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ARTICLE

Sero-prevalence, Risk Factor and Community Perception of Foot and Mouse Disease in Cattle under Extensive Management in Southern Tigray, Ethiopia

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ABSTRACT

To determine the sero-prevalence of foot and mouth disease in southern zone of Tigray, North Ethiopia, a cross-sectional examination of 340 sera samples were conducted from November 2015 up to May 2016. In addition, a structured questionnaire survey was done to know the perception and knowledge of the local community about the disease and 120 informants were interviewed. The overall sero-prevalence was 20.9% and there was no statistical significant difference (P>0.05) in prevalence of foot and mouth disease between sexes, agro-ecology, breed and vaccination history. However, a statistical significant difference (P< 0.05) was noticed between the age groups, different body conditions, farming systems, and history of contact with wild life. The logistic regression analysis indicated that all the factors which had an association with sero-positivity were found significant risk factors for the disease. The questionnaire survey indicated that 65% of the contacted informants described the disease consistent with the major clinical signs mentioned in literature. The study revealed that the virus is circulating in the area and requires further identification of the serotypes. Moreover, implementing control of foot and mouth disease with integrated approaches has paramount importance.

1. Introduction

Ethiopia is believed to have the largest livestock population in Africa. An estimate indicates that the country is home for about 56.7 million cattle, 29.3 million sheep and 29.1 million goats, 1.2 million camel, 9.9 million equine and 56.9 million poultry [1]. The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians. The subsector contributes about 16.5% of the national GDP and 35.6% of the agricultural GDP [2]. Although the contribution to the national economy is quite high, the productivity of the livestock sector to huge resource is little. This is associated with a number of complex and inter-related factors among which foot and mouth disease (FMD) is one of the major diseases that limit export [3,4].

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In Ethiopia FMD is seen as a major hindrance to international trade as national freedom from FMD is required before getting access to the export market [5]. However; the distribution, prevalence and risk factors of the disease must be assessed prior to designing a control program. A study in 2008 by Zerabruk *et al*. [6] indicated that the overall prevalence of FMD in Tigray was 15.4%. Based on the report the prevalence in central, western, southern and eastern zones of Tigray was 5%, 16.9%, 24% and 10% respectively. The study indicated the disease was highly prevalent in the southern zone followed by western zone of Tigray region [6]. However, the current status and dynamics of the disease with special emphasis to southern Tigray was not known. Moreover, there was no detailed information on the perception of local community about FMD in the area. Therefore, the study was conducted with the following objectives:

(1) To determine the sero-prevalence of FMD in cattle under extensive management

(2) To identify the possible risk factors associated with FMD

(3) To assess the perception of the community about FMD

2. Materials and methods

2.1 Study Area and Population

The study was conducted in Southern zone of Tigray Regional State, Northern Ethiopia. It is located at 660 km North of Addis Ababa, and 120 km South of Mekelle. Geographically it is located at 12o 15'and 13o 41' north latitude and 38o 59' and 39o 54' east longitude, constituting an area of 9,446 km^2 at an altitudinal range of 930 – 3925 masl. The total human population of the study area is 1,004,558 (12, 4813 from urban and 879,745 from rural) [7]. The zone consists of five administrative districts; namely Raya Alamata, Alaje, Endamohoni, Ofla, and Raya azebo under different agro ecological zones. However, it is dominated by two major agro-ecologies (lowlands and highlands) and the study mainly focused on these two major agro-ecologies covering a large area of the zone. The livestock population consists of 404427 cattle, 322774 sheep, 161415 goats, 516 horses, 66910 donkeys, 381 mule, 27762 camel, 397512 poultry and 24129 beehives [1].

2.2 Study Animal

Herds of cattle managed under traditional extensive production system were used in this study. All animals were greater than six month of age and were randomly selected for sampling. The animals were categorized in to two age groups i.e., < 3years of age (young) and ≥ 3years of age (adult). The age determination was done based on the knowledge of the animal owners and dentition [8]. Body condition score (BCS) was made based on Nicholson and Butterworth [9] and the animals were further categorized in to three category i.e. with BCS 1, 2 and 3 as poor, BCS 4 and 5 as medium and BCS 6-9 as good.

2.3 Study Design and Sampling Technique

A cross-sectional study was carried out to determine the sero-prevalence of FMD in the study area from November 2015 up to June 2016. Multistage simple random sampling with zone as highest and animal as lowest sampling stages, district and peasant association in between the two stages was used to collect sample from animals. First the zone was selected and categorized in to two groups based on agro-ecology (lowland and highland), then two districts out of the five districts, one from each group (agro-ecology) was selected randomly. Twelve out of 39 peasant associations (six peasant associations per district) were randomly selected using lottery methods and then animals from each peasant association were selected randomly proportionally to the population size. Structured questionnaire survey was designed and used to collect information related to knowledge and perception of the community about the disease.

2.4 Sample Size Determination

The sample size was determined by the formula stated in Thrusfiled [10] with 95% confidence interval and 5% of absolute precision and considering that expected prevalence is 24% as reported by Zerabruk *et al*. [6].

$$N = \frac{1.96^2 Pexp\ (1 - Pexp)}{d^2}$$

Therefore, using the formula the minimum sample size was calculated to be 280 but to increase the precision of the result the sample size was increased to 340.

3. Data Collection

3.1 Sample collection

Blood samples were collected from the jugular vein of cattle using 10 ml sterile plain vacutainer tubes and then the samples were properly labeled. The blood samples were allowed to stand overnight at room temperature and centrifuged to allow serum separation. The sera were collected using cryovials and transported using an icebox (at -18^{o}c) from the collection site to the National Animal Health Diagnostic and Investigation Center (NAHDIC),

Sebeta, Ethiopia for further processing. The sera then were stored at -20 °C till laboratory examination was performed. The duration of transport and duration until examination was 12 hours and five days respectively.

3.2 Serological Examination

Serum samples were examined for non-structural proteins of FMD virus using 3ABC ELISA. The ID Screen® FMD NSP Competition 3ABC-Ab ELISA Kit (rue Louis Pasteur-Grabels-France) was used to detect FMDV specific antibodies in Bovine serum samples. The kit has 95% sensitivity and 97% specificity. The kit procedure was based on a solid phase competition ELISA as documented in OIE [11] according to the instruction of the manufacturer.

3.3 Questionnaire Survey

Structured questionnaire was developed to assess the knowledge and perception of local community towards FMD. The questionnaire was pretested first in 30 animal owners in the area and administered to the respondents. About 120 animal owners were randomly interviewed from two districts (50 from Endamekoni and 70 from Raya azebo districts) proportionally to the population size and their response was recorded. The participants included both male and female, and they were categorized by age into young adults (ages 18-35 years), middle-aged adults (ages 36-55 years), and older adults (ages older than 55 years) [12].

3.4 Data Analysis

The collected data from the study areas was recorded in database based on Microsoft® Excel (Microsoft Corporation, USA) spread sheet and coded properly. Then analyses were done by using STATA (STATA Corp LP, USA). The chi-square (x^2) test was used to assess the difference in the frequency of the disease between different variables. All variables which had a significant difference (p-value <0.05) in chi-square test were also analyzed using logistic regression. Frequencies and percentages were used to describe the questionnaire results. P-value < 0.05 was reported as statistically significant.

4. Result

4.1 Serological Examination

The present serological analysis using 3ABC ELISA test indicated that the overall prevalence of FMD is 20.9% (71/340). There was slightly difference in the prevalence of the disease in district of Endamekoni (20.2%) and Raya azebo (21.2%). However, the difference was not statistically significant between the two areas (p=0.828) (Table 1.). The sero-prevalence between the different age groups indicated that the point prevalence was 22.7% (71/313) in adult cattle compared to the young cattle having the point prevalence of 0% (0/27). A statistical significant difference was noticed in the sero-prevalence of FMD between the age groups (p=0.005), different body conditions (p=0.038), farming systems (p=0.018), history of FMD disease (p=0.027), and history of contact with wild life (p=0.034). Highest prevalence was observed in adult animals with the rate of 22.7% (71/313), pastoral farming system 66.7% (4/6), poor body condition 26.1% (23/88), history of FMD 29.9% (23/77) and contact with wild life 33.3% (14/42) (Table 1.). Moreover the odds ratio of farming system (OR=8.0952, p=0.017), body condition (OR=2.106226, p=0.028), FMD disease history (OR=1.907793, p=0.0290) and history of contact with wild life (OR=2.114035, p=0.0370) indicated that the variables were found statistically significant risk factors for the disease (Table 2.).

Table 1. Sero-prevalence of FMD and X^2 analysis of various variables

Risk factor	Animals sampled	Seropositive	Prevalence (%)	X^2	P-value
Agroecology				0.0474	0.828
Highland	109	22	20.2		
Lowland	231	49	21.2		
Farming system				7.9976	0.018
Mixed	318	63	19.8		
Agropastoral	16	4	25		
Pastoral	6	4	66.7		
Breed				0.1913	0.909
50%holestian cross bred	7	1	14.3		
Highland zebu	118	25	21.2		
Raya	215	45	20.9		
Sex				0.7476	0.387
Female	138	32	23.2		
Male	202	39	19.3		
Age group				7.7411	0.005
Adult	313	71	22.7		
Young	27	0	0		
Body condition				6.5538	0.038
Good	146	21	14.4		
Medium	106	27	25.5		
Poor	88	23	26.1		
Vaccination history				0.5895	0.443
No	319	68	21.3		
Yes	21	3	14.3		
History of contact with wild life				4.4964	0.034
No	298	57	19.1		
Yes	42	14	33.3		
Total	340	71	20.9		

Table 2. Logistic regression analysis result of significantly associated various variables

Risk factor	Animals sampled	Sero-positive	OR	CI (95%)	P-value
Farming system					
Mixed*	318	63	1	-	-
Agro-pastoral	16	4	1.3492	0.42097-4.3242	0.614
Pastoral	6	4	8.0952	1.4501-45.1913	0.017
Body condition					
Good*	146	21	1	-	-
Medium	106	27	2.0344	1.0769-3.8429	0.029
Poor	88	23	2.1062	1.0852-4.08799	0.028
History of contact with wild life					
No *	298	57	1	-	-
Yes	42	14	2.1140	1.0461-4.2721	0.037
Total	340	71			

Note: N.B: * indicates variables used as references to calculate the odds ratio

4.2 Structured Questionnaire Survey

The questionnaire survey was administered in two districts i.e., Endamekoni and Raya azebo districts of southern Tigray. The total respondents were 120, out of which 50 (41.7%) were from Endamekoni and 70 (58.3%) were from Raya azebo district. Out of the total 120 interviewed respondents 16 (13.3%) never heard about FMD before and it was their first time to hear about. Moreover, 13 (10.8%) of the contacted householders ranked FMD as the first important cattle disease in their locality (Table 3).

Table 3. Summary of knowledge and perception of informants about FMD

Features	Category	Frequency	Percent
Awareness about FMD	Yes	104	86.7
	No	16	13.3
Rank of FMD	First	13	10.8
	Second	18	15
	Third	34	28.3
	Fourth	18	15
	Fifth	6	5
	Not important	31	25
Knowledge about the clinical feature of FMD	Excellent	21	17.5
	Good	57	47.5
	Poor	25	20.8
	No knowledge at all	17	14.2
Season of disease occurrence	Autumn	4	3.3
	Spring	38	31.7
	Winter	20	16.7
	Summer	12	10
	Both spring and winter	30	25
Breeds mostly affected	Local	95	79.2
	Cross bred	9	7.5
Age group mostly affected	<3years	56	46.7
	3-10	18	15
	>10years	11	9.2
	All equally affected	19	15.8
	No	16	13.3
Risk factors of FMD	Dry season	66	55
	Loss of body condition	16	13.3
	Mixing with other animals	9	7.5
	All	13	10.8

Note: N.B: Excellent = Described the clinical signs very well (lesions in feet & mouth, loss of condition, lameness, & kills calves); Good =Described the clinical picture well (lesions in mouth & feet, and loss of condition); Poor= Know only some points (only sign of lesion in mouth).

5. Discussion

The present study indicated that FMD is still a disease of concern in the area. The overall prevalence of the disease was found to be 20.9% (71/340). The current finding is slightly lower as compared to the study of Zerabruk *et al*. [6] who found a prevalence of 24% in 2008 in the current study area. On the other hand the present overall prevalence was in agreement with the findings of Duguma *et al*. [13] 21.6% in Bale zone Ethiopia; Desissa *et al*. [14] 21.4% in Kellem Wellega zone, southwestern Ethiopia; and Nawaz *et al*. [15] 19.3% in buffalos and cattle of Punjab. Moreover, it was also comparable to the finding of Mekonen *et al*. [16] who reported 24.6% in Borana and Guji zones of southern Ethiopia. The difference in prevalence in Endamekoni district (highland) and Raya azebo (lowland) district was not statistically significant ($p>0.05$). This was in agreement with Mohamoud *et al*. [17] who reported non-significant difference in different locations in Awbere and Babille districts of Jigjiga zone Ethiopia. However, unlike to the present finding different studies [6, 16, 18, 19] in different parts of Ethiopia reported a significant association between location and prevalence of FMD.

The current prevalence was significantly ($p<0.05$) higher in adults than in young. This may be due to a longer exposure time to the virus in adults because as age increases the chance of exposure to the disease increases. This was in agreement with the reports of other researchers [17, 20]. The prevalence was significantly higher ($p<0.05$, OR=2.1) in those animals having poor body condition. This could likely be due to the disease's debilitating effect on body condition of animals [21] or perhaps other concurrent diseases which lower the immunity of the animal, thereby making it more susceptible to FMD. The current study revealed that the prevalence was higher in females (23.2%) versus males (19.3%) but the difference was not statisti-

cally significant (p>0.05). This is in agreement with different authors [17, 20, 22] who similarly reported no significant difference in the prevalence of FMD between sexes. Only the study of Olabode *et al*. [23] on trade cattle in kwara state of Nigeria indicated a significantly higher prevalence in cows (62.1%) than bulls (37.9%). In the present study there was no statistically significance difference (p>0.05) in the prevalence of FMD in different breed types of cattle. This was in agreement with the work of Duguma *et al*. [13] who reported non-significance difference.

The highest prevalence was observed in animals under a pastoral farming system (66.7%) followed by agro-pastoral (25%) and mixed farming system (19.8%). The difference was statistically significant (p<0.05). This could probably be because of animals under pastoral and agro-pastoral farming systems had a higher chance of mixing with other animals than mixed farming system. This was in agreement with studies in other parts of Ethiopia [16,19]. The prevalence was also compared with vaccination history for FMD and statistically non-significant (p>0.05) difference was observed. The prevalence in non-vaccinated animals (21.3%) was higher than in vaccinated animals (14.3%). The small prevalence in vaccinated animals agrees with the science that vaccinated animals could probably be protected against infection as indicated in different literatures [24,25,26,27]. There was a higher prevalence (33.3%) in animals which had previous history of contact with wild animals and the difference was statistically significant and the odds of risk in animals with previous history of contact with wild life is 2.1140 more at risk than in animals with no history of contact with wild life. This is because animals which had contact with wild life have the highest probability of acquiring the disease from wild animals. This was in agreement with the finding of Molla *et al*. [28] who reported positive association between the presence of FMD and history of contact with wild life which might serve as reservoirs.

The structured questionnaire survey revealed that 16 (13.3%) of the interviewee never heard about FMD before and it was their first time to hear about and this showed there was some gap in the awareness about FMD in the area. From the total respondents 13 (10.8%) of the contacted householders ranked FMD as the first important cattle disease in their locality while 31 (25%) individuals explained the disease is not much significance in their area because of its low mortality rate in adult animals, or may be due to awareness shortage of the respondents. Based on the knowledge of the farmers the season of FMD occurrence is mostly spring as indicated by 38 (31.7%) of the interviewee where it is hot season and there is no enough feed availability. The community knowledge indicated that the disease mostly prevalent in animals <3years of age and this was inconsistent with the present serological finding of higher prevalence in adults and also contradicts with the semi-structured questionnaire survey finding of Duguma *et al*. [13] a report of increase in incidence with increase in age. However it agrees with Longjam *et al*. [26] that indicate calves are more susceptible to FMD than adults and mortality is higher in calves.

From the total respondents 21 (17.5%), 57 (47.5%), and 25 (20.8%) individuals had excellent, good, and poor knowledge about the clinical picture of FMD respectively whereas, 17 (14.2%) had no knowledge about FMD at all. Individuals having excellent and good knowledge described the disease well which was in agreement to the major clinical signs described in literatures [29, 30] while individuals with poor knowledge touched only some points regarding the disease nature. Therefore, only 65% of the informants described the disease well which is lower than the finding of Duguma *et al*. [13] who reported 93% valid and consistent response on the clinical picture of the disease in Bale zone of Ethiopia. The informants listed dry season, body condition loss, and mixing with different animals as a risk factors for the occurrence of FMD. According to the recorded response in the current study 55% of the informants ranked dry season as the first risk factor for the occurrence of the disease, where the season is hot and feed is scarcely available. This perception was in line with the finding of Molla *et al*. [31] who reported higher incidence of the disease in dry season than cold season in South Omo zone of Ethiopia.

6. Conclusion and Recommendation

The current sero-surveillance study using 3ABC ELISA indicated that the virus is circulating with higher prevalence and factors such as age, farming system, body condition, history of disease and history of contact with wild life were found having an association with the sero-positivity of the disease. At the same time the present finding also revealed that there was gap in awareness of farmers about the disease in the area and some cultural beliefs and perceptions discourages vaccination for FMD, though there is traditional knowledge of treating the disease. Generally FMD was found to be an important disease in the area and the current finding has provided insight information on the sero-epidemiology of FMD, its associated risk factors and its potential impacts on households. Therefore, according to the concluding remark the following points were recommended:

(1) Any intervention program should consider the risk factors which have association with sero-positivity of the disease

(2) Further molecular characterization and stereotyping of the virus is required to apply effective control and preventive measure

(3) Consistent community sensitization should be in place to avoid any awareness related problems of the community

(4) Regular vaccination program for FMD should be given in the area

(5) Taking into account the local indigenous knowledge and community participation should be encouraged in controlling the disease

(6) Further detail study on the traditional knowledge of treating the disease is required to enhance the science of disease treatment

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