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Full Length Research Paper

Prevalence and associated risk factors of equine wound in and around Asella town, South Eastern Ethiopia

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Equines are essential in the farming and transport systems of many areas of developing countries including Ethiopia. However, their socioeconomic importance is often under recognized and they suffer from poor husbandry practices which threaten their welfare and health. Wound is main problem emanated from such practice that results in deviation of their health and welfare. Cross-sectional study was conducted from November, 2016 to January, 2017 with the objective to determine the prevalence and associated risk factors of wound in randomly selected equine in and around Assella town. Physical examination and semi-structured questionnaire were simultaneously employed to collect necessary information and possible risk factors. Out of 400 equines (278 horses and 122 donkeys) examined 250 were found to have wound on one or more of their body parts and the overall would prevalence was 62.5% of which 65.8% was in horses and 54.9% was observed in donkeys. Multivariable logistic regression analysis showed that the prevalence of wound was significantly higher in horse (65.8%) than donkeys (54.9%) (OR=3.509; 95% CI=1.505, 8.184, *p*= 0.004), the prevalence was higher in adult (66.6%) than in young equine (43.8%) (OR= 2.782, CI= 1.244, 6.225, *p*=0.013), in males (69.4%) than in females (42.1%) (OR= 4.192, CI=2.122, 8.281, *p*= 0.000), in poor body conditioned equines (97.0%) than in good body conditioned equines14.6% (OR=454.614, CI=124.291, 1662.829). Moreover, the prevalence of wound in relation to harnessing type was 69.3, 62.8 and 52% in grass, plastic and traditionally prepared leather, respectively. However, this variation was not statically significant (*p*= 0.111).There was significant variation in causes of wound between horse and donkeys and the wound caused by improper harness was highest (X^2=39. 357, P-=0.000) in both horses (35.55%) and donkeys (25%). Similarly, the owners response to the management of wound in horses and donkeys was significantly (X^2=15.308, *p*=0.032) different and the majority of donkeys (71.6%) and horses (65.5%) did not receive any help from their owners. This study revealed a high prevalence of equines wound in and around Asella town which indicate the prevailing situation of equine welfare and health problems. This strongly calls for a continuous awareness creation to equine owners on proper management and handling and improve their welfare and health thereby enhance the utilization and improve the livelihood of the community.

Key words: Equines, wound, prevalence, risk factors, Asella.

INTRODUCTION

The equine population of the world is currently reported to be about 112.5 million of which 44.3 million donkeys, 58.5 million horses and the remaining are mules (FAO, 2013). The number of equines in Africa is in the range of 17.6 million comprising 11.6 million donkeys, 2.3 million mules and 3.7 million horses (Mulate, 2005). In the distribution pattern, 98% of all donkeys, 97% of all mules and 60% of all horses were noted to be found in developing countries (Fielding, 1991). Ethiopia possesses approximately half of Africa's equine population with 37, 58 and 46% from total of donkeys, horses and mules, respectively (FAO, 2003). The country ranks 8th in the world and there are about 7.88 million donkeys being the second largest donkey population in the world next to China, 0.41 million mules and 2.08 million horses (CSA, 2016).

Equines (donkeys, mules and horses) play an important role as working animals in many parts of the world, for packing, riding, carting and ploughing (Feseha et al., 1991). They have a prominent position in agricultural systems of many developing countries including Ethiopia (Feye and Bekele, 2016). Equine power is very crucial in both rural and urban transport system. This is because of its cheapness and availability and so provides the best alternative transport means in places where the road network is insufficiently developed and the landscape is rugged and mountainous and in the cities where narrow streets prevent easy delivery of merchandise (Feseha et al., 1991). In areas away from roads, many people use mules and donkeys to transport food and other supplies to villages (Yoseph et al., 2005). Horses involved in pulling carts often work continuously for 6 to 7 hours/day, carrying 3 to 4 persons in a single trip. Donkeys often are involved in more multipurpose activities than horses. They transport goods to and from markets, farms, and shops, travelling long distances (Biffa and Woldemeskel, 2006).

Despite the huge numbers of equine population and their invaluable contributions as an engine that power rural as well as urban economic development of the nation, equines in Ethiopia are the most neglected animals and little attention is given to study their health status. Equines suffer from a number of diseases including infectious and non-infectious throughout the globe affecting the health status (Sumbria et al., 2017). The information on the wound prevalence and associated risk factors are scarce at national level and in Assella in particular despite, the invaluable contribution of such study in exploring their welfare and health status. Therefore, the main objectives of this study were to determine the prevalence and associated risk factors of equine wounds in and around Asella town, south eastern Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted in Asella town of Arsi zone, Oromia region, which is located in South East of Ethiopia within 6° 59' and 8°49' latitude and 40°44' E longitudes and is located at 175 km South East of Addis Ababa. The town has an elevation of 2,430 m.a.s.l and characterized by mid subtropical temperature ranging from 5 to 28°C. The annual average rainfall is 1200 mm and mostly with clay type of soil and in rare case black soil (APEDO, 2007). The annual temperature range is 10 to 22.6°C. It has a daily maximum temperature that can reach up to 28°C and minimum temperature of 10°C (NMSA, 2013). Asella town and the surrounding farming community, has a total area of 300.21 km^2. This, about 208.43 km^2 (69.4%) of the total area is agricultural land, 40.61 km^2 (13.5%) pastoral land, 6.74 km^2 (2.3%) forest, 39.34 km^2 (13.5%) land for construction and 5.08 km^2 (1.69%) non-fertile land (ABTW, 2010/2011).

Study design and study population

A cross-sectional study design was employed from November, 2016 to January, 2017 for assessing the prevalence and associated risk factors of equine wound in and around Asella town. The study population include local breed of equines (horses and donkeys) population found in and around Assella town. The population comprise horses and donkeys of different sex, age, and body condition.

Sample size determination and sampling technique

The sample size for the study was calculated using the formula given by Thrusfield (2007) based on the expected prevalence of 50%, with 95% confidence interval and 5% absolute level of precision. Accordingly, the required number of animals was 384. However, to increase precision the sample size was increased to 400. Simple random sampling method was used for selecting study population.

Study methodology

Each of the selected equines was physically examined to check for any grossly visible wounds. Furthermore, the age and body condition determination were performed during physical examination. The age of the selected equines were determined by inspecting and estimating the incisor eruption times (Crane, 1997; Svendsen, 1997). Equines were grouped into two age categories namely young (< 5 years) and adult (>5 years). The body condition was scored as poor, medium and good as described by Carroll and Huntington (1988) and Svendsen (1997).Wounds were classified as

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abrasion when it involves superficial denuding of the epidermis with minimal (capillary) bleeding and usually some serum/plasma exudation. Non-penetrating wounds of the skin that arises from abrasion against a rough or hard object such as a road surface were considered as abrasion. Moreover, the wounds in the skin and hoof that arises from sharp objects such as nails, glass shards, or other foreign bodies that penetrate and generally look minor by making small skin tears or holes were categorized as puncture wound. Furthermore, a wounds with sharp defined margin and caused by sharp metal or glass in which the skin is cut cleanly with minimal tearing and bruising of the wound margins were categorized as incision wounds whereas, the traumatic tearing of the skin in an uncontrolled direction was considered laceration as described by Knottenbelt (2003). Wounds were also classified as severe when there was ulceration involving a pronounced contusion in wide areas, tissue hypertrophy and sever complication. A wounds involving coalition of small wound with tissue sloughing involving no complication and hypertrophy and some with chronic courses were categorized as moderate wounds. Furthermore, the wounds that involve only loss of epidermis and superficial layers with no further trauma were categorized as mild according to classification used by Biffa and Woldemeskel (2006). In addition to physical examination a semi-structured questionnaire was also developed to collect data, including harnessing type, intensity of wound, cause of wound, and owners' responses with regard to the management of wounds.

Data management and analysis

The data was entered and edited in a Microsoft Excel spread sheet and analysed using Statistical Package for Social Sciences version (SPSS) 20. Descriptive statistics was used to determine frequencies and percentages of the data. Prevalence of wounds related to specific risk factors was determined as the proportion of would positive animals out of the total sample. Specific category frequency of a given factor was computed as the proportion of cases out of the total cases of that hypothetical factor. The strength of association of factors to occurrence of wounds was investigated using multivariable logistic regression. The 95% confidence interval of OR and p-values were used to describe statistical significance associations and value of $p<0.05$ was considered as significant. Furthermore, chi-square test was used for determining difference between horse and donkey in relation to wound by type and intensity, distribution, causes and owners' responses to the management of wound.

RESULTS

In this study a total of 400 equines (278 horses and 122 donkeys) were investigated to determine the prevalence and associated risk factors of wound. The overall prevalence of 62.5% was recorded of which 65.8% was from horses and 54.9% from donkeys. In this investigation, significantly higher prevalence of wound was observed in horse (65.8%) than in donkeys (54.9%). Furthermore, the age of animals was also found to be statistically significantly associated with wound prevalence being higher in adult (66.6%) than in young (43.8%). Adult animals were 2.782 times more likely to be positive of wound than young (Table 1).The prevalence of wound based on sex was 69.4% and 42.1% in males and females respectively. This variation was also statistically significant being higher in male (69.4%) which was 4.192 times more likely to be wound positive than female (42.1%). The association of body condition with occurrence of wound was found to be significant (p= 0.000) and highest in poor body conditioned equines (97.0%) 454.6 followed by medium body conditioned equines (58.5%) which were 15.240 times more likely to be wounded than good body conditioned equines (Table 1). The prevalence of wound in relation to harnessing type was 69.3, 62.8 and 52% in grass, plastic and traditionally prepared leather, respectively. However, this variation was not statically significant (p=0.111) despite the observation of highest wound prevalence in grass harnessing type (OR=2.205, CI=0.821, 5.925) and plastic harnessing type (OR=0.876, CI=0.324, 2.367) than traditionally prepared leather. The prevalence of wound in relation to harnessing type (plastic, grass and traditionally prepared leather) is summarized in Table 1.

Abrasion was the most frequently observed wound type in both horses (50.2%) and donkeys 55.2%) and followed by lacerative (35.2%), puncture (9.6%) and incision wound (3.6%). Furthermore, moderate wounds were most frequently observed than other wound severity in both horses and donkeys which was 62% of the cases. No significant difference in both type and intensity of wound was observed between horse and donkeys (p>0.05).The proportion of wound by type and intensity was summarized in Table 2.

In the examined equines wound was frequently observed on wither (23.6 %) and followed by back and shoulder (Figure 1) wound which account for about 15.6 and 12% of the wound distribution respectively. However, no significant difference (p>0.05) was observed between horse and donkey in relation to distribution of wound on various body parts. No single wound was observed on pre scapular area of donkeys compared to 1.6% in horses. Wound on mixed area (distributed in different area) accounts for 22.4% of wound observed in horse. The distribution wound on various body parts is summarized in Table 3.

There was significant variation in causes of wound between horse and donkeys and the wound caused by improper harness was highest (X^2=39. 357, P-value= 0.000) in both horses (35.55%) and donkeys (25%). The next leading cause of wound was infectious disease in horses (11.4%) and overworking (19.4%) in donkeys. None of the observed donkeys had wound caused by nail piercing (Table 4). In addition owners response to the management of wound in horses and donkeys are significantly (X^2=15.308, P-value 0.032) different, majority of donkeys (71.6%) and horses (65.5%) did not receive any help from their owners. The owner's responses to the management of wound are summarized in Table 5.

DISCUSSION

This study revealed an overall prevalence of 62.5% of

Table 1. Logistic regression analysis output of factors associated with equine wound in and around Assela town, South Eastern Ethiopia.

Risk factors		Number examined	Wound positives	Prevalence (%)	Univariable			Multivariable		
					OR	(95% CI)	P- value	OR	95% CI)	P- value
Species	Horse	278	183	65.8	1.581	1.0, 2.4	0.039	3.509	1.5, 8.2	0.004
	Donkey	122	67	54.9						
Sex	Male	298	207	69.4	3.121	2.0, 5.0	0.000	4.192	2.1, 8.3	0.000
	Female	102	43	42.1						
Age	Young	73	32	43.8	2.562	1.5, 4.3	0.000	2.8	1.2, 6.2	0.013
	Adult	327	218	66.6						
Body Condition	Poor	136	132	97.0	195.250	60.7, 627.7		454.6	124.3, 1662.8	
	Medium	181	106	58.5	8.362	4.239, 16.5	0.000	15.2	7.1, 32.9	0.000
	Good	83	12	14.6						
Harnessing Type	Plastic	288	181	62.8	1.561	0.9, 2.9		0.9	0.3 2.4	
	Grass	62	43	69.3	2.089	1.0, 4.5	0.168	2.2	0.8 5.9	0.111
	Traditionally prepared leather	50	26	52						

equine wound in and around Assela town which is in agreement with the finding of study by Fikru et al. (2015) who reported an overall prevalence of 64% in and around kombolcha town. The result of current study is higher than the finding of Tesfaye et al. (2015) who reported 30.3% in and Around Mekelle town, Northern Ethiopia and result of Usman et al. (2015) who reported 37.9% of equine wound prevalence in and around Batu Town, East Shoa, Central Ethiopia. However, this finding is lower than the reports of Biffa and Woldemeskel (2006) who reported 72.15% of equine wound prevalence in Hawassa town, Southern Ethiopia. This variation might be due to difference in husbandry practices and health care given by the owner to their equines among the study area.

Similar to the report of Fikru et al. (2015) the present study showed higher prevalence of wound in horse (65.8%) than donkeys (54.9%). This could possible associated higher ability of donkey to survive in harsh condition and less susceptibility to infectious disease than horse. Furthermore, this may be due to the fact that horses are more commonly used in cart than donkeys which may expose them to different cause of wound like nail piercing and higher number of horse included in this study might also be associated with higher prevalence of wound in horse.

This study revealed higher prevalence of wound in horses as compared to a study conducted in Mekelle, Northern Ethiopia (Sisay, 2013) who reported 25% prevalence of wound in cart horses. However, this result is almost similar with result of Biffa and Woldemeskel (2006) and Fikru et al. (2015) who reported 65.4 and 64.20% prevalence in Hawasa and Kombolcha town, respectively. The prevalence in donkey was comparable with finding of Herago et al. (2015) who reported 58.6% in Wolaita SoddoZuria district. However, this finding is higher than the result of Tsega et al. (2016) and Birhan et al. (2014) who reported 30.3 and 42.2%, respectively. Furthermore, this study revealed lower prevalence of donkey wound than the result of Fikru et al. (2015) and Biffa and Woldemeskel (2006) who revealed 63.40 and 79.4%, respectively. This variation in prevalence could be associated with variation in husbandry and management practice at deferent study area.

In this study the age of animals was found to be significantly associated with wound prevalence being higher in adult (66.6%) than young (43.8%). This finding is in agreement with Biffa and Woldemeskel (2006), Birhan et al. (2014) and Fikru et al. (2015) who reported significantly higher prevalence in adult than young. This could.

Table 2. Proportion of wound by type and severity.

Parameter		Frequency and proportion				
		Horse	Donkey	Total	X^2	*p*-value
Type of wound	Abrasion	92(50.2%)	37(55.2%)	129(51.6%)	10.0	0.92
	Lacerative	70(38.2%)	18(26.8%)	88(35.2%)		
	Puncture	16(8.7%)	8 (11.9%)	24(9.6%)		
	Incision	5(2.7%)	4(5.9%)	9(3.6%)		
Severity of wound	Mild	27 (14.7%)	11(16.4%)	38(15.2%)	7.3	0.063
	Moderate	109(59.5%)	46(68.6%)	155(62%)		
	Severe	47 (25.6%)	10 (14.9%)	57(22.8%)		

Table 3. Distribution of wound on various body parts.

Position of wounds	No. of horse (%)	No. of donkey (%)	Total (%)
Wither	37 (20.2)	12(17.9)	59(23.6)
Flank	7(3.8)	3(4.4)	10 (4)
Head	11(6.0)	2(2.9)	13 (5.2)
Neck	4(2.1)	1(1.5)	5(2)
Shoulder	19 (10.3)	11(16.4)	30(12)
Chest	17(9.2)	9(13.4)	26(10.4)
Front Limb	10(5.4)	5(7.4)	15(6)
Pre scapular	3(1.6)	0(0)	3(1.2)
Back	26(14.2)	13(19.4)	39(15.6)
Abdomen	3(1.6)	2(2.9)	5(2)
Hind Limb	5(2.7)	3(4.4)	8(3.2)
Mixed	41(22.4)	6(8.9)	47 (18.8)
Total	183	67	250

X^2 = 14.826; P-value = 0.251.

Table 4. Causes of wound in horses and donkeys.

Causes of wound	No. of horse (%)	No. of donkey (%)	Total (%)
Improper harness	65 (35.5)	17(25)	81(32.4)
Saddle design	10(5.4)	11(16.4)	21(8.4)
Overloading	3(1.6)	5(7.4)	8(3.2)
Overworking	21(11.4)	13 (19.4)	33(13.2)
Infectious disease	41(22.4)	4(5.9)	45(18)
Nail piercing	9(4.9)	0(0)	9(3.6)
Biting	2(1.1)	6(8.9)	8(3.2)
Cauterization	2(1.1)	0(0)	2(0.8)
Unknown	8(4.3)	5(7.4)	13(5.2)
Multi factorial	22(12.0)	6(8.9)	28(11.2)
Total	183	67	250

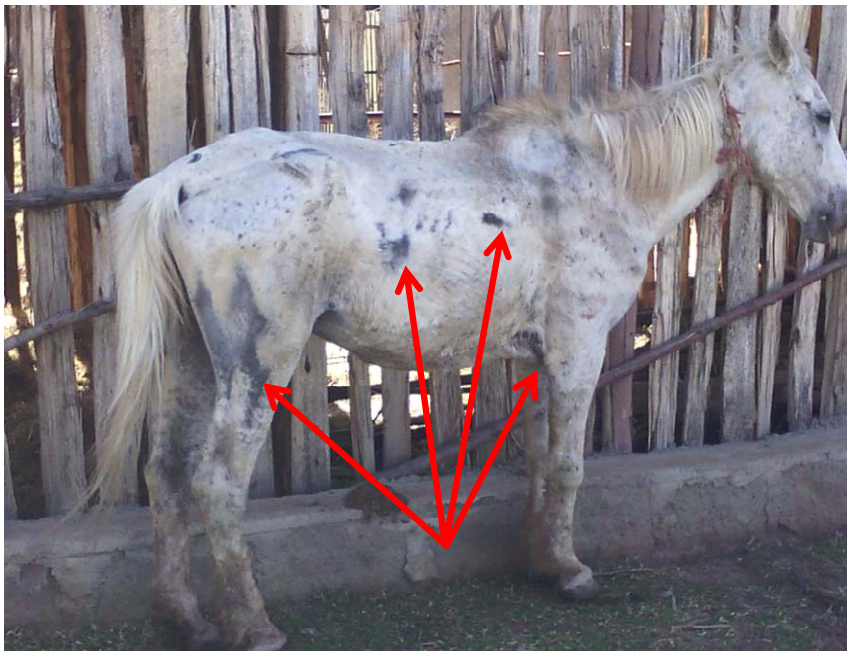
X^2 = 39. 357; *P*-value= 0.000.

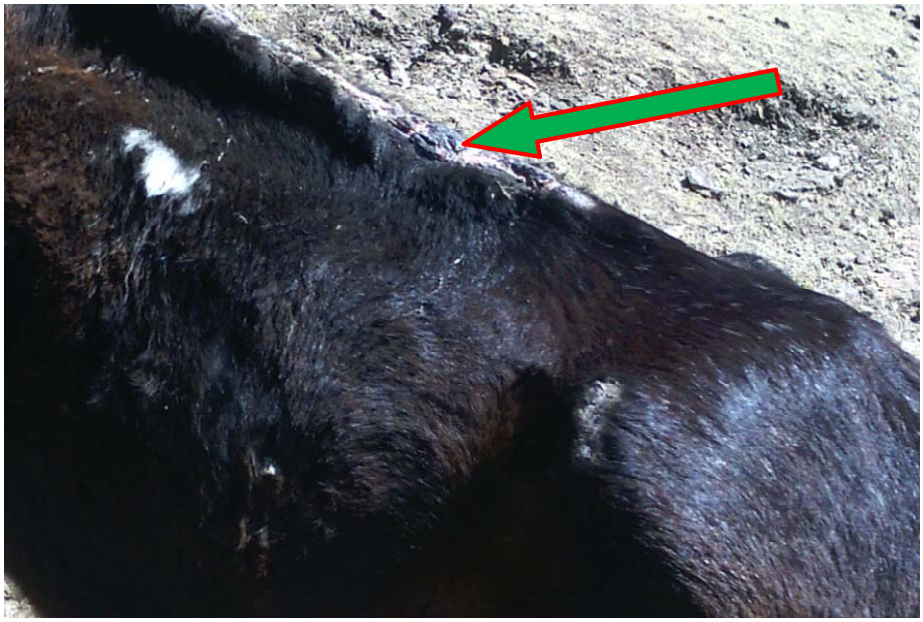
be due to the fact that adult animals exposed to different types of diseases and stress in their entire life which may affect the normal process of wound healing. Furthermore, adult were made to carry heavy loads over long distances

Table 5. Owners' responses to the management of wound.

Causes of wound	No. of horse (%)	No. of donkey (%)	Total
Take to nearby veterinary clinic	35(19.1)	6(8.95)	41(16.4)
Use sulphuric acid	8(4.3)	4(5.9)	12(4.8)
Use burned oil	12(6.5)	1(1.5)	13(5.2)
Take to local healer	4(2.1)	4(5.9)	8(3.2)
Treat with medicinal plants	4(2.1)	3(4.4)	7(2.8)
Treat with medications purchased from local market	0(0)	1(1.5)	1(0.4)
Do nothing	120(65.5)	48(71.6)	168(67.2)
Total	183	67	250

X^2 = 15.308; *P*-value 0.032





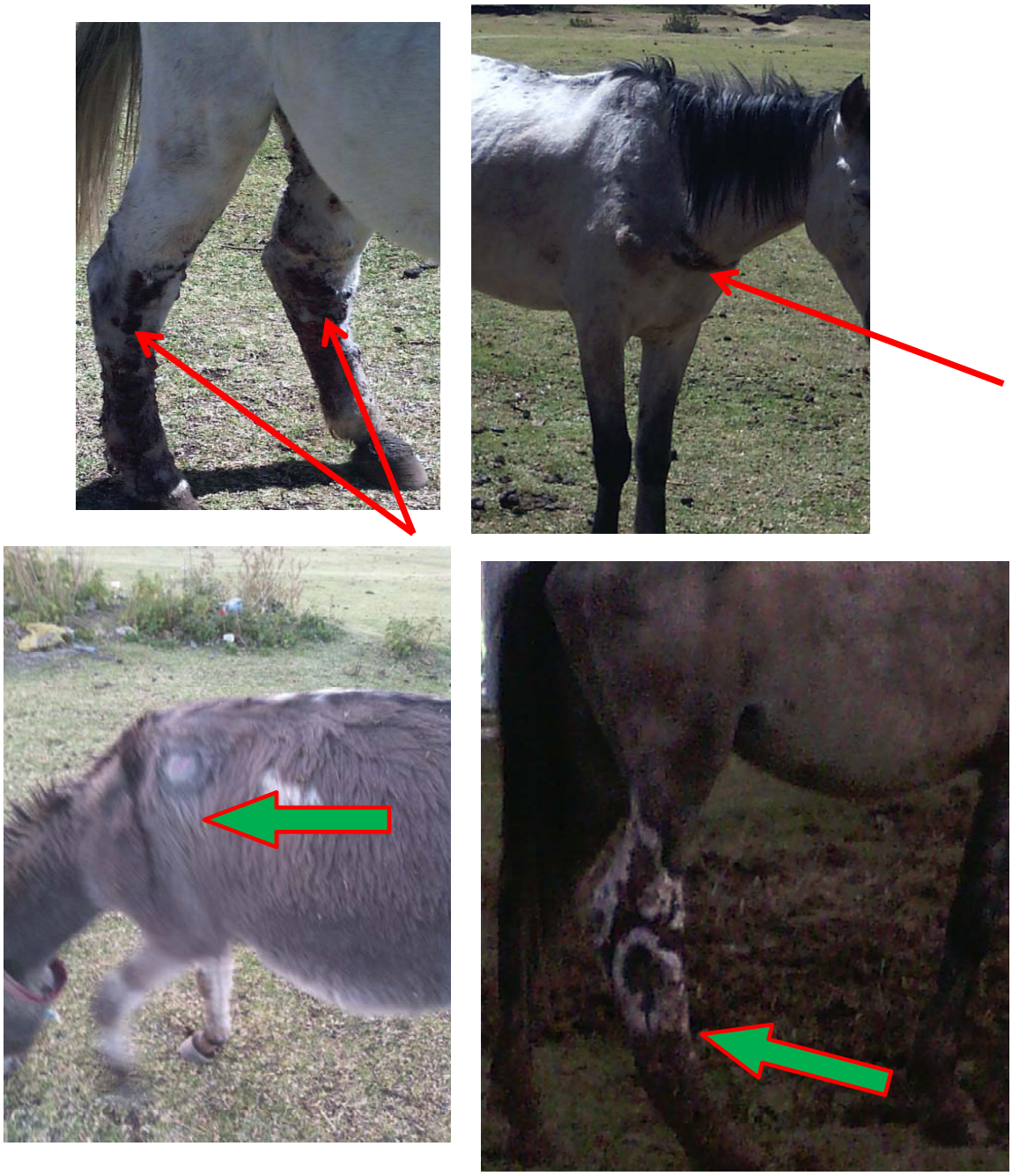


Figure 1. Wound on different body part of equine photographed during study period.

and hours this may expose them to wound The result of this study shows that the prevalence of equine wound was significantly associated with their sex and higher number of wound was observed in male (69.4%) than female (42.1%) (*P*=0.000). This result is also supported by Satessa and Lemma (2014) who reported significantly higher prevalence in males than females. This could be associated with work type since males are involved in works that predispose them to wound like cart pooling and they also suffer from overloading that lead to falling and consequently exposing them to wound. Furthermore, the higher number of male considered in this study could also be the possible reason.

In this study the association of body condition with occurrence of wound was significant (*p*= 0.000) and poor body conditioned animals are 454.614 times more likely to be wounded than good body conditioned (Table 1). This finding is in agreement with the report of Birhan et al. (2014) and Tsega et al. (2016) who reported significant difference between poor and good body conditioned

equine. Furthermore, Pearson et al. (2000) and Mekuria et al. (2013) indicated that poor physically conditioned equines mainly due to malnutrition are the leading causes of sores in equine. The probable reason for such association is due to equine with a poor body condition score may have less natural padding protecting them from pressure, friction and shear lesions caused by saddle. Less owners' attention to wound management and reduced immune defence mechanism of an animal with age advancement might also be the possible cause.

Similar to the finding of Fikru et al. (2015) abrasion was the most frequently observed wound type in both horses (50.2%) and donkeys 55.2%) and followed by lacerative (35.2%), puncture (9.6%) and incision wound (3.6%). There was significant variation in causes of wound between horse and donkeys and the wound caused by improper harness was highest in both horses (35.55%) and donkeys (25%).

This in line with other reports from peri-urban areas of Ethiopia such as Gondar North(Biffa and Woldemeskel, 2006), Mekelle (Helen, 2001) and Northern Ethiopia (Sisay, 2013).

With regard to wound management, the majority of equine owners did not receive any help from their owners which was in agreement With the finding of Biffa and Woldemeskel (2006) and Fikru et al. (2015) who similarly reported a widely existing equine welfare problem in Kombocha and Hawasa town, respectively.

Conclusion

This study revealed a high prevalence of equines wound in and around Assela town. Improper harnessing and infectious diseases were the major leading cause of the wound. Despite the significant role they have in day to day life of community the majority of equine did not receive any help from their owners while wounded. This strongly calls for a continuous awareness creation to equine owners on proper management and handling and improve their welfare and health thereby enhancing the utilization and improve the livelihood of the community. Furthermore, policies and legal frameworks that support animal welfare issues and inspect animal facilities should be promoted in order to ensure animal welfare issues.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

ABTW (2010/2011). Agricultural Bureau of TiyoWoreda Arsi Plan and Economic Development Office (APEDO) (2007). Socio Economic on Arsi Zone; Asella, Arsi. pp. 1-105.

Mulate B (2005).Preliminary study on helmenthosis of equines in south and north Wollo zones. J. Vet. Assoc. 9(2):25-37.

Biffa D, Woldemeskel M (2006).Causes and factors associated with occurrence of external injuries in working equines in Ethiopia. Int. J. Appl. Res. Vet. Med. 4(1):1-7

Birhan G, Chanie M, Tesfaye T, Kassa A, Mekonnen B, Wagaw N (2014). Incidence of wound and associated risk factors in working donkeys in Yilmana Densa District. Glob. Vet. 13(1):133-140.

Carroll CL, Huntington PJ (1988). Body condition scoring and weight estimation of horses. Equine Vet. J. 20(1):41-45.

Crane M (1997). Medical. In: The professional hand book of the donkey, 3rd edition.Whittet Books Limited, 18 Anley Road,London W14 OBY. pp.19-36.

CSA (2016).Federal democratic republic of Ethiopia.Central statistical agency. Agricultural sample survey, Volume II, Report on livestock and livestock characteristics.Statistical bulletin 583, Addis Ababa, Ethiopia.

FAO (2013). Economic and social department. The statics division, online data base FAO. Available at: http://faostat.fao.org/default.aspx

FAO (2003). Food and agriculture organization, Rome, Italy. Available at: http://faostat.fao.org/default.aspx

Feseha G, Mohammed A, Yilma J (1991). Vermicular endoparasitism in donkeys of DebreZeit and Menagesha, Ethiopia. Donkeys, mules and horses in tropical agricultural development. Proc. Colloq. On donkeys, mules and horses. Eds. D. Fielding and R.A. Pearson, University of Edinburgh, Center for tropical veterinary medicine: UK. pp. 156-160.

Feye A, Bekele T (2016). Prevalence of Equine Lung Worm (Dictyocaulus Arnfieldi) and Its Associated Risk Factors in Jimma Town, South West Ethiopia. Adv.Life Sci.Tech. 40:26-30.

Fielding D (1991). The number and distribution of in the world in proceeding of the colloquium on donkeys, mules and horses in tropical agricultural development, Edinburgh, 3-6 September,1991. pp. 62-66.

Fikru A, Tadese A, Gebreegziabher Z (2015). Prevalence of Equine Wound and Associated Risk Factors in and around Kombolcha Town, North Ethiopia. J. Vet. Sci. Technol. 6:234.

Helen B (2001) The Gharry horses of Gonder. Draught Animal News. Centre for Tropical Veterinary Medicine: University of Edinburgh, Scotland. 35:23-24.

Herago T, Megersa M, Niguse A, Fayera T(2015). Assessment on Working donkey welfare issue in WolaitaSoddoZuria District, Southern Ethiopia. Glob.Vet. 14:867-875.

Knottenbelt DC (2003). Handbook of Equine Wound Management. Liverpool, UK: WB Saunders. pp. 5-11

NMSA (2013). National Metrology Service Agency. Addis Ababa, Ethiopia

Pearson R, Mengistu A, Agajie T, Eleanor F, David G, Mesfin A (2000). Use and management of donkeys in peri-urban areas of Ethiopia, Draught Animal Power Technical Report 5, Scotland, University of Edinburgh: Centre Trop. Vet. Med. 4:260-275.

Satessa GD, Lemma FA (2014). Prevalence of External Injuries in Working Equines in Mehal Saint Woreda of South Wollo Zone, Ethiopia. J. Vet. Adv. 1(4):654-660.

Sisay WZ (2013). Causes and Factors Associated with the Episode of External Injuries in Cart-Horses of Mekelle Town, North Ethiopia. J. Vet. Adv. 3:265-274.

Sumbria D, Singla LD, Sharma A, Bal MS, Randhawa CS (2017). Molecular survey in relation to risk factors and haemato-biochemical alteration in *Theileria equi* infection of equines in Punjab Province, India. Vet. Parasit. Reg. Stud. Rep. 8:43-50.

Svendsen ED (1997).Parasites abroad. The professional hand book of the donkey, 3rd edition, Whittet Books Limited, 18 Anley Road, London W14 OBY. pp.166-182.

Tesfaye A, Yohannes T, Habtamu T, Kalab G, Hagos T (2015). Survey of Common Skin Problem of Working Equines in and Around Mekelle, North Ethiopia. Acad. J. Anim. Dis. 4(1):30-38.

Thrusfield M (2007) Veterinary Epidemiology (3rd edn)Blackwell science Ltd London, UK. pp. 228-246.

Tsega AM, Worku Y, Tesfaye T, Nazir S (2016). Prevalence of Wound and Associated Risk Factors of Donkeys in Merawi District, North-Western Ethiopia. J. Anim. Res. *6*(5):765-771.

Usman S, HaimanotDisassa TK, Kebede TZG (2015). Health and Welfare Related Assessment of Working Equine in and Around Batu Town, East Shoa, Central Ethiopia. Nat. Sci. 13(10):1-8.

Yoseph S, Smith DG, Mengistu A, Teklu F, Firew T, Betere Y (2005). Seasonal variation in the parasite burden and body condition of working donkeys in East Shewa and West Shewa regions of Ethiopia. Trop. Anim. Health. Prod. 37(1):35-45.

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A cross-sectional study on bovine Schistosomiasis in and around Kemissie,Dawa Cheffa District

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A cross sectional study was conducted in and around Kemissie, Dawa Cheffa District to estimate the prevalence and identify possible risk factors for the disease in the study area. Animal identification based on age, sex, breed and body condition score and management system of the study animals were taken into account followed by coprological examination for the presence of the developmental stages of parasites or parasite in naturally infected cattle. For this purpose, four hundred and five randomly selected animals were examined during the study period out of which 75 (18.5%) were found positive for schistosomiasis based on fecal examination. Variation together with age and sex of animals did not show statistical significance (P>0.05) in the disease occurrence. However, the prevalence of the disease was highest in young animals (23.14%), followed by adults (17.61%) and least in old animals (15.49%). On the other hand, statistical significant association (P<0.05) was seen with the variation of breeds, body condition score and management systems in the disease occurrence. In conclusion, relatively moderate prevalence (18.5%) was recorded in and around Kemissie and based on the results obtained, recommendations were forwarded.

Key words: Cattle, coproscopy, Kemissie, prevalence, Schistosomiasis.

INTRODUCTION

Animal production has been considered as the main component of agricultural development in most parts of sub-Saharan Africa. Like in many developing countries of the region, domestic animals play a crucial role in Ethiopia. They provide food in the form of meat and milk, and non-food items such as draft power, manure and transport services as inputs into food crop production, and fuel for cooking. Livestock are also a source of cash income through sales of the above items, animal hides determine social status within the community. Ethiopia is known for its high livestock population, being the first in Africa and tenth in the world (Gebrecherkos and Berihun, 2012). The recent livestock population estimate shows that the country has about 52.1 million heads of cattle, 24.2 million sheep, 22.6 million goats and 44.9 million poultry (MoARD, 2013).

Trematode parasitism is one of the biggest problems reducing ruminant productivity around the world and

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skins. Furthermore, they act as a store of wealth and (Vercruysse and Claerebout, 2001). In Ethiopia, the potential of livestock sector is not efficiently and fully exploited due to several constraints like malnutrition,traditional management practice, poor genetic makeup and prevailing diseases. Among the prevailing diseases in the country, trematodes are one of the main parasitic problems of cattle and other ruminants (Fromsa et al., 2011).

These parasitic diseases are found in vast water lodged and marshy grazing field, a condition anticipated to be ideal for the propagation and maintenance of the intermediate host snails and hence the high prevalence of trematode infection (Solomon and Abebe, 2007).

Among these trematode infections, Schistosomiasis (also known as Bilharzias) is economically important worldwide. It is a chronic and debilitating tropical disease caused by adult blood flukes (parasitic trematode worms) of the genus, *Schistosoma* that deposit eggs in blood vessels surrounding the bladder or gut of infected mammalian hosts (McManus et al., 2009).

It is an endemic disease of cattle in Africa and Asia while at least 165 million cattle are infected with bovine Schistosomiasis worldwide. Animal Schistomes are mainly restricted to tropical and sub tropical areas (Upadhayay, 2005). It has a restricted distribution, which is found commonly in northern, eastern, southwestern and central parts of Ethiopia (Habtamu and Mariam, 2011). Routine diagnosis of visceral Schistosomiasis relies heavily on observation of clinical signs and fecal examination for eggs of the parasite. It is a zoonotic disease affecting both humans and livestock. The growing interest in organic, outdoor and aquaculture farming are likely to present higher risk of infection (Chhabra and Singla 2009).

The blood flukes are grouped under the genus *Schistosoma* (McCauley et al., 1984) and the family Schistosomatidae. Schistosomes under this group are elongate, unisexual and dimorphic trematodes, which inhabit the blood vessels of their hosts. Members of Schistosomatidae show morphological and physiological peculiarities which set them apart from all other trematodes. Firstly, they are dioecious, the male bearing the female in a ventral canal, gynaecophoric canal and secondly they live in the blood stream of warn-blooded hosts, being the only trematodes to do so (Smyth, 2005). One of the most important in animals is *Schistosoma bovis* which occurs in the portal and mesenteric veins of cattle, sheep and goats in Central, East and West Africa, the Mediterranean area and in the Middle East (Soulsby, 2006).There are three main species of Schisotomes infecting humans, *Schistosoma mansoni*, *Schistosoma japonicum* which inhabit the mesenteries around the intestine and *S. haematobium*, which are found in the venules surrounding the bladder (Upadhayay, 2005).

Although, little or no overt clinical signs may be seen over a short period, frequent Schistosome infections, in the long term, cause significant losses to the herd (Ravindran et al., 2007).The disease is characterized by its chronic nature and affects the productivity and reproduction performances; and predisposes animals to other diseases (McCauley et al., 1984). Within the last five years, no work has been done indicating the current situation of bovine schistosomosis in the study area. Therefore, the aims of this study were to estimate the current prevalence of bovine schistosomosis and to identify major risk factors associated with the disease in the study area.

MATERIALS AND METHODS

Study area

The study was conducted to determine the prevalence of bovine Schistosomosis in and around Kemissie, Dawa Cheffa District from September 5, 2011 to May 10, 2012, Oromo Nations Zone of the Amhara Regional state, Northeastern Ethiopia. It is located at 325 km North of Addis Ababa. The approximate geographical location of the area is between 10°01' to 11° 25' N and 39° 41' to 40° 24' E. The altitude of the area ranges from 1000 to 2500 m above sea level and the maximum temperature is 33°C and the minimum temperature of the area is about 12°C. The mean annual rainfall of the area ranges from 600 to 900 mm. The area has a long heavy rainy season from June to September and short rainy season from March to May (OZARD, 2006).

Study population

The study was conducted in local Zebu and cross breeds between exotic and local breeds of cattle in the study area that was managed under extensive and semi-intensive management systems in the study area. The study population comprises of cattle at different age (De launta and Habel, 1986) and sex category. Four peasant associations (PAs) were selected purposively for their accessibility (convenience) of transportation and nearness to towns. These PAs were Kemissie, Shekla, Woledi and Tuche, all of which are under the same climatic and geographical features (OZARD, 2006). All the local breeds were often kept out-doors grazing on a marshy land and watered on natural rivers whereas most of the crossbreeds were kept in-door especially during milking periods where there is sufficiently gathered feed resources but watering is usually out-door especially during the dry season where it is difficult to fetch from a distant area for animals to drink. During sampling, deworming history of individual animals was obtained from the owners and recently dewormed animals were excluded from being sampled.

Study design

The study design for this particular study was cross sectional. The sampling method used was simple random sampling. To determine the sample size, an expected prevalence of 50% was taken into consideration since there was no previous study conducted recently within the last five years in the study area. The desired sample size for the study was calculated by the formula given by Thursfield (2005) with 95% confidence interval and 5% absolute precision and it was 384. However, to increase the precision level, 405 animals were selected randomly from the selected PAs of the study area.

Study methodology

Sample collection and transportation

About 10 g (Foreyt, 2001) of fresh fecal samples were collected per rectum from each cattle using sterile rectal plastic gloves and placed in a clean plastic container and each sample was clearly labeled with animal identifications, such as body condition score (Nicholson and Butterworth, 1986), sex, age (De launta and Habel, 1986), breed and management systems for each animal on a data recording format.

Coprological examination

Coproscopy was used to determine positivity of the animals for the disease. Fecal samples collected from the study animals directly from the rectum were stored in a clean universal bottle containing 10% formalin and labeled separately. A modified simple sedimentation technique (Gupta and Singla, 2012) was employed. Each sample was repeatedly examined more than four times recommended by Habtamu and Mariam (2011) to observe the eggs of the parasites by using a light microscope.

Data analysis

Data were entered and stored in a Microsoft Excel spread sheet program and were coded for analysis. SPSS version17.0 software, data were analyzed. Chi-square ($\chi 2$) test was used to determine the variation in the infection and prevalence among ages, sexes, breeds, body condition score and management systems. Statistical significance was set at $P<0.05$ to determine whether there are significant differences between the parameters measured between the groups.

RESULTS

Out of 405 fecal samples examined, an overall prevalence of 18.5% was observed as 75 samples were found positive for schistosomiasis in the study area. Slightly higher prevalence of the disease was seen in young cattle (23.14%) followed by adults (17.61%) and least in old age (15.49%) as shown in Table 1. However, the prevalence of schistosomiasis iid not vary significantly ($p>0.05$) among the age groups.

Prevalence of Schistosomiasis in female and male animals was 18.66 and 18.37%, respectively. However, no significant difference ($P>0.05$) was observed between sexes (Table 2).

Prevalence of the disease in the cross breeds (48.61%) was higher, which showed higher variation from local breeds (11.41%). The result of statistical analysis revealed a significant difference ($P<0.05$) between breeds of animals (Table 3).

Prevalence of schistosomiasis in poor body condition animals (31.16%) was found to be highest. However, the prevalence in animals with medium and good body condition was 9.38 and 1.28%, respectively. A significant difference ($P<0.05$) in prevalence was observed in body condition of the study animals (Table 4).

The prevalence of the disease in animals under semi-intensive management system (59.26%) was higher. However, the prevalence of the disease in animals under extensive management was only 12.25%. The result of statistical analysis revealed a significant difference ($P<0.05$) in each management system (Table 5).

DISCUSSION

An overall prevalence of 18.5% bovine schistosomiasis was recorded based on coprological investigation. This result agrees with previous reports of Getachew et al. (2006) in Kemissie who reported similar prevalence of 17.2% as in the present case. This may be because both studies were conducted in the same study area. However, the result of the present study was not in agreement with the previous reports by Ameni et al. (2001) who reported higher prevalence (28%) in Kemissie. This may be due to climatic changes such as repeated draught leading to drying of natural habitats of the intermediate host, snail and the larval stages of the parasite may not be reached by infective stages and may decrease their population leading to decrease in the prevalence of the disease in the area. Hansen and Perry (1993) reported that schistosomiasis is closely associated with large permanent water bodies such as ponds, lakes and marshy pastures; and according to Urquhart et al. (1996), it may be due to development of resistance for the disease when animals are repeatedly exposed to the infection in the study area. The prevalence of the disease was also not in agreement with the previous reports in different areas by different authors; Habtamu and Mariam (2011), 37.3% in Bahir Dar; 43% in Bati (Getachew et al., 2006), 57.3% in India (Ravindran et al., 2007). This might be due to the differences in temperature, moisture, humidity, availability of large permanent water bodies and soil that might favor multiplication and survival of the intermediate host, snails. Hansen and Perry (1993) reported that a key determinant in the epidemiology of bovine schistosomiasis is the relative abundance of the intermediate hosts and their ability to develop and survive in the environment and associated with large permanent water bodies. It was also reported by Urqhart et al. (1996) that *Schistosoma* species are totally dependent on water as a medium for infection in both the intermediate host and final host.

Prevalence of the disease in different age groups has values of 23.14% in young, 17.61% in adults and 15.49% in old animals with a non-statistical difference ($P > 0.05$). However, the result of the study indicates that the prevalence of the disease decreases as age increases. This may be because young animals have lower immunity when compared with adult and older cattle. According to the reports by Habtamu and Mariam (2011), calves are traditionally weaned at about 1.5-2 years and then allowed to graze with adult cattle. In addition to this, adult and old group of cattle are left to graze on the field where cercaria infection is high, furthermore in this group

Table 1. Prevalence of bovine schistosomiasis in different age groups.

Age	Animals examined	Animals affected	Prevalence (%)	χ2	P value
Young	121	28	23.14		
Adult	142	25	17.61	2.653	0.265
Old	142	22	15.49		

Table 2. Sex wise prevalence of bovine schistosomiasis.

Sex	Animals examined	Animals affected	Prevalence (%)	χ2	P value
Male	196	36	18.37	0 .006	0.940
Female	209	39	18.66		

Table 3. Breed wise prevalence of bovine schistosomiasis.

Breed	Animals examined	Animals affected	Prevalence (%)	χ2	P value
Local	333	38	11.41	62.703	0.00
Cross	72	35	48.61		

Table 4. Body condition score based prevalence of bovine schistosomiasis.

Body condition score	Animals examined	Animals affected	Prevalence (%)	χ2	P value
Poor	199	62	31.16		
Medium	128	12	9.38	43.511	0.00
Good	78	1	1.28		

Table 5. Prevalence of bovine Schistosomiasis based on management system.

Management	Animals examined	Animals affected	Prevalence (%)	χ2	P value
Extensive	351	43	12.25	68.538	0.00
Semi-intensive	54	32	59.26		

of animals, acquired immunity is not established, hence egg shed in these animals is high. There was statistically non-significant difference (P > 0.05) between the sexes categories indicating that it has no effect on the prevalence of the disease. This may be because exposure of both sex groups in similar pasture lands and watering points is the same and eventually developing the disease equally (Habtamu and Mariam, 2011).

A significant difference (P < 0.05) was observed between breeds in the study animals. High prevalence was recorded in cross breed cattle (48.61%) than in local breeds (11.41%). This wide gap may be due to local breeds acquired a high degree of immunity as a result of repeated natural exposure to the disease for a longer period. The main manifestation of immunity was suppression of worm fecundity (Cheng, 1986). It was also reported that local cattle that naturally acquired infections are capable of reducing egg production. Furthermore, there is difference in natural or innate immunity between indigenous and cross breed of cattle (Habtamu and Mariam, 2011).

The results of this study indicated that there is a significant difference in body condition scoring (P<0.05). Infection rates in poor body condition animals were significantly highest (31.16%), moderate in medium (9.38%) and least in animals having good body condition

(1.28%). Based on the reports of Urqhart et al. (1986) and Hansen and Perry (1993), the disease causes anorexia and emaciation which leads to weakening of the immune status of the animal that leads to low immune response to the parasite and predisposes animals to other diseases McCauley et al. (1984). This indicates the importance of the disease in causing poor body condition (emaciation).

An attempt was also made to analyze the prevalence of the management system of the animals. The prevalence of the disease in animals that were kept under semi-intensive management system was higher (59.26%) than animals kept under extensive management system (12.25%). The result of statistical analysis revealed that there is a significant difference ($P < 0.05$) in the management system. This may be because extensively managed animals acquired a high degree of immunity as a result of repeated natural exposure to the disease (Cheng, 1986). However, animals kept in semi-intensive management system become susceptible to the infection as they have no acquired immunity to withstand the disease.

CONCLUSION AND RECOMMENDATIONS

The result of this study indicated that schistosomiasis is a moderately prevalent bovine infection in the study area. Even though its prevalence seems lower, it has higher economic importance due to loss of productivity and mortality in animals and it is a zoonotic disease. However, it is evident that proper evaluation of the epidemiology of the disease is absent in the study area recently. The major risk factors associated with the disease on this finding were management system, body condition score and cattle breeds. However, sex and age were not that much significant in this study. However, the prevalence of the disease was highest in young cattle followed by adults and least in older age animals. The result of the present study showed that there is a reduction in its prevalence when compared with previous reports in the study area. However, micro dams constructed for irrigation purpose may be threatening factors to increase its prevalence again in the future in the area. In the area, no measures being taken to control the disease and no drugs available in veterinary clinics even though the disease is endemic.

Therefore, detailed studies should be conducted on the epidemiology of the disease to expand and implement disease investigation and control strategy. Young aged animals should be kept at home or the weaning time of calves should be extended until they become mature or until their immunity develops well. Fencing water bodies is supposed to be practiced to reduce water contamination with fluke eggs. Applications of molluscicide ought to be used to reduce snail population at seasons where the number of the population increases in the area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

Ameni G, Erko B, Bogale T (2001). Preliminary study on the major bovine trematode infection around Kemissie, Northeastern Ethiopia and treatment trial with praziquantel. Bull. Anim. Health. Prod. Afr. 49:62-67.

Cheng TC (1986).General Parasitology, 2nd edition, Academic Press, Medical University of South Carolina, Charlton. pp. 332-342.

Chhabra MB, Singla LD (2009). Food-borne parasitic zoonoses in India: Review of recent reports of human infections. J. Vet. Parasitol. 23(2):103-110.

De launta A, Habel RE (1986). Applied Veterinary Anatomy. W.B. Saunders Company. USA.

Foreyt WJ (2001). Veterinary Parasitology Reference Manual, 5th edition, Black well,Lowa State University Press, Washington DC, USA. P 3.

Fromsa A, Meharenet B, Mekibib B (2011). Major Trematode Infections of Cattle Slaughtered at Jimma Municipality Abattoir and the Occurrence of the IntermediateHosts in Selected Water Bodies of the Zone. J.Anim. Vet. Adv. 10(12):1592-1597.

Gebrecherkos, Berihun A (2012). Prevalence of bovine fascilosis in municipal Abattoir of Adigrat, Tigray, Ethiopia. Mekelle University College of Veterinary Medicine, Mekelle Ethiopia.

Getachew T, Tesfu K, Berhanu E, Legesse W, Ahmed A, Nega B, Girmay M (2006). Pilot control of fasciolosis and related animal fluke infections by the use of Endod and reduced morbidity: I pre-intervention studies. Ethiop. vet. J. 10(1):67-70.

Gupta SK, Singla LD **(**2012). Diagnostic trends in parasitic diseases of animals. In: *Veterinary Diagnostics: Current Trends.* Gupta RP, Garg SR, Nehra V and Lather D (Eds), Satish Serial Publishing House, Delhi. pp. 81-112.

Habtamu A, Mariam SW (2011). Repeated simple sedimentation technique and prevalence of bovine schistosomosis in selected sites of Bahir Dar woreda. Ethiop. Vet. J.15(1).

Hansen J, Perry B (1993). The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants, 2nd edition, published by the ILRAD, Nairobi, Kenya. pp. 40-41.

McCauley EH, Majid AA, Tayeb A (1984). Economic evaluation of the production impact of bovine schistosomiasis and vaccination in the Sudan.Preven. Vet. Med. *2*(6):735-754.

McManus DP, Li Y, Gray DJ, Ross AG. (2009). Conquering 'snail fever': schistosomiasis and its control in China. Exp. Rev.Anti-infect.Ther. 7(4): 473-485.

Ministry of Agriculture and Rural Development(MoARD)(2013).Major challenges and Achievements in Ethiopian Livestock production.

Nicholson MJ, Butterworth MH (1986). A Guide to Body Condition Scoring in Zebu Cattle. International Livestock Center for Africa (ILCA). Addis Ababa, Ethiopia.

OZARD (2006). Annual Report, Oromya Zone Agricultural and Rural Development Department, Amhara Regional State, Kemmisse. P 19.

Ravindran R, Lakshmanan B, Ravishankar C, Subramanian H (2007). Research note. Visceral schistosomiasis among domestic ruminants slaughtered in Wayanad, South India. Southeast Asian J. Trop.Med. Public Health 38(6):1008.

Smyth JD (2005). Animal Parasitology. Cambridge University Press.3rd edition. London. P 236.

Solomon W, Abebe W (2007). Effects of a strategy antehelmtic treatment intervention bovine fasciolosis. A conducted in facilities in endemic area in north western Ethiopia. Vet. J. 11(2):59-68.

Soulsby EJL (2006). Helminths, Arthropods, and Protozoas of Domestic Animals. 7th edition. London. P 72.
Thrusfield M (2005). Veterinary Epidemiology.2nd edition, UK, Blackwell Sci. pp. 228-247.
Upadahayay AKU (2005). Textbook of Preventive Veterinary Medicine. 1st edition. pp. 380-381.
Urquhart GM, Armour J, Duncan JL, Jennings FW (1996). Veterinary helminthology: Veterinary Parasitology. New York, Churchill: Livingstone Inc. pp. 114-116.
Vercruysse J, Claerebout E(2001). Treatment vs non-treatment of helminth infections in cattle: defining the threshold. Vet. parasitol. 98(1):195-214

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