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Human Brucellosis in Traditional Pastoral Communities in Ethiopia

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Abstract: In Ethiopia, brucellosis is prevalent in traditional pastoral communities such as Borana and Hamer. The disease is common in particular among patients with a recurrent unresolved febrile illness but due to lack of awareness the disease is not diagnosed and treated. Risk factors for brucellosis in these communities are living in close proximity of livestock, milking livestock and consumption of raw milk and fresh cheese. Diagnosis will be improved by providing testing for brucellosis. Brucellosis should be included in disease education programs and control measures.

Key words: Zoonoses, brucellosis, recurrent infections, point-of-care test, pastoralists, rural development

INTRODUCTION

Brucellosis is a zoonosis of worldwide importance that is caused by small gram-negative coccobacilli belonging to the genus *Brucella* (Young, 1995a). Human brucellosis is a systemic infection with protean acute, sub-acute or persistent clinical manifestations (Young, 1991). Characteristically, patients with brucellosis present with fever, sweats, fatigue and joint pain. Abnormal physical findings are few with the exception of occasional hepato-splenomegaly. The infection may become localized affecting any organ system and on rare occasions localized disease becomes chronic with periodic relapses of symptoms. As no characteristic constellation of symptoms and signs exists the diagnosis may be readily missed; laboratory testing by culture or serology is essential to confirm the disease (Young, 1995b). Brucellosis is transmitted to man mainly by direct contact with infected livestock and the consumption of non pasteurized contaminated milk and other dairy products. Cattle, goats, sheep, camels and other livestock may be infected and transmit the disease to the human population and pastoralists in endemic areas are at high risk of infection. Brucellosis is treated with a combination of doxycycline with either rifampicin or streptomycin for a minimum of 6 weeks (Skalsky *et al*., 2008).

In Ethiopia, brucellosis is known to be present in livestock of intensive dairy farms located in the vicinity of Addis Ababa, the capital city and recent studies reported its presence in camels in different camel-rearing regions and in small ruminants in Afar state in eastern Ethiopia (Teshome *et al*., 2003; Ashenafi *et al*., 2007). The seroprevalence among camels was 5.7% in the Rose Bengal plate agglutination test and ranged from 5.2% in the complement fixation test for camels in the Afar region in the northeast to 1.2% in the Borana region in the south. The seroprevalence among small ruminants in Afar varied from 3.2% in sheep to 5.8% in goats). Most of the livestock in Ethiopia is kept by sedentary farmers and transhumane pastoralists applying a wide range of mostly traditional husbandry systems. Because of these farming practices, their traditional lifestyle and dietary habits most of the rural communities in Ethiopia seems to be at risk for brucellosis. Evidence of exposure to brucellosis was found in abattoir workers in Addis Ababa

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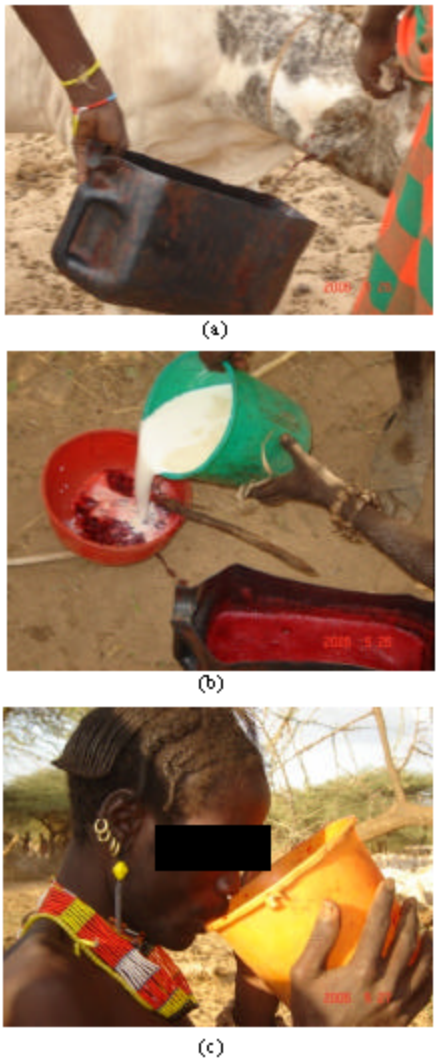
(Kassahun *et al*., 2006). However, very little is known about the presence and risk factors of human brucellosis in rural areas of Ethiopia. The Borana and Hamer people in southern Ethiopia who until recently were almost untouched by modern developments life in intimate contact with their livestock and most of their nutrition comes from their animals. In this study, we looked for brucellosis as a cause of disease in these 2 communities and investigated the clinical presentation and risk-factors. In addition, we looked for brucellosis among pastoralists in the Metema area in northwest Ethiopia.

MATERIALS AND METHODS

Study areas, population characteristics and sites: The Borana and Hamer are tribal, mainly pastoralist people. The Borana live in the Oromiya Regional State, Borana Zone of southern Ethiopia and in northern Kenya (Aguilar, 1996). The Hamer live in the Omo valley in the Hamer district of the Southern Nations, Nationalities Peoples' Regional State in south-western Ethiopia. Roughly 300,000-350,000 people identify as Boran and just over 40,000 people indentify as Hamer. Although, originally mainly cattle owners, the Boranas also keep sheep, goats and camels following recurrent drought, as a coping strategy through herd diversification. These pastoralists almost entirely depend on their livestock for their living and their diet consists mainly of milk on occasions supplemented with blood collected from their animals (Fig. 1), some meat and some cereals such as sorghum and maize. Most of the farmers from Metema in the Amhara Regional State near the border with Sudan in north-east Ethiopia are settled in small villages and still mainly keep cattle.

The health care center in Yabello district in the Borana area and the one in Metema that participated in the study are staffed with a minimal number of medical staff lacking any type of laboratory support other than a microscope. Because of the absence of a health facility in the Omo valley where most of the Hamer live, the study was performed by a mobile outreach medical team supported by a non-governmental organization, the Ethiopian Pastoralist Research and Development Association (EPaRDA). Before the start of the study, staff involved in the study received an update on brucellosis and were trained in the use and interpretation of the serological assays provided for the confirmation of brucellosis.

Patients and sample collection: Patients with febrile illness presenting with clinical signs and symptoms compatible with brucellosis were included in the study. After the purpose of the study was explained and consent



(a) (b) (c)

Fig. 1: Hamer people preparing and consuming a meal consisting of milk mixed with blood. Collecting blood (a), mixing with milk (b) and consuming the meal (c)

to participate in the study was obtained from either the patients or their parents and guardians, patients were interviewed using a structured questionnaire to collect demographic, epidemiological and clinical data and a blood sample was obtained by finger prick. The blood was collected using a heparinized glass capillary and tested immediately. Eighty-eight patients were included at the Yabello health center, 17 in Hamer and 100 in Metema. Patients were stratified according to the duration of illness in acute (<6 months of illness), subacute (6-12 months) and persistent (>12 months). Of the 205 patients 129 were considered acute, 45 subacute and 49 had persistent disease. The duration of illness was not recorded for 16 patients.

Serology: The *Brucella* IgM/IgG immunochromatographic lateral flow assay was applied for the detection of *Brucella* specific IgM and IgG antibodies (Smits *et al*., 2003; Irmak *et al*., 2004). The assay consists of 2 assay devices, one for the detection of specific IgM antibodies and the other one for the detection of specific IgG antibodies. The assay was performed by application of 10 μL, whole blood onto the sample pad of the assay device followed by the addition of 130 μL running buffer supplied with the test. Finger prick blood was transferred to the assay device by using a heparinized glass capillary. The running buffer was added using a disposable plastic Pasteur pipette. Test results were read after 10-15 min by visual inspection for staining of the test line in the test window of the assay device. The test was scored negative when no staining at the test line was observed. Positive test results were subjectively rated 1+ when staining of the test line was weak, 2+ when moderately strong, 3+ when strong and 4+ when very strong. The flow assay was obtained from Omega Teknika Ltd, Ireland. Flow assays were individually packed in a sealed moisture and light resistant foil and the running buffer was supplied in glass vials containing liquid for 25 tests. The test devices and vials with running buffer were transported and stored at ambient temperature.

Data processing and analysis: Data was double entered in an electronic data base at AHRI, verified and analysed using STATA (StataCorp LP, Texas, USA) version 7 statistical software package. Risk factors was analysed using the Pearson Chi-square test for statistical significance.

Ethical clearance: Permission to perform the study was obtained from the institutional (Armauer Hansen Research Institute and Gondar University, regional (Oromia and SNNPR) and national ethical committees.

RESULTS

The blood sample collected from 30 (34.1%) patients from Borana, 5 (29.4%) from Hamer and 3 (3%) from Metema tested positive in the *Brucella* IgM IgG^{-1} lateral flow assay (Table 1). Of the 38 seropositive samples 13 were IgM positive and IgG negative, 12 were IgM and IgG positive and 13 were IgM negative and IgG positive. Of the seropositive patients 21 (61.7%) were acute, 5 (14.7%) subacute and 8 (23.6%) had persistent disease (Table 2). The male to female ratio of seropositive patients was 1.4 but no difference in seropositivity was observed between the 2 sexes (p = 0.47). More than half (54.3%) of the seropositive patients all of whom were diagnosed at the Yabello health center or by the medical team in Hamer suffered from a recurrent febrile illness with 2 or more episodes of unresolved disease. Because of the difference in seroprevalence between the Borana and Hamer study groups and the Metema study group the data from Borana and Hamer were combined and analysed separately from those of Metema. All seropositive patients from Borana and Hamer suffered from arthralgia and backpain. Arthritis and splenomegaly were other prominent symptoms but of these only backpain was observed slightly more often (p = 0.037) among seropositive patients compared with seronegative patients. All seropositive patients showed significant improvement after treatment.

Most (60.6%) patients were pastoralist and the majority (95%) of them owned mixed livestock with goats, camel, sheep and cattle being kept by 95, 75, 75 and 65%, respectively. Living nearby an animal shelter (Odds ratio (OR), 3.59), keeping animals on the yard (OR, 5.16), attending animals in the pasture (OR, 5.14), milking animals (OR, 2.07), ingestion of raw milk (OR, 3.33) and consumption of fresh cheese (OR, 5.39) were associated with brucellosis (Table 3). Other potential risk factors commonly practiced by the study population such as assisting with parturition, slaughtering of animals, disease in animals and consumption of blood or raw meat did not significantly differ for patients with brucellosis. Being a farmer did not give an increased risk for having

Table 1: Antibodies against *Brucella* in patient from selected communities in Ethiopia

Brucella IgM IgG^{-1} flow assay	
Study site	No. patients positive/ No. patients tested (%)
Borana	30/88 (34.9%)
Hamer	5/17 (29.4%)
Metema	3/100 (3%)

Table 2: Brucellosis in patients according to stage of illness

	No. patients in each of the following subgroups (%)		
Group (No.)	Acute	Subacute	Persistent
Non-brucellosis (n = 189)*	108 (57.1)	40 (21.2)	41 (21.7)
Brucellosis (n = 34)*	21 (61.7)	5 (14.7)	8 (23.6)
Borana (n = 27)	17 (63.0)	3 (11.1)	7 (25.9)
Hamer (n = 4)	3 (75.0)	1 (25.0)	-
Metema (n = 3)	1 (33.3)	1 (33.3)	1 (33.3)

*The duration of illness was not recorder for 12 non-brucellosis patients and 4 brucellosis patients

Table 3: Risk factors for brucellosis among tribal communities in Borana and Hamer

Risk factors	Non brucellosis number (%)	Brucellosis number (%)	p-value	Odds ratio (95% Confidence interval)
Profession (pastoralist)	40 (60.6)	20 (60.6)	0.221	1.00 (0.43-2.35)
Ownership of livestock	54 (77.1)	29 (82.9)	0.489	1.43 (0.51-4.06)
Family owns livestock	59 (88.0)	29 (82.9)	0.469	0.66 (0.21-2.07)
Livestock in shelter near house	46 (67.7)	30 (88.2)	0.025	3.59 (1.21-11.45)
Livestock kept at yard	29 (52.7)	23 (85.2)	0.004	5.16 (1.57-16.89)
Livestock kept in pasture	21 (41.2)	18 (78.2)	0.003	5.14 (1.65-16.03)
Contact with livestock	49 (70.0)	29 (82.9)	0.155	2.07 (0.75-5.73)
Cleaning stable / animals	42 (60.0)	24 (77.4)	0.090	2.29 (0.78-6.02)
Grooming livestock	19 (27.9)	8 (27.9)	0.972	0.98 (0.37-2.60)
Milking	36 (51.4)	25 (78.1)	0.011	3.37 (1.29-8.81)
Assisting with parturition	27 (39.7)	13 (46.3)	0.544	1.32 (0.54-3.20)
Slaughtering livestock	30 (42.9)	20 (62.5)	0.066	2.22 (0.94-5.24)
Involved in grooming, milking, parturition and slaughtering of livestock	16 (27.6)	5 (16.7)	0.255	0.52 (0.15-1.79)
Trauma in livestock	14 (25.5)	8 (29.6)	0.688	1.23 (0.44-3.44)
Consumes raw milk	45 (64.3)	30 (85.7)	0.022	3.33 (1.15-9.67)
Consumes fresh cheese	39 (56.5)	31 (88.6)	0.001	5.39 (1.90-18.7)
Consumes blood	19 (27.5)	13 (38.2)	0.270	1.63 (0.68-3.87)
Consumes raw meat	57 (81.4)	33 (94.3)	0.076	3.76 (0.80-17.72)
Consumes any of these four products	64 (91.4)	35 (100.0)	0.074	not calculated*
Previous brucellosis	1 (1.5)	3 (8.8)	0.069	6.58 (0.66-65.82)
Previous brucellosis in family	2 (2.9)	1 (2.9)	0.981	0.97 (0.08-11.09)

*One of the subgroups had zero as value

brucellosis either. Very few patients recalled having been treated for brucellosis in the past or to have had a family member suffering from brucellosis.

DISCUSSION

The study was initiated at the Yabello health center as it was reported that pastoralists from the Borana area seeking medical attention were diagnosed with brucellosis in a hospital in Kenya across the border where expertise apparently was available that was lacking in Ethiopia. Upon confirmation of brucellosis in Borana patients at the Yabello health center, the study was extended to Hamer tribal communities since these people are supposed to live in even more intimate contact with their livestock and no adequate medical services are available within their area. We found that a high proportion of the patients from the Borana and Hamer communities who suffered from recurrent disease in fact had brucellosis. This demonstrated the importance of awareness of the medical staff concerning the presence of the disease and the importance of the availability of a laboratory test for brucellosis (Franco *et al*., 2007). Before the start of this study and the introduction of laboratory testing for brucellosis medical staff at the Yabello health center was unaware of the existence of this disease in these parts of Ethiopia. The medical staff at the health center knew many of these patients from earlier episodes and either had treated these patients for another commonly occurring infectious disease such as malaria or had not been able to help these patients. After treatment at these earlier occasions patients either had not shown improvement or had become ill again. Frequent changes of staff together with the periodical absence of medical staff due to draught and famine together with poor record keeping however did not allow us to trace back the exact medical history of these patients. Studies in Greece, Saudi Arabia, Israel and Yemen have shown that shepherds form an important risk group but that the condition is easily misdiagnosed (Abramson *et al*., 1991; Galanakis *et al*., 1996; Malik, 1997; Al-Shamahy *et al*., 2000; Tsolia *et al*., 2002).

Well known risk factors including living in close proximity of livestock, keeping and attending to livestock and the consumption of raw milk and fresh cheese were identified as risk factors for having brucellosis by the Borana and Hamer people. The somewhat higher number of males than females with the disease could indicate that contacts of males with animals may pose a higher risk of infection than the consumption of dairy products. The consumption of blood and raw meat which were on the diet of, respectively 31.1 and 85.7% of the patients were not significantly associated with brucellosis. The number of *Brucella* bacteria in dairy products and animal excretions can be very high, while in the blood their number is generally low or the pathogen is present intermittently (Godfroid *et al*., 2005). Precise knowledge of the different risk factors is important for the development of control and preventive measures. For instance, El Sherbini *et al*. (2007) found that in villages in Egypt keeping sheep but not the consumption of fresh diary products was associated with brucellosis and suggested that this was related to the relatively low prevalence of the infection. Our questionnaire also, included questions related to knowledge of brucellosis but as expected none of the patients had any knowledge

about the cause, prevention and treatment of brucellosis although, many had heard about the disease. Health education could help to prevent brucellosis but given the living conditions and dietary habits of these pastoralist communities, control of brucellosis in the livestock population may be the main option to prevent disease.

We did not study the prevalence of brucellosis in the livestock of the Borana and Hamer people and we have not investigated potential risk factors for the presence of brucellosis in the livestock of these pastoralist communities. Recent studies have indicated that brucellosis is common among camels in Borana and is present among sheep and goats in the Afar region in north-eastern Ethiopia (Teshome *et al*., 2003; Ashenafi *et al*., 2007). Factors that may increase the risk for brucellosis include mixed husbandry practices, exchange of animals for breeding purposes, absence of clean drinking water and lack of knowledge. Borana and Hamer while, traditionally being cattle herders, have recently adopted, instigated in part because of increased draught, mixed livestock husbandry practices including small ruminants and camels in their herds and the presence of ruminants may well have increased the prevalence of brucellosis. Communities near Metema mainly keep cattle and this could explain to lower percentage of *Brucella* patients identified among patients attending the health care centre in Metema.

The control of brucellosis in rural Ethiopia will be challenging given the mobile lifestyle of the rural population, the diversity of farming practices and husbandry systems and the high number and diversity of animals involved. Most of the Borana and Hamer own goats, sheep, camels and or cattle each of which may be infected and transmit brucellosis. The likely presence of different *Brucella* species in these animals and the possibility that *Brucella* may be transmitted from one animal species to the other will complicate the control of brucellosis by vaccination (Godfroid *et al*., 2005). Of the most commonly used vaccines the Rev-1 vaccine is designed for the control of *B. melitensis* in small ruminants and the S19 vaccine for the control of *B. abortus* in cattle. Therefore, knowledge of the type of brucellosis and the prevalence in the different animal species is needed before vaccination as part of a control program can be instigated effectively.

Our study points to a clear need for improved medical services for the Borana and Hamer communities (Sheik-Mohamed and Velema, 1999). For the prevention of zoonoses such as brucellosis and to control other disease in their livestock improvement of the veterinary services is essential as well. With the growing population pressure to improve the agricultural system is increasing. Diseases such as brucellosis are impediments for export and economic growth. Vaccination of livestock is a well-recognized and accepted strategy for brucellosis control (Zinsstag *et al*., 2007). Experience in developed countries has shown that it takes decades to control brucellosis through a control strategy based on vaccination and that the presence of a test and slaughter policy of infected animals could be crucial. In Ethiopia vaccination may become available for intensive dairy farms. The availability of laboratory testing for brucellosis at medical health facilities in rural areas in Ethiopia could help to reduce the risk of severe disease and disability.

CONCLUSION

This study shows that brucellosis should be considered as a major public health problem among pastoralists in Ethiopia. Diagnosis of the disease and patient management can be improved by implementation of laboratory testing. The development of disease control measured requires knowledge of the type of brucellosis and its prevalence in the different livestock species.

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