

Trends of human brucellosis in pastoralist communities based on hospital records during 2013–2016 in Ngorongoro District, Tanzania

H.E. Nonga¹ and E.R. Mwakapeje²

¹Sokoine University of Agriculture, P. O. Box 3021 Morogoro, Tanzania

²Norwegian University of Life Sciences, Campus Adamstuen, P.O. Box 8146 Dep, N-0033 Oslo, Norway

Email: nongahezron@yahoo.co.uk / hezron@suanet.ac.tz

SUMMARY

Brucellosis is among the neglected zoonotic disease which mostly affects the pastoral and agro-pastoral communities because they are exposed to many risk factors for the infection. A four-year (2013–2016) retrospective study was carried out to determine the sero-prevalence of human brucellosis in patients at Wasso and Endulen hospitals in Ngorongoro district, Tanzania. Hospitalization records were reviewed and serological positive cases of brucellosis were classified according to: year recorded, hospital facility, areas of residence, age, sex and season of the year. A total of 794 (5.8%) brucellosis cases from 111 villages/areas were diagnosed out of 13642 patients admitted at Wasso and Endulen hospitals. Most of brucellosis cases (35.5%, n=282) and (34.8%, n=276) were recorded in 2014 and 2015 respectively. Wasso hospital had more cases (6.9%) compared to Endulen (3.5%) and the difference was statistically significant ($P=0.0000001$). More *Brucella* positive cases ($P=0.0006681$) were observed in females than males. Similarly, adult individuals suffered more ($P=0.0000001$) than young ones. Most of the cases ($P=0.0000001$) were observed during the rainy seasons. Brucellosis is prevalent in Ngorongoro district which affects mostly women and adults, and therefore, an important public health problem. These findings merit for more extensive epidemiological investigations of brucellosis in pastoral and agro-pastoral communities in Tanzania.

Keywords: Brucellosis, zoonotic disease, sero-prevalence, hospital records

INTRODUCTION

Brucellosis is among the important neglected disease which is known to affect mostly the pastoral and agropastoral communities (Swai *et al.*, 2009; Wankyo, 2013). The vulnerability of the pastoral and agropastoral communities to brucellosis is based on their intimate contact with animals and their eating habits. These communities keep big herds and flocks of ruminants which rarely get veterinary services. Such animal serve as reservoirs of different disease conditions including brucellosis. The major manifestation of brucellosis in animals is abortion but sometimes may be infected without showing any sign. Such animals keep on shedding the pathogens to the environment which further spread the infection to other animals and humans brucellosis (Kunda *et al.*, 2010).

The affected animals are the major sources of infection to humans. The transmission from animals to humans mainly is through eating raw or undercooked food of animal origin. The foods that act as source of infection include raw milk and milk products, meat and raw blood which are sourced from infected animals. Also it is an occupational disease transmitted through handling meat, aborted

fetuses and foetal membranes from infected animals. The *Brucella* from infected animals are secreted in placenta, fetal fluids, aborted fetuses, other uterine discharges, milk, feces, vaginal mucus, urine, semen and other body fluids serve as sources of infections to humans through contact since can penetrate an intact skin (Blood *et al.*, 2007). In conditions of high humidity, low temperatures and no sunlight, *Brucella* can remain viable for several months in the aborted fetuses, other animal discharges deposited to the environment and in water. Therefore, contaminated water bodies can also serve as sources of infection to humans and animals (Newitt *et al.*, 1939; Aillo and Moses, 2010).

Brucellosis in human displays mixed signs including fever and general body weakness. Other common signs and symptoms depend on the affected body system. Clinical features like headache, sweating, loss of appetite, muscular pain, lumber pain and weight loss are common (Habib *et al.*, 2003; Bosilkovski *et al.*, 2007; Minas *et al.*, 2007). When the infection occurs in skeletal, nervous and urogenital systems can lead to arthritis, sacroiliitis, spondylitis, abortions and epididymo-orchitis (Chin, 2000; Bosilkovski *et al.*, 2007). Brucellosis is wide spread in many developing countries and is always poorly diagnosed due to poor health facilities, diagnostic facilities and

limited awareness of the disease among medical practitioners (Kunda *et al.*, 2010). Its diagnosis is complicated by the fact that it shares symptoms with malaria and typhoid fever which are common cause of fever in Sub-Saharan Africa (Pappas *et al.*, 2006).

Maasai are famously known by being good pastoralists in Tanzania. The Maasai are mostly found in Arusha region entirely occupying Ngorongoro and Monduli districts. In Ngorongoro, the main health facilities available are Wasso and Endulen hospitals where medical doctors reported that brucellosis is among the leading causes of hospital admissions (Dr. Mallange, E. and Mkenda, N., personal Communication, 2016). As it is common with several neglected zoonoses, the status of human brucellosis in the pastoral community is poorly known and therefore there is little interest for development of control programmes. The aim of this study was to compile brucellosis data from hospital records in Ngorongoro district as an attempt to characterize aspects of the disease in an endemic pastoral community.

MATERIALS AND METHODS

Study area and population

The study was conducted in Ngorongoro District which is in Arusha Region. It is bordered to the north by Kenya, to the east by Monduli District, to the south by the Karatu District and to the west by the Mara Region. Administratively, the District is divided into three divisions, namely Ngorongoro, Loliondo and Sale and has 21 wards. According to the 2012 Population and Housing Census, the population of the Ngorongoro district was 174,278 (PHCT, 2013). The climate in the district is semi arid with two distinct rainy seasons, short rains in October to December and long rains during March to May with a mean annual rainfall of about 700 mm (Rohde and Hilhorst, 2001).

The major ethnic group in the district is Maasai who practice traditional pastoralism and following a semi-nomadic lifestyle. Maasai nomadic communities live in close contact with livestock and are always exposed to many zoonotic diseases

RESULTS

Prevalence of brucellosis in admitted patients

During the period of four years, a total of 794 (5.8%) brucellosis cases were diagnosed out of 13642 patients who were admitted at Wasso and

including brucellosis. The district designated hospital is Wasso which is located in the northern half of Ngorongoro district nearby Loliondo town and it provides health services to majority of the people in the district. Endulen is another hospital located in the southern part of the district in Ngorongoro division that is contained within the Ngorongoro Conservation Area.

Selection of brucellosis cases

Admission records at Wasso and Endulen hospitals for the period of four years from January 2013 to October 2016 were reviewed, and all brucellosis cases were identified. Recommendation by a clinician to test for brucellosis was based on the presence of clinical signs and symptoms of fever, headache, back pain, sweating, fatigue, arthralgia, miscarriage or abortion and other symptoms as defined by the Centers for Disease Control and Prevention (CDC, 1997). Serological testing was done at the hospitals by the plate agglutination test. Serologically positive cases with clear clinical records were classified according to the village/area of residence, age, sex, date recorded, hospital facility and season of the year. Recorded patients with the age of below 18 years were categorized as young and above 18 years as adults. Suspect cases were not included in the present survey to avoid overestimations.

Data analysis

Data were analysed using Epi Info version 7 statistical software (Coulombier *et al.*, 2001). Using Statcalc, proportions of categorical variables were computed and further compared using the chi-square test at a critical probability of $P < 0.05$. The strength of associations between dependent and independent variables were determined using 2 x 2 contingency tables.

Ethical consideration

The permission to conduct this research was granted by the National Institute of Medical Research (NIMR) which provided an ethical clearance with reference number NIMR/HQ/R.8aVol.IX/2286. Endulen hospitals in Ngorongoro district (Table 1). Out of 794 cases, 81.7% were recorded from Wasso hospital. The monthly and annual distribution of brucellosis cases are shown in Figures 1 and 2. In 2014 and 2015, accounted for 35.5% and 34.8% of all the recorded cases, respectively.

Table 1. Brucellosis infection rates in hospitalized patients in Ngorongoro district

Hospital	Year	Total admissions	Number of brucellosis positives	Percent of brucellosis positives
Wasso	2013	2169	105	4.8
	2014	2050	232	11.3
	2015	3421	229	6.7
	2016	1811	83	4.6
Endulen	2013	No records	No records	-
	2014	1609	50	3.1
	2015	1501	47	3.1
	2016	1081	48	4.4
Total		13642	794	5.8

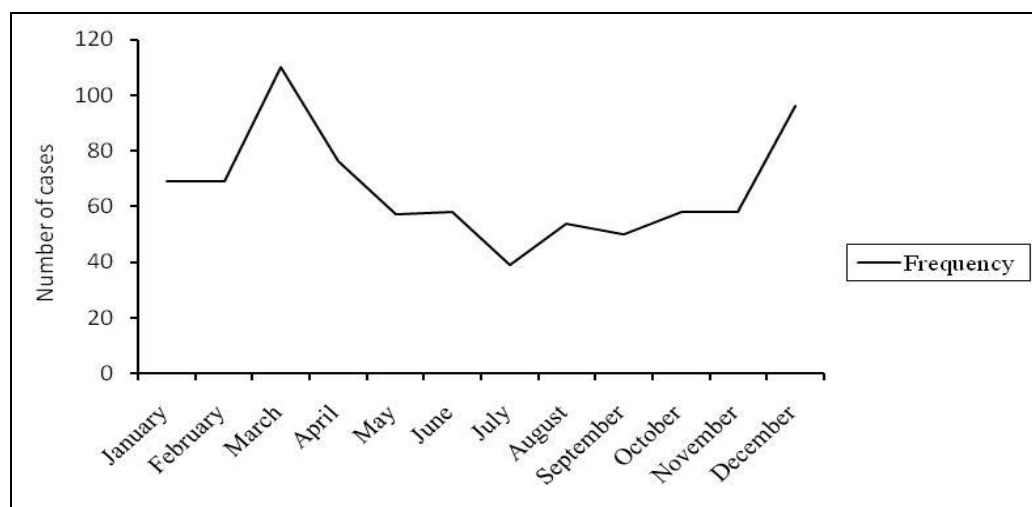


Figure 1. Monthly distribution of brucellosis cases in Ngorongoro district

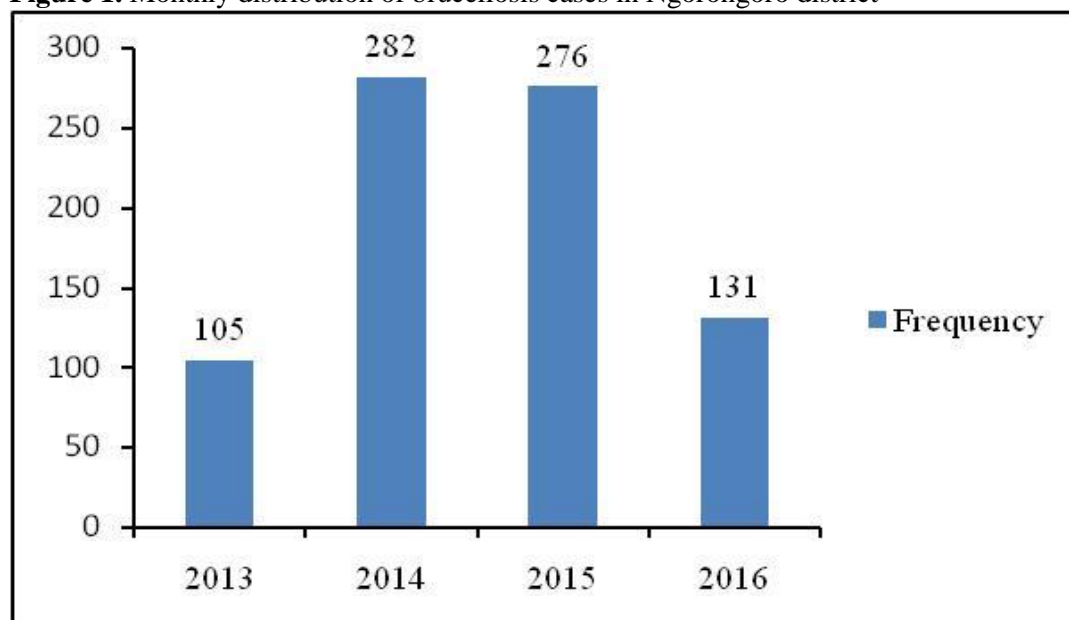


Figure 2. Annual distribution of brucellosis cases in Ngorongoro district

Socio-demographic characteristics and sero-prevalence of *Brucella* in Ngorongoro district

Some socio-demographic characteristics were assessed against *Brucella* sero-prevalence among participants as indicated in Table 2. All the socio-demographic characteristics showed some statistical significance which implied that: female were more

affected than males, adult individuals suffered more and most cases were observed during the rainy seasons. In addition, Wasso hospital had more cases (6.9%) compared to Endulen (3.5%) and the difference was statistically significant (P=0.0000001).

The brucellosis patients had come from 111 villages/areas of Ngorongoro district. Wasso area

had 65 brucellosis cases equivalent to 8.2% of all the reported cases. Other areas with high number of cases were Loliondo (36), Arash (34), Oloipiri (27), Sukenya (24), Oldonyowasi (22) and Maaloni (22).

Table 2. Descriptive socio-demographic characteristics and brucella sero-prevalence of admitted patients

Parameter assessed	Category	Number of <i>Brucella</i> positive	Percent of <i>Brucella</i> positive	P value
Sex	Female (n=7419)	476	6.4	0.0006681
	Male (n=6223)	318	5.2	
Age	Adult (n=5222)	487	9.3	0.00000001
	Young (n=8420)	307	3.7	
Season of the year	Rainy (n=6433)	455	7.1	0.00000001
	Dry (n=7209)	339	4.7	
Hospital facility	Wasso (n=9451)	649	6.9	0.00000001
	Endulen (n=4191)	145	3.4	

DISCUSSION

The purpose of this paper was to review the magnitude of human brucellosis by using a 4-years hospital records in Ngorongoro district, Tanzania. The general results indicated that the problem of brucellosis in the pastoral and agropastoral communities in the district is big although not always given a priority by the Ministry of Health as among the common diseases in Tanzania. Nevertheless, the true magnitude of infection is probably much higher as many cases are likely to remain unnoticed or undiagnosed because of lack of routine screening of patients. Noteworthy, the currently reported information on the high rate of brucellosis cases, its significance and hospitalization involved, illustrates both the magnitude of the public health problem, which the disease represents to pastoral and agropastoral communities. To safeguard the pastoral and agropastoral communities from this public health problem, a more extensive epidemiological investigation is recommended to better determine the prevalence of the brucellosis in humans and domestic animals, its risk factors and suggest the practical methods of prevention and control.

Brucellosis is a disease of animals, while humans get infected through contact with the infected animal secretions and consumption of contaminated animal products (Corbel, 2006). Normally, the

prevalence of brucellosis in humans in a given geographical area tends to correspond to that in animals (Corbel, 2006; Kohei *et al.*, 2010). Studies by Mellau *et al.* (2009) and Shirima *et al.* (2010) in Ngorongoro district reported brucellosis seroprevalence in cattle to range between 5 and 15%. The current study reports brucellosis seroprevalence of 5.8% in hospitalized patients in Ngorongoro district. This is a high rate of infection since brucellosis in humans is not always tested and most clinician consider other causes of febrile illnesses like malaria and typhoid (Wankyo, 2013; Kunda *et al.*, 2005). The seroprevalence recorded during this study is in line with the 7.7% previously reported in Arusha region (Kunda *et al.*, 2010) and 5.5% in Tanga region (Swai, 2009). Other studies on brucellosis in humans in Tanzania have reported high infection rate compared to the current study (Mellau *et al.*, 2009; Wankyo, 2013). Elsewhere, brucellosis has also been reported in humans with sero-prevalence of 10 - 32% in Uganda (Nabukenya *et al.*, 2013; Tumwine *et al.*, 2015; Kansime *et al.*, 2015), 3.8% in Chad (Schelling *et al.*, 2003), India 25.5% (Kumar, 1997) and 37.7% in Algeria (Habib *et al.*, 2003).

There are number of risk factors that may be considered to account for the observed prevalence of brucellosis. Eating habits of Maasai who always consume raw milk, meat and blood and their products that may come from infected livestock predisposes humans to brucellosis (Swai *et al.*, 2009; Kunda *et al.*, 2010; Wankyo, 2013). Also

other activities that enhances contacts with animals like assisted calving, removal of retained placenta using bare hands, contact with manure and general poor hygiene predisposes an individual to brucellosis.

The results of this retrospective study showed that the trend and distribution of human brucellosis in the study area varied in different years, with the most noticeable increase in prevalence recorded in 2014 and 2015 which accounted for 35.5% and 34.8% of all the recorded cases, respectively. A probable explanation for this increase is that awareness on the disease has been created to the clinicians and the health education about brucellosis and other zoonotic diseases has been provided through dissemination of previous studies conducted in the area (Shirima, 2005; Kunda *et al.*, 2005; Kunda *et al.*, 2010). Also improved availability of laboratory reagents to carry out the routine diagnosis of brucellosis in the two hospitals.

Based on the hospital records, it was found that females were more affected than males. This is in agreement with other studies by Wankyo (2013) who reported an infection rate of 21.6% in females compared to males with 19.1% in Morogoro, Tanzania. Makita *et al.* (2011) also found high rates of infection in females. The predominance of female cases of brucellosis in Ngorongoro might be due to particular gender roles of women in the Maasai households. In Maasai traditions, females do most of the work associated with milking and milk processing, cleaning of livestock houses, house repair using cattle dung, helping the calving cows and handling of the newly borne calves, which may predispose them to infection. Women and children also drink a bigger share of raw milk. All these activities are the risk factors for brucellosis infection and may account for the high prevalence of the disease in women. Nevertheless, in African settings, most women attend more to health facilities than men and hence a possibility for being diagnosed with different diseases including brucellosis becomes high. Other studies reported higher brucellosis infection rates in males than females (Kracalik *et al.*, 2015; Tumwine *et al.*, 2015; Maiyo and Obey, 2016). Differences in prevalence rates between the sexes may be attributed to different behavioural attitudes towards livestock handling and preparation of food of animal origin in the communities from the two studies.

It was further found that adult individuals suffered more from brucellosis as compared to the young ones as reported by other scholars (Makita *et al.*,

2011; Buçaj *et al.*, 2015; Tumwine *et al.*, 2015; Maiyo and Obey, 2016). This shows that elders have more frequency of exposures to risk factors like slaughter of animals and others detailed above and spontaneously develop this chronic disease. A study by Tumwine *et al.* (2015) reported that some adults who take animals for grazing drink cow's urine as they believe it cures some diseases. Then if the herd of animals is infected, elders can easily succumb to infections. The current study also is in agreement with the studies by Al Dahouk *et al.* (2007) and Maiyo and Obey (2016).

The results showed that more of the cases were observed during the rainy seasons especially in March and April. A study by Makita *et al.* (2011) reported also high incidences of brucellosis in Uganda during the rainy season. Milk yields do correlate with rainfall since there is plenty of pasture leading to increased milk production which in turn led to increased milk consumption rates and the chance of infection with brucellosis may also increase. Other reasons that may be considered include, many people fall sick during rainy seasons because of humid wet climate which favours growth and multiplications of many pathogens in the environment. Indeed, the hospital records showed that most of the admissions are observed during the rainy seasons. Therefore, this also gives a chance even for diseases like brucellosis to be more detected during this period.

In the two hospitals of Ngorongoro district, majority of the cases (81.7%) were recorded from Wasso hospital. This further supports that Wasso hospital is a big health facility in the district and many sick individuals would like to go there for medical care. Nevertheless, the hospital is located in Wasso area which is just nearby Loliondo town, the district headquarters with relatively high populations. Indeed, the hospital records showed that all the brucellosis patients who had come from 111 villages/areas of Ngorongoro district, Wasso area contributed up to 8.2% of all the reported cases. Therefore, all these may have accounted for a high number of brucellosis cases reported at Wasso hospital. It is concluded that the magnitude of brucellosis in the pastoral and agropastoral communities in Ngorongoro district is big. The problem of human brucellosis has been found to be related to sex and age but also differ depending on the season of the year and village/area of residence. Although hospital based records have limitations, they are an economical way of gathering information on common human diseases in the community and give a picture on what is in

the society. It must be remembered that the actual brucellosis prevalence in admitted patients may be underestimated due to inadequate laboratory facilities, awareness of clinicians to recommend testing for brucellosis as a cause of fever and Maasai community not always going for health services whenever are sick. The present survey provides a preliminary baseline data for the future monitoring of human brucellosis in pastoral and

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