Full Length Research Paper

Seroprevalence of foot and mouth disease in Bench Maji zone,Southwestern Ethiopia

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A cross-sectional sero-epidemological study was conducted in two districts of the Bench Maji Zone, Southwestern Ethiopia between November 2007 and February 2008 with the objective of determining the seroprevalence of Foot and Mouth Disease (FMD) in cattle and identifying the potential risk factors associated with the disease. Sera samples were collected from a total of 273 cattle in 98 herds. The sera were submitted to the National Veterinary Institute (NVI), Debre zeit, Ethiopia for screening using the 3ABC-ELISA. The overall seroprevalence of FMD was 12.08% (n=273). Significantly higher seroprevalence (20%) was recorded in the Surma district compared to the Semen Bench district (5.88%). Peasant associations (equivalent to villages in a district) had prevalence rates of 25, 20, 15, 8.16, 5.66 and 3.92% for Kibish, Tulgit, Koka, Aman, Mizan and Temenja-yasz respectively. From the various risk factors analyzed peasant associations, cross boundary movement and herd size were seen to be statistically associated (p<0.05) with the seroprevalence of FMD. There was no significant variation in seroprevalence among sex, age and herd type. The result of the present study showed that FMD is an important cattle disease in the study area. Thus, an appropriate control strategy has to be designed and applied which could involve regulation of transboundary cattle movement and vaccination using the circulating virus strain.

Key words: Bench Maji zone, cattle, FMD, risk factors, sero-epidemiology.

INTRODUCTION

Foot and Mouth Disease (FMD is caused by a virus of the genus Aphthovirus, family Picornaviridae. There are seven serotypes of the virus namely: A, O, C, SAT-1, SAT-2 SAT-3 and Asia 1. Infection with one serotype does not confer immune protection against another. Within serotypes many subtypes can be identified by biochemical and immunological tests (OIE, 2004). The disease is characterized by high fever, loss of appetite, salivation and vesicular eruptions on the feet, mouth and teats (Thomson, 1994).

The disease has a high morbidity although mortality is rare in adult animals. However, myocarditis may occur in young animals resulting in death. The recovered animals remain in poor physical condition over long periods of time leading to economic losses for livestock industries

(Sangare, 2002).

FMD is endemic to most of sub-Saharan Africa, except in a few countries in southern Africa, where the disease is controlled by the separation of infected wildlife from susceptible livestock as well as by vaccination. Largely due to the endemicity of the disease, and the fact that FMD does not normally cause high rates of mortality in adult animals, FMD outbreaks are not perceived as important and are not reported or investigated further to determine the causative serotypes. However, a number of countries now realise that FMD is one of the transboundary diseases that should be controlled to ensure economic stability and access to lucrative international export markets for animal and animal products (Sahle, 2004).

Studies have shown that serotypes O, A, C and SAT 2 were responsible for FMD outbreaks between 1974-2003 (Sahle, 2004) while serotypes O, A and C were the responsible serotypes for the FMD outbreaks in cattle from 1957 to 1979 in Ethiopia (Roeder et al., 1994). Antibodies

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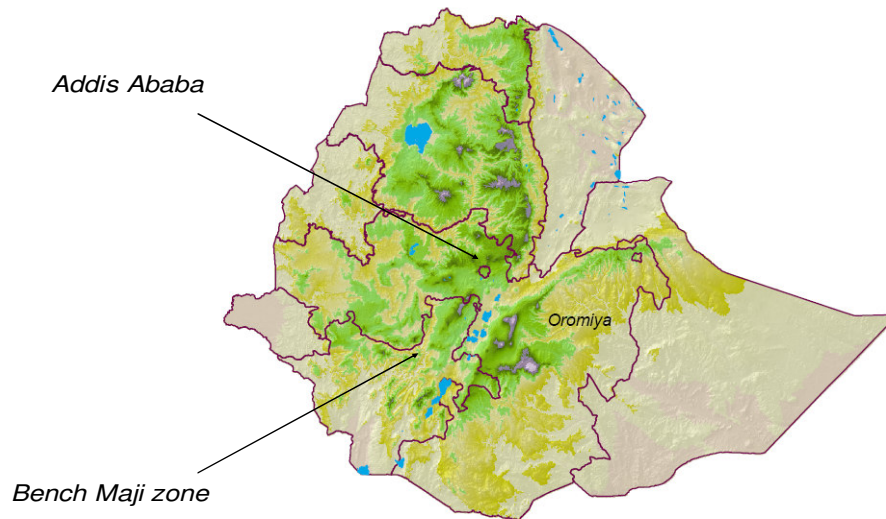*Corresponding author. E-mail: egelaye@yahoo.com.

Figure 1. Map of Southwestern Ethiopia shwing Bench Maji zone and Addis Ababa.

to SAT 2 were also detected in 1971 from cattle in the study region now known as North Omo, Southwestern Ethiopia (Martel, 1974; Roeder et al., 1994). During the period from 1988-1991, serotyping of FMD was conducted by the National Veterinary Institute (NVI), Ethiopia and the World FMD Reference Laboratory, Pirbright, UK. Serotype O and SAT 2 were identified (Roeder et al, 1994). From records of an outbreak investigations conducted by NVI between 1982-2000, serotype O, A and SAT 2 FMD viruses were identified (Gelaye et al, 2005). The prevalence of FMD can be detected serologically by measuring the antibody level to the 3ABC non-structural (NSP) FMD protein (Diego et al., 1997).

FMD is an important constraint to international trade in animals and animal products. It specially restricts world trade in South-North direction. The endemically or sporadically infected countries, which are mainly in the south, generally face total embargoes on the export of their live animals and fresh meat to many other countries in the world (FAO, 1997).

The current situation of FMD in Ethiopia is alarming. There is no national control strategy, no legislation exists for making FMD notifiable to the veterinary authorities nor for animal movement restrictions to be imposed. Therefore, livestock are at risk from endemic strains as well as from antigenic variants prevailing in neighbouring countries. The official data may not reflect the reality of the disease along with the unreported cases by farmers and the few samples submitted fro diagnosis (Sahle, 2004).

There is no clear picture regarding the distribution pattern and prevalence of the disease in the Bench Maji zone in Southwestern Ethiopia. Therefore, the objective of the present study was to determine the seroprevalence of FMD and to identify some of the risk factors associated with the disease in the study area.

MATERIALS AND METHODS

Study area

The present study was carried out in the Bench Maji zone of South Nations Nationalities and Peoples Regions (SNPPR) 561 km southwest of the capital city Addis Ababa (Figure 1). The altitude of the zone varies between 700-2500 meters above sea level, and the mean annual rainfall and temperature varies between 400-2000 mm and 15-27°C respectively. Extensive farming and pastoral systems are practiced in this area with livestock production constituting the major economic activity of the zone.

Study design

A cross-sectional seroprevalence survey was conducted and a questionnaire was designed to collect information on individual herds from the animal owners. Risk factors such as age, sex, peasant association origin, herd type, herd size and cross border migration of livestock were considered. A peasant association is the association of peasants found in a certain locality where they have common grazing and watering resources. A district can have more than two peasant associations.

Blood samples were collected from the jugular vein of randomly selected animals using vacutainer tubes and an identification code was given to the sample. The blood samples were allowed to stand overnight at room temperature to allow serum separation. The sera were transported from the collection site to the National Veterinary Institute using an ice-box and were then kept at -20°C until analysis.

The serum samples were tested using the FMD non-structural protein ELISA as described below to determine if animals in the herd had been recently infected with FMD virus/es, thereby estimating the seroprevalence in the herd, district or zone.

Sampling methods

Study animal

The study population involved cattle of the Surma and Semen

Table 1. FMD infection rate in the peasant associations considered.

Peasant Association	No cattle sampled	No of sero negative	No of sero positive	Seroprevalence rate (%)	95%CI
Kibish	40	30	10	25	10.97-39.02
Koka	40	34	6	15	3.43-26.56
Tulgit	40	32	8	20	7.04-32.95
Aman	49	45	4	8.16	0.21-16.10
Mizan	53	50	3	5.66	0.77-12.09
Gayasz	51	49	2	3.92	1.59-9.43
Total	273	240	33	12.08	8.19-15.97

Bench districts of the Bench Maji zone. Animals were selected based on their agro-ecology and socioeconomic characteristics from six peasant associations namely Koka, Tulgit and Kibish from the Surma district and Mizan, Aman and Temenga-Yasz from the Semen Bench district.

Sample size

A two stage cluster sampling technique was used to determine the sample size. The sampling frame of peasant associations was prepared with the assistance of a zonal agricultural office and were picked randomly but giving specific attention to agro ecology (that is, low land and highland regions). To this effect the actual sample size was calculated with the following predetermined parameters.

Confidence interval= 95%
Expected prevalence = 12.5% (NVI record)
Desired level of precision= 5%
In between cluster variance= 0.0002441

The in between cluster variance was determined by estimating the standard deviation (that is, the average difference expected between individual cluster prevalence and the overall mean cluster prevalence) and then squaring the standard deviation to give the variance components between clusters (Thrusfield, 1995). The average individual owned herd size was determined to be 30 cattle in the study area.

$$g = \frac{1.96^2(nvc + Pexp\,(1-Pexp))}{nd^2}$$

$$Ts = \frac{1.96^2 * g * Pexp\,(1-Pexp)}{gd^2 - 1.96^2 vc}$$

Where; n= herd size; vc= in between cluster variance; d= desired level of precision;
Pexp= expected prevalence; g= number of clusters needed;
Ts =Total sample size.

A total of 273 animals were sampled from 98 herds (clusters).

Measurement of FMD non-structural antibodies

The sera samples were screened using the FMD-3ABC-ELISA kit (Bommeli Diagnostic, Switzerland) using the procedure described previously (Diego et al., 1997). Briefly the test sera, negative and positive reference sera were added to 96 well ELISA plates coated with 3ABC antigen. Following 60 min incubation at 37°C, plates were washed 3 times with washing buffer after which a peroxidase conjugated anti-ruminant antibody was added to the plate and incubated for another 30 min. After further washing, tetramethyl benzidine (TMB) substrate was added and plates were incubated at room temperature for another 15 min. The reaction was terminated by adding 1M sulphuric acid stopping solution. The optical density of the samples were measured at 450 nm and the result was expressed as an index derived by dividing the absorbance value of the test serum by that of the cut-off control (OIE, 2004). Samples with a %OD>30% were considered positive, %OD<20% negative and samples between 20-30% as ambiguous.

Data analysis

The data were stored in Microsoft Excel Spreadsheet. Descriptive and analytical statistics were computed using STATA 9.0 software. Univariant logistic regression analysis was employed to test for association of risk factors with that of Foot and Mouth Disease infection.

RESULTS

During the study period, 273 cattle were examined in 98 herds for the presence of antibody against Foot and Mouth Disease virus (FMDv) in their blood sample using the 3ABC ELISA test. The overall prevalence of FMD in the study area was 12.08% (33/273).

Districts

The highest seroprevalence was observed in Surma district 20% (n=120), while the seroprevalence of FMD in Semen bench was 5.88% (n=153) and the difference was statistically significant (P<0.05; OR=4.95%; CI= 1.7823 - 8.9774).

Peasant associations

The highest seroprevalence at peasant association (PA) level was observed in Kibish 25% (n= 40), followed by Tulgit 20% (n= 40), Koka 15% (n= 40), Aman 8.6% (n=49), Mizan 5.66% (n=53) and the lowest was in Temenga yasz 3.92% (n= 51) (Table 1). There were significant differences (P<0.05) in seroprevalence between Kibish (25%), Tulgit (20%), Koka (15%) and Temnga Yasz (3.92%).

Table 2. FMD infection rate in relation to Herd type.

Herd type	No of cattle sampled	No of sero negative	No of sero positive	Seroprevalence rate (%)	95%CI
Mixed species	174	147	27	15.52	15.95-36.81
Cattle only	99	93	6	6.06	1.45-19.38
Total	273	240	33	12.08	8.19-15.97

Table 3. Infection rate of FMD in cattle in relation to herd size.

Herd size	No of cattle sampled	No of seropositive	Seroprevalence rate (%)	95%CI
Small	206	10	4.85	1.89-7.81
Medium	36	3	8.33	1.15-17.8
Large	31	20	64.52	4646.67-82.3
Total	273	33	12.08	8.19-15.9

Herd type

Evaluation of herds for the presence or absence of other species was also made with respect to FMD prevalence. Herds with different species present had an FMD prevalence rate of 15.52% while those which did not have any other species had a prevalence rate of 6.06%. The difference however was not statistically significant, ($P>0.05$) (Table 2).

Cross-boundary movement

Those herds reporting cross boundary animal movement had a prevalence rate of 20% while those that did not report movement beyond the national boundary had a 5.88% prevalence rate. This observed difference demonstrated significant statistical variation ($P<0.05$; OR=4; 95% CI=1.78-8.97).

Herd size

In this study herds were categorized into three groups, small (1-15), medium (16-30) and large herds (> 30 cattle). The prevalence rate for small herds was 4.85%, 8.33% for medium herds and 64.52% for large herds. There was no significant difference between small (4.85%) and medium (8.33%) herds; however, the differences observed between large (64.52%) and small (4.85%) and large (64.52%) and medium (8.33%) were statistically significant ($P<0.05$; OR=35) (Table 3).

Age category

Cattle were grouped into three age categories: calf (<1 year), young (1-3 years) and adult (>3 years). A prevalence rate of 36.36% (n=11) was found in calves, 29.41% (n=34) in young cattle and 8.33% (n=228) in adult cattle (Table 4). There was no significant difference in prevalence between these age categories.

Sex

The prevalence rate among female animals was determined as 15.7% (n=140) while in males it was 8.27% (n=133). There was no significant difference in FMD prevalence rates between females and males.

FMD herd prevalence in peasant associations

The prevalence of positive herds in selected peasant associations was determined. The highest herd prevalence was observed in herds in Kibish 58.33% (n=12) followed by Tulgit 31.58% (n=19), Koka 21.05% (n=19), Aman 26.67% (n=15), Mizan 23.08% (n=13) and Temenga Yasz 10% (n=20) (Table 5). There was a significantly lower herd prevalence ($P<0.05$) in Temenga Yasz compared to Kibish peasant associations only.

DISCUSSION

This survey revealed that Foot and Mouth Disease is a significant disease in Southwestern Ethiopia with a prevalence rate of 12.08% (n=276). Of the total herds sampled, 26.53% (n=98) showed evidence of recent FMD infection and this is comparable to the 10.3% prevalence rate reported among dairy cows of Addis Ababa (Yishak, 2007) and the 12.5% FMD prevalence rate at the national level (NVI, 2004). The consistent finding here confirms the disease is endemic in Ethiopia. At a district level, higher prevalence was observed in Surma 20% (n=120) than Semen Bench 5.88% (n=153). This probably relates to difference in the existing livestock production system. According to the questionnaire survey the Surma district follows the traditional pastoral productio

Table 4. Infection rate of FMD in cattle in relation to age groups.

Age category	No of sampled	No sero positive	Seroprevalence rate (%)	95%CI
Calf	11	4	36.36	2.46-70.25
Young	34	10	29.41	13.3-45.5
Adult	228	19	8.33	4.7-11.9
Total	273	33	12.08	8.19-15.97

Table 5. FMD herd prevalence in peasant associations.

PA	Number of herds			Seroprevalence rate (%)
	Total	Sero-negative	Sero-positive	
Kibish	12	5	7	58.33
Koka	19	15	4	21.05
Tulgit	19	13	6	31.58
Aman	15	11	4	26.67
Mizan	13	10	3	23.08
Temenga Yasz	20	18	2	10
Total	98	72	26	26.53

system while in Semen Bench cattle were sedentary. Likewise a similar prevalence (21%) was reported in the Borena pastoral production system (Ruffael, 2006). In the pastoral production system animals travel long distances and can cross national boundaries. This can facilitate contact between different herds from different localities, including neighboring countries, and wild ruminants which are a continuous source of infection. A similar prevalence (3.6%) to cattle in the Semen Bench district was found in bulls tested in the Jimma district (n=2000) (Bedru, 2006). Limited movement and minimal contact with other herds probably explains the low prevalence in sedentary systems.

Among the sampled peasant associations, the highest prevalence was observed in Kibish (25%) and the lowest in Temenja Yasz (3.92%). The difference between these was deemed to be statistically significant (P<0.05). This difference is probably due to the location of Kibish which is adjacent to the border with Sudan and is a center where animals from both countries frequently mix. In contrast, Temanga Yasz is situated in a high land area where the contact with other herds has been found to be minimal.

In this study, no significant differences in FMD seroprevalence was observed between mixed herds and cattle only herds. However, higher prevalence was present in mixed herds 15.52% (n=174), where small ruminants were kept together with cattle than in cattle only herds 6.06% (n=99). In previous studies it has been shown that small ruminants are important reservoirs for FMD infection in cattle (Siefert, 1996). However, in this study the difference was not statistically significant.

In this study FMD prevalence tended to increase with herd size. This finding was in agreement with a previous study where herd size was designated as a risk factor in FMD; that is, 68.3% of the dairy herds with more than 80 cows were infected compared to 6.8% of the herd with less than 10 cows in Cheshire, UK in 1967-68 (Hugh-Jones, 1972). This could be due to the contagious nature of the disease and mode of transmission which is enhanced by crowding and frequency of contact (Ruffael, 2006).

No significant difference (P>0.05) was observed in the prevalence of FMD between female and male cattle in this study. This finding was consistent with the previous finding in the Borena pastoral area reported by Ruffael (2006), where sex appeared not to have a significant effect on seropositivity in univariant analysis.

In the Bench Maji zone nearly one third of the herds were observed to be infected with the virus. Particularly in those peasant associations closer to the Ethiopian-Sudanese border, the herd level infection rate observed reached 58.33% (n=12). This indicates that the best applicable prevention and control methods in the study areas should be the strict control of animal movement along with the application of annual FMD vaccination using the locally circulating FMD virus serotypes.

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