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Research Article

A Cross Sectional Study on Risk Factors Associated with Lameness of Working Donkeys in and around Hawassa, Ethiopia

Ashenafi Kiros[1]*, Mamuye Gezahegn[2], Alemu Aylate[1]

[1]*School of Veterinary Medicine, Wolaita Sodo University, Ethiopia;* [2]*School Veterinary Medicine, Wollo University, Dessie, Ethiopia.*

Abstract | A cross sectional study for risk analysis was undertaken on randomly selected working donkeys (n=384) at the city Hawassa and its surroundings to estimate the prevalence of lameness. Among the lameness examined donkeys, all the lamed donkeys were subjected towards veterinary clinics for detailed characterization. Focus group discussion was carried out in 10 study sites with 60-70 donkey owners and cart-drivers. Locomotion scoring was recorded on a scale of (0–4; sound-non weight-bearing) at a walk of about 20 meters distance. From the total examined donkeys, 19.53% were found with lameness, in which 72% were of low-grade lameness, 17% moderate grade followed by high-grade lameness (9.33%). Multiple chronic pathological abnormalities within each limb were associated with different lameness types, in which sole bruise (3.64%) was on the peak that followed by puncture wound (3.12%) and subsequently by thrush, sub solar abscess, and hoof cracking with 2.34% each. Moreover, the risk factors associated with older donkeys were noted with significantly higher ($p<0.05$) than donkeys. Likewise the donkeys used to work with poor body condition had higher ($p<0.05$) prevalence of lameness. These results should assistthe implementation of interventions to reduce the prevalence of lameness in working equids.

Keywords | Lameness, Donkey, Hawassa, Prevalence, Gait

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***Correspondence** | Ashenafi Kiros, School of Veterinary Medicine, Wolaita Sodo University, Ethiopia; **Email:** nafikw@gmail.com
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INTRODUCTION

Donkeys are one of the most important domestic animals most intimately associated with humans. They contribute a lot through their involvement in different social and economic sectors (Bojiae et al., 2005). The donkey is harder than the horse, survives with much less attention, drives sustenance from poor quality food and can tolerate considerable heat and dehydration. This makes it a suitable animal for harsh environments and difficult working conditions. Its main role is that of a beast of burden, typically transporting materials such as grains, fuel wood, water, crop and building materials (Alemu et al., 2004). Donkeys (*equusasinus*) are said to have originated in North-East Africa and then spread to other parts of the world. The world donkey's population is 44 million; half is found in Asia, just over one quarter in Africa and the rest mainly in Latin America (Fernando and Starkey, 2004).

In Ethiopia, there are only few published reports about donkey lameness and all the available data are on lameness and restricted to only some areas of the country (Kanchula and Abebe, 1997; Assefa and Abebe, 2001; Shelima et al., 2007; Abebe and Wolde, 2010). Donkeys have been used as beast of burden for a long time in Ethiopia and still render their valuable services, mostly as pack animals, throughout the country in general and in areas where modern of transportation is absent, unaffordable or in-accessible in particular (Getachew et al., 2008). Despite their prominent role in agriculture based policy of the country, knowledge on physiology, nutritional requirements, health problems and management systems is limited except the attempts made by the donkey sanctuary since its inception (Starkey and Starkey, 1997).

Yet, despite of their valuable contribution to human society, knowledge about donkeys is limited as they are given less consideration than other species of livestock and their welfare is often neglected. Indeed, Aluja and Lopez (1991) considered the donkey certainly the most neglected and abused animal in Mexico. The donkeys provided with adequate food, water, appropriate shelter and health care, attention paid to its behavioural needs, and make them free from fear is considered in their good welfare. Many of these points have to be guided by common sense in the absence of firm knowledge about the needs and motivation of donkeys (Aluja and Lopez, 1991).

Even though donkeys have often been described as sturdy animals, they succumb to a variety of diseases and a number of other conditions. Most important among these are parasitic attacks, saddle sore problem and severe lameness. Lameness is the most common cause of poor performance in working donkeys. Diseases or injuries of the musculoskeletal system are the major cause of wastage and poor performance in working donkeys. Lameness typically results from pain associated with the musculoskeletal system, including abnormalities with joints, bones, tendons, ligaments and muscle (Kahn, 2005). The major objective in undertaking this work on donkeys in and around Hawassa district was therefore to assess the prevalence of lameness, to characterize major types of lameness and to determine the major risk factors associated with lameness in and around Hawassa.

MATERIALS AND METHODS

Study Area Description

A cross sectional study was carried out at Hawassa town of Southern Ethiopia, situated at 275km south of Addis Ababa (the capital of Ethiopia) at a latitude of 7˚04' N and a longitude 38˚31' E on the escarpment of the Great Rift Valley. The altitude ranges from 1650 to 1700 meter above sea level. The mean annual rainfall and temperature are 900-1100 mm and 27˚C, respectively. The population of donkey (*Equusasinus*), mule (*Equushemonious*) and Horse (*Equuscabalis*) of Hawassa town are 13961, 369, 5161, respectively (CSA, 2008). A total of five areas of Hawassa were included in the study *viz*., Cheffe, Korem, Dato, Wukro and Hykedar.

Study Animals

A total of 384 working donkeys of all age groups from different sites in Hawassa town and in the localities around Hawassa were randomly selected between October-April 2011/2012. The breed of the working donkeys were local breed called as Abyssinia type with the characteristic feature of short, compact, lower feed requirement and easily manageable. The assessment was carried out correspondingly with the required data as sex, age, body condition, address etc.

Study Design and Sampling Techniques

A cross sectional study was undertaken in two phases. The first phase involved clinical examination of all animals to generate categorical variables that help to quantify and describe the magnitude of musculo-skeletal disorders (lameness) while, the second phase involved only lame donkeys for a detailed characterization of lameness. Donkeys were sampled by simple random sampling techniques for the determination of prevalence of lameness, characterization of lameness, and estimation the major causes and associated risk factors of lameness. The sample size determined was based on the formula given by Thrusfield (2005).

Data Collection and Examination Protocols

Data was collected from donkeys representing the most prevalent work type locally; all donkeys pulled carts and were employed in the transportation of goods and people in and around Hawassa. Working donkeys encountered in and around Hawassa were examined opportunistically, with owners' consent and without reference to existing or pre-existing lameness. They were unhitched from their carts and all harnessing was removed for characterization of lameness in the clinic. A head-collar with attached rope was also fitted to each donkey for handling during examinations. The inclusion criteria required that donkeys could be handled with only the halter for restraint could be walked in-hand without force, and that all their limbs could be safely observed, palpated and manipulated. Data on pathological abnormalities and pain responses in the feet, limbs and spine were collected through observation, palpation, manipulations and gait assessment in working donkeys as per procedures of Palmer (1990). Lameness at the walk was scored on a scale of 0–5 (sound – non weight-bearing).

During each examination, assessment and data recordings on the recording sheet format was carried out. Briefly, a standard lameness examination (Ross and Dyson, 2003) was adapted for field use. The sex, age, body condition score (BCS) and demeanour of each donkey were noted. Body condition was scored using the descriptive criteria in Pritchard et al. (2005). Age determination was undertaken based on dentition. Foot examinations included aspects of pathology, foot pain and symmetry was assessed by response to digital pressure, hoof testers and percussion with a small hammer at set points over the sole, frog, heels and hoof wall. A foot measurement previously shown to relate to lameness was recorded. Limb palpation was performed from distal to proximal, noting pain responses, swelling, cracks and wounds. Spinal palpation and manipulation was included as a standard element in a complete lameness examination (Alvarez et al., 2007).

Study Methodologies

Direct observational visits and examination procedures of lameness: Observational visits were undertaken to key locations and institutions of importance to the defined donkey population including the main market places, watering places, veterinary clinics, livestock market, main cart donkey stops and stables for one hour in the morning and the afternoon on alternate days to take into account the morning and afternoon shift donkeys. The requirement of the present study was to develop a lameness assessment protocol suitable for use in the field locations where donkeys were examined, including rest places, near markets and, along roadsides, and in rural villages. Time available for each examination was limited because owners were dependedmostly on their animals for income. Prior to data collection, the assessment protocol was tested under field conditions in Hawassa on October-April 2011/2012.

Examination procedures of lameness: The distal and hind limbs were inspected for signs of crack, discharges, uneven wear and poor conformation (Ross and Dyson, 2003). Uneven trimming of the foot was evaluated by, when one stands behind the donkey and evaluate the symmetry of the heels. The heels were considered as "sheared" appearance if the ground contact was not even due to one of the bulbs of the heel being pushed higher than the other. Signs of increased heat around the coronary band and hoof wall were determined by comparing with the opposite foot. With weight off the foot, the palmar region was examined for determining any loss of elasticity of the lateral cartilages, indicating the development of side bone. Hoof testers were used to determine if pain was there in any part of the foot. With the foot on the ground, the hoof wall in then tapped with a hoof hammer to determine if any painful areas are present, which may have been unapparent with hoof testers. Moreover, inspection of the fetlock joints, tendons and palpation of dorsal thoracic spinus was done as per procedures of Palmer (1990) to find lameness.

Indirect assessment: Focus group discussions were held on ten occasions in public areas with cart donkey owners, and clients for indirect assessment. The discussions were focused on major health problems, major feet associated health problems, risk factors associated with limb problems, the association between limb problems and risk factors, treatment options undertaken when donkeys get lameness, what should (owners, governments, nongovernmental organizations and municipality) do to prevent this limb problems and the measures of management system directly related with the lameness of the donkeys. The focus group discussions took place near to the owners and donkey drivers' village. Groups were between 6-15 people and the results were pooled into general observations and compared with results from the observation.

Data Management and Analysis

The data collected from the study area was entered into MS excel spread-sheets and analysed using SPSS version 20.0. Descriptive analyses were carried out using SPSS version 20.0 taking each Keble separately to enable the prevalence of pathological abnormalities to be documented and compared. The lameness scores were computed in association with specific pathological abnormalities (arthritis, thrush, sub solar abscess, hoof cracks, joint swellings, myopathy, sole bruise, puncture wound, and white line disease) and body conditions, age, address and etc. In all models, the non-independence of limbs from each donkey (a random factor) was taken into account, as well as factors including the Keble, work type, age, sex, or body condition. The models were multivariable; so several predictors of interest (whether categorical or continuous) could be tested simultaneously, allowing the strengths of their relationships with the outcome variable to be compared. Interactions between factors of interest were also investigated.

RESULTS

From the total of 384 examined donkeys, 75 (19.53%) were found with lameness, in which 72% were of low grade lameness, 17% moderate grade lameness that followed by high grade lameness (9.33%; Table 1).

Table 1: Grade of lameness with their percentage

Lameness grade	No of positive animals	Prevalence (%)
Low grade lameness (grade 1)	54	72.0 % (54/75)
Moderate grade lameness (grade 2)	13	17.0 % (13/75)
High grade lameness (grade 3)	7	9.33 % (7/75)
Immobile (grade 4 / 5)	1	1.33 % (1/75)
Total	**75**	**19.53%(75/384)**

Prevalence of Lameness with Respect to Risk Factor

The data was analysed for observing the association of the risk factors (age, BCS and behaviour) with the presence of lameness. The age groups between 0-5, 6-10 and11-15 and greater than 15 years had lameness with prevalence of 1.56%, 4.14%, 6.77%, and 7.03%, respectively. The prevalence based on body condition scoring of 2, 2.5 and 3 were 10.4%, 6.51% and 2.60%, respectively. The highest number of donkeys with lameness (15.36%) was found with depressed behaviour followed by alert (2.34%) and friendly or normal behaviour (1.82%). According to the study, prevalence of lameness had played significant role in the behaviour of donkeys. Variation of lameness among age and body condition score of donkeys was also statistically

Table 2: Association of lameness with age, body condition and behaviour

Risk Factor	Category	Prevalence	X^2	p-value
Behavior	Normal (friendly) N=7	7(1.82%)	50.7	0.00
	depressed (n=62)	59(15.3%)		
	alert (n=13)	9(2.34%)		
Age (years)	0-5 (n=6)	6(1.56%)	10.8	0.00
	6-10 (n=16)	16(4.17%)		
	11-15(n=26)	26(6.77%)		
	>15(n=27)	27(7.03%)		
	Total =75	75(19.5 %)		
Body condition	Poor (BCS -2) (n=40)	40(10.4%)	11.3	0.03
	Moderate (BCS-2.5)(n=25)	25(6.51%)		
	Good (BCS-3)(n=10)	10(2.60%)		
	Total=75	75(19.5%)		

significantly (P<0.05;Table 2).

Results of Major Feet Associated Lameness Problems

Multiple chronic pathological abnormalities within each limb were associated with different lameness types, in which sole bruise (3.64%) was on the peak that followed by puncture wound (3.12%) and subsequently by thrush, sub solar abscess, and hoof cracking with 2.34% each as shown in Table 3.

Table 3: Major feet associated lameness problems encountered during the study period

Major feet associated lameness problems	Total No of animals	Prevalence (%)
Arthritis	5	1.30
Sole bruise	14	3.64
Sub solar abscess	9	2.34
White line disease	7	1.82
Puncture wound	12	3.12
Thrush	9	2.34
Myopathy	6	1.56
Hoof cracking & overgrowth	9	2.34
Navicular disease	4	1.01

Results of Indirect Assessment

An indirect assessment on prevalence of different major health problems of donkeys was carried out in five kebeles of Hawassa, indicated in (Table 4). From the total of 110 peoples in 10 groups with donkey owners and drivers association were made the focus group discussion and put their answers on the general health problems of donkeys and with simple ranking and proportional pilling were found to be with 27% of donkeys have wounds, 20% have internal parasites and coughing, 14% have lameness, 7% have hoof over growth and cracking, 6% have colic and 8% were encountered with other problems. The incidence of wound was recorded as the highest major health problem followed coughing (in wukrosefer) and internal parasites (in hykdar) (Table 4). According to the survey, lameness was the fourth most important health problem with the prevalence percentage of 14, often higher in datokebele followed by cheffe.

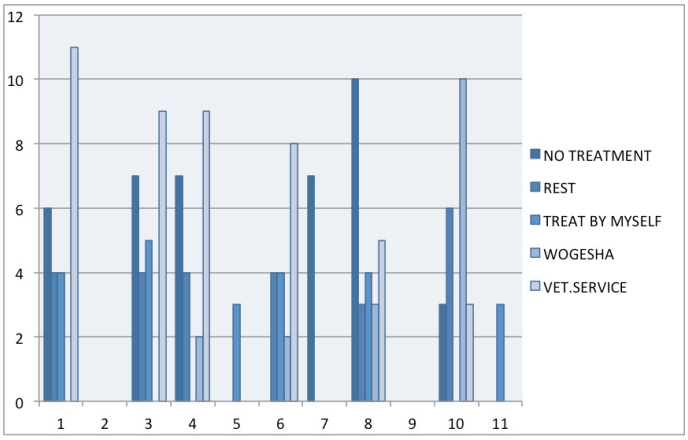

Figure 1: Available treatment options for the treatment of foot problems

Focus group discussion were made by drawing a total of 530 bills or gravels among a group of 6-15 people for each donkey owners and drivers association. Owners were allowed to put their answers on the causes of certainly specified criteria related to the limb problems of donkeys. Results of the indirect assessment through a focus group discussion revealed that bruising and abscess, thrush, myopathy, arthritis, hoof cracking and over growth and luxation, dislocation and fracture in donkeys were due to strenuous work or restlessness, beating, over loading, housing problem, road problem as well as accident (Table 5). During the focus group discussions, all members of the focus group gave similar responses about the treatment options

Table 4: Results of indirect assessment with donkey owner and cart-drivers

Major Health Problems	Prevalence of Health Problems					Overall Prevalence (%)
	Cheffe	Korem	Dato	Wukro	Hykedar	
Wound	25	25	23	31	24	27
Coughing	14	20	22	25	17	20
Internal parasite	25	19	15	18	21	20
Lameness	15	14	16	10	11	14
Hoof cracking over growth	5	7	7	5	7	7
Colic	4	8	6	4	7	6
Others	10	5	8	5	12	8

Table 5: Major foot problems (%) in different areas of Hawassa

Site	Bruising & Abscess	Thrush	Myopathy	Arthritis	Hoof cracking and over growth	Luxation, dislocation and fracture	Others
Cheffe 1	36	24	12	6	4	3	15
Korem 1	29	20	18	11	8	7	7
Dato 1	25	18	17	10	9	8	13
Dato 2	28	17	21	6	5	4	19
Korem 2	29	14	17	9	10	7	14
Wukro 1	31	10	15	10	14	8	12
Wukro 2	28	21	17	8	13	7	6
Cheffe 2	33	16	28	6	10	4	3
Hykedar 1	23	21	14	8	18	6	10
Hykedar 2	31	17	22	6	10	7	7
Total	**293**	**178**	**181**	**80**	**101**	**61**	**106**

of donkeys by putting veterinary service as primary, followed by no treatment and wogesha(an alternative therapy done by a trained therapist) in addition to other options (Figure 1).

DISCUSSION

Aim of the investigation was to assess the prevalence of lameness as well as to characterise its types with the determination of risk factors associated with lameness in working donkeys. Lameness was seen in 19.53% examined donkeys. If pain is considered as a component of lameness, then 100% of donkeys were experiencing pain, and for working donkeys that typically pull loads for long hours daily (Pritchard et al., 2005), this is of considerable welfare concern. Indeed in the current study, higher lameness scores were significantly associated with pain responses to percussion of the hoof walls, palpation of the distal flexor tendons (DFTS), distal limb joint flexion, carpal joint flexion and thoracolumbar spine manipulation. There were no other significant associations with pain, but of course, a lack of statistical significance may not mean that no other associations existed. For example, the pain measures used in this study were limited to digital pressure and joint manipulation tests suitable for field conditions, but other tests less amenable to the circumstances, such as diagnostic analgesia, may have revealed additional associations. Also, not all possible relationships were tested here as a trade-off between Type I and II errors (Bender and Lange, 2001), so some associations may have been missed.

Apart from pain, lameness can arise from mechanical dysfunction. Here, it was suggested by the correlations between high lameness scores and stiffness in the upper limbs, swelling (but apparently not pain) in many limb structures, and proprioceptive abnormalities indicated by the foot replacement test (Broster et al., 2009).

The working donkeys with body condition scoring of 2, 2.5 and 3 were had lameness prevalence of 10.4%, 6.51% and 2.60%, respectively. The body condition were had significant association with the prevalence of lameness (p=0.03) which has been found previously (Pritchard et al., 2005), raises questions regarding the direction of its causality. Lameness could reduce body condition through lame donkey expending more energy on locomotion than sound donkeys (Weishaupt et al., 2004; Weishaupt et al., 2006), with most donkey owners in developing countries being

unable to increase the quantity of food provided. This suggests that lame donkey are less efficient (i.e. produce less work for a given amount of food/energy) than sound ones, so it is in owners' long-term interests to reduce lameness if possible. Lameness could also reduce body condition indirectly through pain, perhaps through loss of appetite (Dobromylskyj et al., 2000; Almeida et al., 2008). Alternatively, lameness could be the consequence rather than the cause of thin body condition; malnutrition could contribute to limb pathology, since nutrition is important in the development (Finkler-Schade, 2007) and maintenance of a healthy musculoskeletal system (Goggs et al., 2005). Finally, overwork could independently lower body condition and increase lameness simultaneously (Maranhão et al., 2006).

Perhaps unsurprisingly, lameness scores increased with age, those age groups between 0-5, 6-10 and-15 and greater than 15 years were had lameness prevalence of 1.56%, 4.14%, 6.77%, and 7.03%, respectively. The chi-square test showed that age has statistically significant association with occurrence of lameness (p=0.00), this relationship was both significant in the forelimbs and hind limbs. But this may have been high in hind limbs because lameness was worse in the hind than forelimbs, possibly suggesting that lameness developed more readily in the hind limbs and therefore was already maximally prevalent even in adult and old donkeys. The reason for such prevalent hind limb lameness here might lie in the propulsion required for the draft work carried out by these equids (Maranhão et al., 2006). The added weight of the cart, especially when heavily loaded, causes a caudal shift in the centre of balance, increasing the likelihood of hind limb lameness in these donkeys (Ross and Dyson, 2003), as might the added traction required for overcoming inertia when starting journeys. Palmer (1990) reported that in Standard bred trotters, the proximal hind limb is a frequent site of lameness, with the hock joint being the most affected.

Regarding the pathologies contributing to lameness, conformational abnormalities were of interest because of their visibility, potentially making them useful field indicators. Limb conformation abnormalities, such as offset knees and sickle hocks, are regarded as potential aetiological factors for lameness (Stashak, 2002; Anderson et al., 2004), but empirical evidence for specific associations is fairly sparse (van Weeren and Crevier-Denoix, 2006). In this study, conformation abnormalities were prevalent and several were associated with pain: upright pasterns, for example, were associated with pain on percussion of the frog and on palpation of the DFTS. The findings indicate that lameness scores increased with direction of causality. Interestingly, carpal valgus was associated with a reduced frequency of pain on carpal flexion in broad agreement with Anderson et al. (2004), who found carpal valgus to be protective for carpal pathology.

The highly prevalent multiple joint and tendon swellings, and reduced joint flexion, are all clinical signs associated with lameness, and have been reported in Brazilian equids to be due to overwork on unsuitable surfaces (Maranhão et al., 2006). The results of the present study found sole bruise (measured as pain and stiffness on manipulation) in the distal limbs to be highly prevalent and more so in the fore than hind limbs, and this pattern fits with the literature, in that most forelimb lameness problems occur in the distal limb, whereas hind limb lameness is predominantly related to the upper limb (predominantly the hock) (Ross and Dyson, 2003). In the present study, limb manipulations demonstrated that pain in the lower joints and stiffness in the upper joints particularly contributed to lameness.

Foot examinations showed that measures of pain, structural abnormalities and an increased digital pulse were highly prevalent. The high proportion of donkeys with, reduced frog size or hoof imbalance suggest that improving foot management could be an effective intervention, but other indications of poor farriery were associated with pain or inflammation in the foot that could contribute to lameness. For example, cracked hoof walls were associated with pain on percussion. These associations are noteworthy because increased digital pulse and hoof wall pain on percussion were both directly associated with higher lameness scores (Broster et al., 2009).

The draft donkeys in this study seem to be representative of the wider working equine population of Hawassa because the prevalence of sex, age, demeanour and body condition scores compared closely to the 384 working equids. Differences between in Hawassa could have been due to many factors including cultural influences, differences between transporting goods versus people, differences in management practices, differences in terrain, and seasonal effects.

In Hawassa, donkeys are used almost exclusively for packing. According to the study, donkeys play a crucial role in transport services in all the study kebeles. Lameness is one of the severe constraints on donkey management. Whereas, Sisay and Tilahun (1997) reported that feed shortage to be the most important constraint in keeping donkeys. Respondents were ranked major management constraints by proportion. From the total of 110 peoples in 10 groups with donkey owners and cart-drivers association were made the focus group discussion and put their answers on the general health problems of donkeys and with simple ranking and proportional pilling were found to be with 27% of donkeys have wounds, 20% have internal parasites and coughing, 14% have lameness, 7% have hoof over growth and cracking, 6% have colic and 8% were other problems.

In summary, this study revealed the broad range and extremely high prevalence of pathological abnormalities associated with lameness in these working donkeys. It describes the associations found between conformation abnormalities, foot, joint, tendon and spinal abnormalities in working draft donkeys of Hawassa. These prevalences may be conservative, since more advanced diagnostic techniques than the field tests used here might have revealed still higher prevalence. A greater understanding of the pathological abnormalities associated with lameness in working donkeys, will allow more strategically targeted interventions to combat lameness. For efficient utilization, the coordination of the community with governmental and nongovernmental organization is an important way to alleviate management and health problems of working donkeys. Formation of association, provision of education to the community, treating of diseased animals, construction of working place and provision of health care measures and feeding of animals were the possible solutions, which were rise by the respondents. This is imperative to help achieve income security among the very poor donkey owners and to improve the welfare of the animal.

CONCLUSIONS

The result of this study indicated that many of the donkeys working in the area were experiencing multiple health problems that lead to lameness. The animal welfare awareness among peoples especially owners of working equine was very low. The main problems (wound, lameness, poor body condition etc.) were largely due to the ignorance and poor attitude of the owners. The finding will be used as a benchmark to start intervention towards improvement of welfare of donkeys. The problems could be improved by combination of simple practice like disinfecting of site of wound and harness materials, by deworming, routine hoof care, provision of adequate water and feed and less stressful working practice.

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AUTHORS' CONTRIBUTION

Ashenafi Kiros was the advisor from beginning to end. Mamuye Gezahegn collected and organized the data. Alemu Aylate provided materials, analysed the data, advised the data collector and edited the final version of this article.

CONFLICT OF INTERESTS

There is no conflict of interest.

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