines, thanks to the Donkey Sanctuary-Bahir Dar project. Moreover, the observed lesions were not deep enough to involve the spinal column and/or ligaments to induce clinical lameness.

Out of 58 mules with different lesions on their back and chest, only 11 (18.96%) were lame. However, all of these lame mules were affected by hoof (n=5) and joint (n=6) problems. Although lameness and back problems are considered to have a cause-and-effect relationship, there is no scientific evidence indicating a quantitative relationship between them (Landman et al., 2004). Regardless, Stashak (2002) emphasized that a horse's back should be examined as a standard element for a complete lameness examination.

The absence of a significant statistical association between the considered host risk factors (age, body condition, and sex) and the prevalence of lameness and wounds on the neck and back of the examined mules could be partly explained by the non-representative sample size among the categories and the existence of other strong environmental risk factors such as husbandry and management. Studies from various countries, including Mexico, Sudan, and Ethiopia, have shown that poor husbandry and compromised welfare are the leading risk factors for harness sores, wounds, foot problems, and heavy worm burdens (El Dirdiri et al., 1986; Rodriguez-Maldonado, 1991; Yilma et al., 1991).

In the absence of advanced diagnostic aids, visual assessment of lameness can be used to locate the source of the problem and subsequently recommend an appropriate treatment strategy. However, it lacks accuracy and repeatability in detecting the subtle movement symmetries of mild hind limb lameness and is dependent on the experience of the veterinarian (Keegan et al., 1998). In this regard, it is important to note that the reported prevalence in the current study likely represents only moderate to severe cases of lameness.

Apart from lameness, a few cases of gait problems were characterized by staggering (incoordination of the limbs) (n=3) and stiffness of the back (n=2) or limbs (n=3). Although the specific causes could not be diagnosed, damage to the central nervous system (for staggering) or peripheral nerves and major muscles (for stiffness) due to various infectious, toxic, and physical causes could be suspected (Higgins and Snyider, 2006; Henson, 2009). Repeated and persistent trauma or pain, coupled with the absence of judicious treatment and poor animal welfare in the area, could also be implicated as potential causes. To identify possible causes, further study, mainly using a case-control study type, is strongly recommended.

Conclusion

Even though cart mules play a significant role for the resource-poor community in the study area, the feeding and housing management systems are poor, leading to various health problems, including musculoskeletal issues. Based on the results of the questionnaire, it can be argued that the majority of owners and/or cart drivers have better knowledge and attitudes but lack the practical implementation of practices related to the health, welfare, and general management system of working mules. Additionally, there is a gap in understanding the possible predisposing factors and corrective measures for major hoof and musculoskeletal disorders. In general, the mishandling and negligence of animal welfare practices might significantly contribute to the occurrence of lameness and other concurrent diseases reported above. For feasible and timely intervention in musculoskeletal problems, it is crucial to institute proper shoeing and conduct regular checkups and treatments for the foot,

joint, and back as routine activities. Further training and/or technical support should be implemented by governmental and non-governmental organizations to improve the owners' awareness and, more importantly, their practices. This can contribute to enhancing the overall health, welfare, and performance of the working mules in the community.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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