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DISTRIBUTION AND PREVALENCE OF HUMAN BRUCELLOSIS AMONG PATIENTS REPORTING AT CHEMUNDU DISPENSARY, NANDI COUNTY, KENYA

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Abstract

Human brucellosis is one of the world's most widespread zoonotic diseases. The disease is caused mainly by Brucella abortus and Brucella melitensis. Studies conducted in Kenya have reported human brucellosis prevalence of up to 20%. In this study, the prevalence and distribution of brucellosis was determined from hospital records of patients reporting to the Chemundu location health center by self-passive administration. The overall prevalence determined was 32.3% (337/1043) over a five-year period. 20.71% (218) were males and 79.3% (824) were females. Out of the males tested, 69 out of 218 (31.7%) were positive. Out of the females tested, 268 out of 824 (32.5%) were positive. Patients reporting to the health center came from 46 villages that were widespread, some of which were out of the Chemundu location. A few of the records had no indication of where the patients were from. The overall results of the study show a moderate increase in the trend of brucellosis over the five years.

Keywords: Brucellosis, Brucella abortus, Brucella melitensis, Chemundu, prevalence

Introduction

Human Brucellosis is one of the world's most widespread zoonotic diseases. The disease is caused mainly by Brucella abortus and Brucella melitensis. Brucella is gram-negative bacilli of the genus Brucella. It is a risk to those occupationally exposed to animals such as farmers, veterinarians, laboratory technicians, and butchers and to the public through the consumption of contaminated unprocessed milk, milk products and meats. Economic losses from B. melitensis infections are very significant and include decreased productivity as a result of abortion, weak offspring and decreased milk production, as well as lost trade opportunities. B. melitensis is very contagious for humans and the disease, unless diagnosed and treated both promptly and effectively, can become chronic, affecting multiple body systems. The infection is acquired by humans following ingestion of contaminated dairy foods and from occupational exposure to infected live animals or carcasses during slaughter. While sheep and goats are the major reservoir of B. melitensis infection, there is increasing evidence of emergence in cattle and camels (FAO, 2010).

In this study, the prevalence and risk factors associated with brucellosis in Chemundu, Nandi County were determined. These results portrayed the health status of residents in the county attributed to brucellosis over a five-year period in 46 villages in Chemundu Location of Nandi County.

Literature Review

Brucellosis is a common disease among pastoralists and nomadic herdsmen in developing countries, who are continually exposed to potentially infected animals (Abdirahman, 2014). Brucellosis is considered one of the most common global zoonoses (McDermott , cited in Ducrotoy et. al, 2014; Mai, Irons, Kabir, & Thompson, 2012).

According to the Kenya National Bureau of Statistics (2012) there were 78 cases of brucellosis by county reported as outpatient morbidity in patients below 5 years of age in 2012. According to World Health Organization, every year 500,000 people were infected (WHO, cited in Wu et al., 2013).Brucellosis is reportable in most countries but surveillance system are weak (Kaneene, 2013)

Brucellosis is an urgent infectious disease of livestock and wild animals and the commonest human zoonosis. Diagnosis of brucellosis is rather complicated and it has to be obligatorily confirmed by laboratory testing. Direct bacteriological and molecular methods and indirect serological tests are used for brucellosis diagnostics (Smirnova et al., 2013). *Brucella abortus* infection in cattle is endemic in Nigeria, resulting in

huge economic losses due to decreased calving percentage, delayed calving, culling for infertility, cost of treatment, decreased milk production, abortions, stillbirth, birth of weak calves and loss of man-hours in infected people (McDermott & Arimi, Ocholi, & Adamu in Mai et al., 2012).

The duration of the human illness and its long convalescence means that brucellosis is an important economic as well as a medical problem for the patient because of time lost from normal activities (WHO, 2006). Practices such as "dry milking", that is: the udder is not washed with water, but dust is wiped from the udder and teats with the palms of the milker's hands and milking is started immediately (Wanjohi, Gitao, & Bebora, 2012).

The bacteria Brucella abortus is the principle cause of brucellosis in cattle. The incidence of the disease in humans, and which directly relates to that in other animals, is highly dependent on animal husbandry practices, the interaction between humans and animals, living standards, hygiene, food customs, and animal and human population density (Mbaire, 2014).

Keeping a mixture of animals is also common in other areas and has economic and ecological advantages (Getahun & Kassa, in Wanjohi et al., 2012). While this may be fine economically, such mixing increases the chances of transmission of brucellosis and other diseases among animals (Wanjohi et al., 2012). Although some countries have achieved success in controlling or eradicating bovine brucellosis, mainly through test-and-slaughter programs (OIE, in Borba et al., 2013), the disease still occurs, at varying levels of prevalence, particularly in countries with lower levels of economic development (Hegazy, in Borba et al., 2013). Large numbers of livestock herds normally congregated at water points, facilitating the spread of disease, because animals had direct access to pond/dam water and contaminated it through discharges (Wanjohi et al., 2012).

Studies in Uganda have shown that differences in disease prevalence in cattle are associated with different production systems; in zero-grazing systems where there is a low level of herd-to-herd contact, the herd-level prevalence was low (5.5%) while in pastoral systems where there are high level of herd-to-herd contact, the prevalence was 100% (Makita et al., 2011). Wu et al. (2013) found that *Brucella melitensis*, *Brucella abortus*, and *Brucella suis* were the three species associated with human disease; further in their study they isolated and identified Brucella melitensis biotype 3, which implied sheep or goat was potential source of infection for brucellosis in Xinjiang area of China. A study conducted in Rwanda revealed a high prevalence (25%) of human brucellosis among women presenting with either abortion or stillbirth (Rujine & Mbanzamihigo, 2014). However, the association between abortion/stillbirth and brucellosis in humans is controversial. This could be due to the absence of erythritol (a 4-carbon sugar alcohol which is the preferred carbon source for Brucella) in human placentas as opposed to ruminant placentas (O'Callaghan and Smith et al., in Rujine & Mbanzamihigo, 2014).

Brucella abortus vaccines play a central role in bovine brucellosis control/eradication programs and have been successfully used worldwide for decades (Dorneles, Sriranganathan, & Lage, 2015). Pastoralists of the study area consume raw camel milk, and do delivery assistance, clean newborns, assist suckling and carry the young from field to home without any protection (Wanjohi et al., 2012). In Xinjiang area, human cases continued to occur due to their traditional use of raw milk products or eating the half-baked meat and having close contact with infected animals or people (Wu et al., 2013).

Human being can be infected with Brucellosis through various routes, eg consumption of contaminated dairy products, microbial inoculation through cuts or abrasions in the skin surface, the conjunctiva inoculation, inhalation of infectious aerosols, accidental human contact with infected animals and consumption of contaminated meat (Fosgate et al., in Wu et al., 2013). The common clinical symptoms included weakness, lethargy, chill, fever, sweating, decreased appetite, arthralgia, myalgia, weight loss, headache, back pain and psychological symptoms (Trujillo et al., in Wu *et al.*, 2013).

Human brucellosis has been found to be prevalent in urban areas. The sources of the risks from informally-marketed milk and the effective control measures for human brucellosis have been described. Constructing boiling centers either in dairy production areas or peri-urban Kampala and enforcing traders to sell to these centers would reduce the risk (Makita et al., 2011).

Genetic variation is an important factor in conferring resistance or tolerance of cattle breeds to a wide range of diseases (Mai et al., 2012). Large quantities of the bacteria are excreted with the fetus, the placenta and the uterine fluid, mainly at the time of calving. After abortion or parturition, the organ-

ism continues to be excreted mainly via the milk of infected cows (DFRA, in Mangen *et al* , 2002). According to DFRA (2002), infected breeding bulls can transmit the infection to cows at the time of service via the semen. Apart from direct contact between animals, other sources of infection within and between herds are contaminated water and feed supplies (Morgan & MacKinnon, 1979 in Mangen, Otte, Pffeiffer, & Chilonda, 2002). Brucellosis is transmitted from animals to humans by ingestion of raw milk, milk products, raw liver, and close contact with animals through breeding, birth, slaughtering and contaminated dust (Cooper, in Wanjohi et al., 2012). While some patients had exposure risk, the other patients got infected through various combinations. Some patients consumed unpasteurized milk, some ate unpasteurized cheese or other dairy products, and some patients ate raw meat, while others got through foodborne infections and direct contact with cattle, sheep and goats (De Massis, Di Girolamo, Petrini, A., Pizzigallo, & Giovanni 2005).

Free movement of the pastoral Fulani herdsmen and interaction of cattle with those of other Fulani herdsmen are major factors in spreading brucellosis, the high prevalence of brucellosis in a pastoral management system may partly be attributed to long distance movement of cattle in search of pasture and water and co-mingling in communal grazing areas and at watering points, particularly during the dry season (Mai et al., 2012). Borba et al. (2013) in their research noted that herds that used rented pasture to feed cattle, and the presence of wetlands on the home farm increased the risk of a herd being brucellosis positive.

Ahmed et al. (2010) conducted a study in Libya and found Brucella seroprevalence in goats, sheep, cattle and camels as well as humans using the Rose Bengal test, tube agglutination test and ELISA assays; amongst livestock, 31% of goats and 42% of cattle were seropositive. Human samples showed a high seropositivity of 40%, with 43% positive for IgM, indicating active or recent infection; rates of seropositivity were 1.6 times higher in goats than in sheep. They also observed that there was more seropositivity among humans who had a history of raw milk consumption than had direct contact with livestock in some areas, and that seropositivity was higher among males than females. This was tied to the culture and tradition of that region in which raw milk is consumed more frequently by men. Wanjohi et al. (2012) used Milk Ring Test (MRT) in camel milk samples from Garissa and Wajir Districts and found that 15.36% tested positive, 2% tested positive using Rose Bengal Plate Test (RBPT) and 10.50% tested positive using Serum Micro agglutination Test (SMT). RBPT is considered as satisfactory screening test (Quinn et al., 2002).

It was found that the age-specific incidence of brucellosis in Germany was highest for persons 60–69 years of age, with a mean annual incidence of 0.05/100,000, and lowest for children <10 years of age, with a mean annual incidence of 0.02/100,000. The age-specific incidence was highest in persons 60–69 years of age, and that in Germany, brucellosis has evolved into a foodborne disease, and unpasteurized goat cheese is the most frequently reported vehicle of exposure in their study population (Al Dahouk et al., 2007))

The date of onset for symptomatic disease was reported for 207 (84%) of 245 cases. In most cases, the onset of disease was in August or September (31%) and another smaller peak occurred in June (Al Dahouk et al., 2007). Kansiime et al. (2015) in their study in Uganda used a modified Poisson regression model to estimate the risk ratio (RR) and 95 % confidence intervals (CIs) to determine the association between brucellosis and independent variables; indicated that Brucellosis cases peaked during the months of April and June. Further, those that tested positive for typhoid were less likely to have brucellosis.

Up to mid-1980s, a substantial decrease in the incidence of human brucellosis was observed in Germany. However, national surveillance data demonstrated a persistent level of reported cases in later years and linked infections primarily to persons with a migrational background. Brucellosis was traditionally more prevalent in German states with a high degree of agricultural activity. However, they have demonstrated a fundamental shift of brucellosis from a rural disease into an infection of urban and suburban residents.

The continuing risk may be attributed to more frequent exposures during summer recreational activities in disease-endemic countries, e.g., when visiting friends and relatives in rural areas. In brucellosis-endemic regions, the peak for human brucellosis is in June and July (De Massis et al., 2005). Dean et al. (2012) indicated that demographic, occupational, and socioeconomic factors may play a role in brucellosis incidence.

Studies in Nigeria found that Seroprevalence of Human Brucellosis among abattoir-workers in Abuja was high. In addition, males appeared to be more at risk of infection with brucellosis. Butchering is a

male-dominated activity and this may have accounted for this finding (Aworh et al., 2013). Although studies have shown seropositive humans in Malaysia, mainly among veterinarians and farmers associated with occupational exposure to animals, the seroprevalence was mainly males (90%) within the age range between 20 and 45 years old
(Hartady, Saad, Bejo, & Salisi, 2014). Kracalik et. al. (2015) indicated that males were more affected by brucellosis (71%) and that the most affected age group was 15-19 years.

Annually, there are >500,000 new brucellosis cases worldwide. It is rare in most industrialized countries and more common in developing ones. The threat exists that brucellosis will expand globally as countries' borders become more porous" (Aloufi, Memish, Assiri, & McNabb, 2016). Most human brucellosis cases, however, have been linked to *B. melitensis* (Anka et al., 2013)

McDermott and Ocholi (cited in Mai et al., 2012) indicated that there is an increase of brucellosis in developing countries and there is lack of proper surveillance and control measures in most parts of Africa that contribute to this increase, as may the importation of animals and their products from more developed countries despite the preventive and control measures in such countries, and despite reports showing the extent of brucellosis there is no record of a proper brucellosis control program. The disease should be controlled by vaccination of camels and primary hosts: cattle and the small ruminants (Wanjohi et al., 2012).

Methodology

Study Site

This study was carried out in Chemundu Location of Nandi County. Patients reporting to the Chemundu Health Center came from villages that were widespread around the health center and beyond. The study area is Chemundu Dispensary. The population is mainly comprised of people whose livelihoods depend on cattle as well as other animal products for food and trade. Chemundu Health center receives patients from both the surrounding or immediate areas such as Baraton, Tilalwa, Kapkobis, as well as patients from some distance away such as Karlel.
A retrospective study was conducted from January 2011 to December 2015, in order to describe trends in the prevalence of brucellosis over a 5-year period.

This was done by reviewing serological reports at Chemundu Dispensary. In this study, the prevalence and distribution of brucellosis was determined from hospital records of patients reporting at Chemundu Dispensary by self passive administration. The collected data was analyzed using IBM SPSS Version 20.0 to generate frequencies, bar charts and tables. Brucellosis test results and socio-demographic data of the patients were obtained from laboratory records. Individual information on sex, age, area of residence, month of diagnosis and antibody titres were obtained. Serological testing was done at the clinic by the antigen-antibody brucella kit. Records were searched for all suspected cases that presented to Chemundu Dispensary during the period between January 2011 and December 2015. Descriptive analysis was used to summarize the data - in form of frequencies and percentages.

Results

The overall prevalence determined was 32.4% (338/1043) over a five-year period. 20.9% (218) were males and 79.1% (824) were females. Out of the males tested, 69 out of 218 (31.7%) were positive. Out of the females tested, 268 out of 824 (32.5%) were positive.

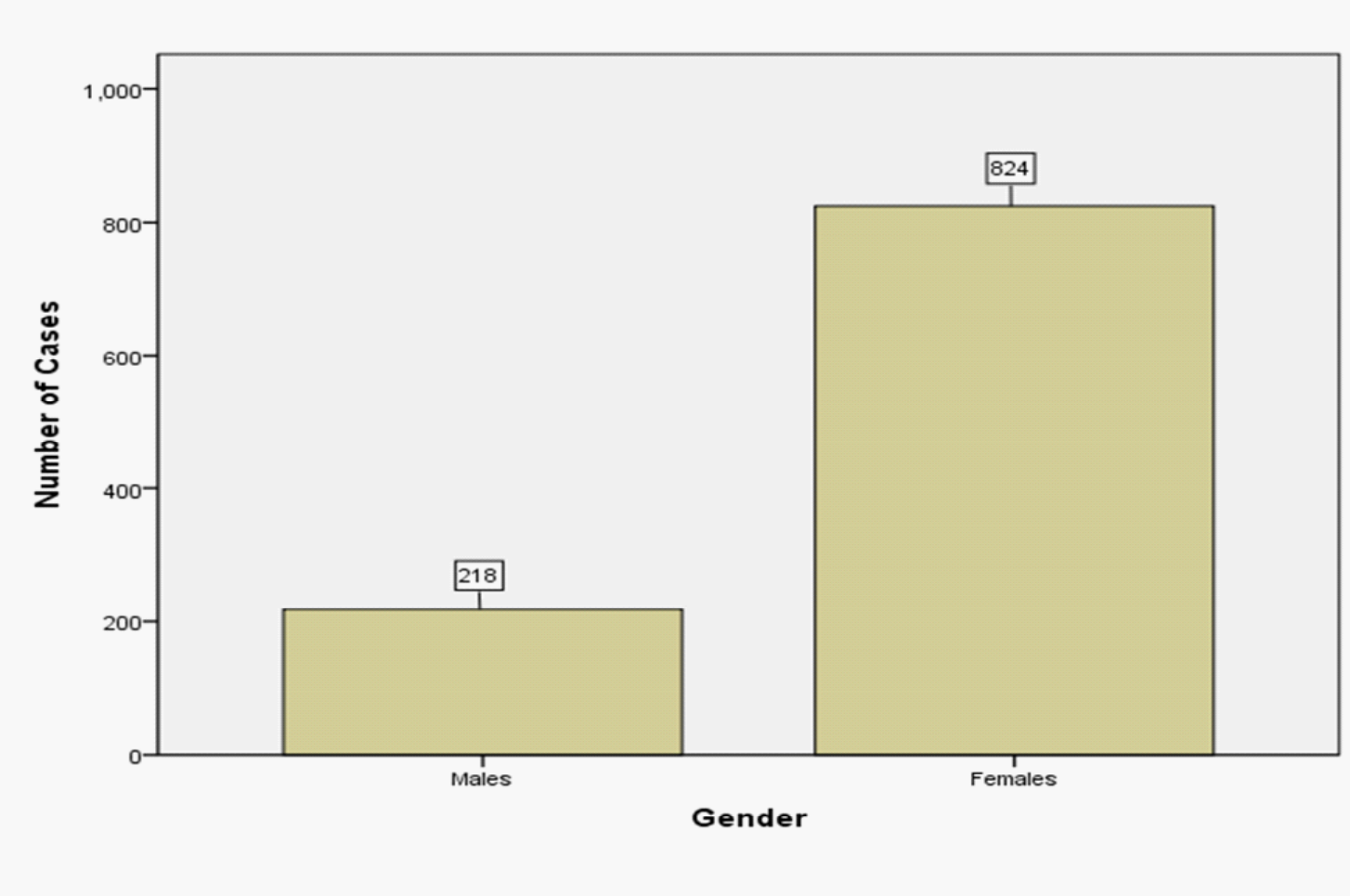

Fig. 1. Gender of patients testing for brucellosis at the Chemundu dispensary.

Those aged 60 and above years had the highest frequencies followed by: 25– 30 years, 45 – 50 years, 30 – 35 years, 35 – 40 years, 20 – 25 years and 40 – 45 years. The age category of 0-10 years had the least frequencies. Some ages were not specified.

People from Baraton had the highest frequencies (21.8%). This was followed by Chemundu (13.4%), Kapkobis 8.8%), Tilalwa (8.0%), Kapkechui (7.5%), Kaptildil (7.2%), Kapmoriongo (5.3%), Mogoon (4.4%), Samoo (3.5%), Kapyagan (3.0%). The rest of the villages had less than 3% of the cases.

As shown in table 1, the highest cases of brucellosis occurred during the month of July. This was followed by September, March and October. Most of the high incidences of brucellosis occurred during the rainy season. The lowest cases were observed in December, followed by May and January.

Table 1

The Frequency of Brucellosis Cases According to Month during the Study Period

MONTH	FREQUENCY (%)
January	6.9
February	8.5
March	10.4
April	8.3
May	6.4
June	8.8
July	11.3
August	8.8
September	10.6
October	9.9
November	6.7
December	3.3

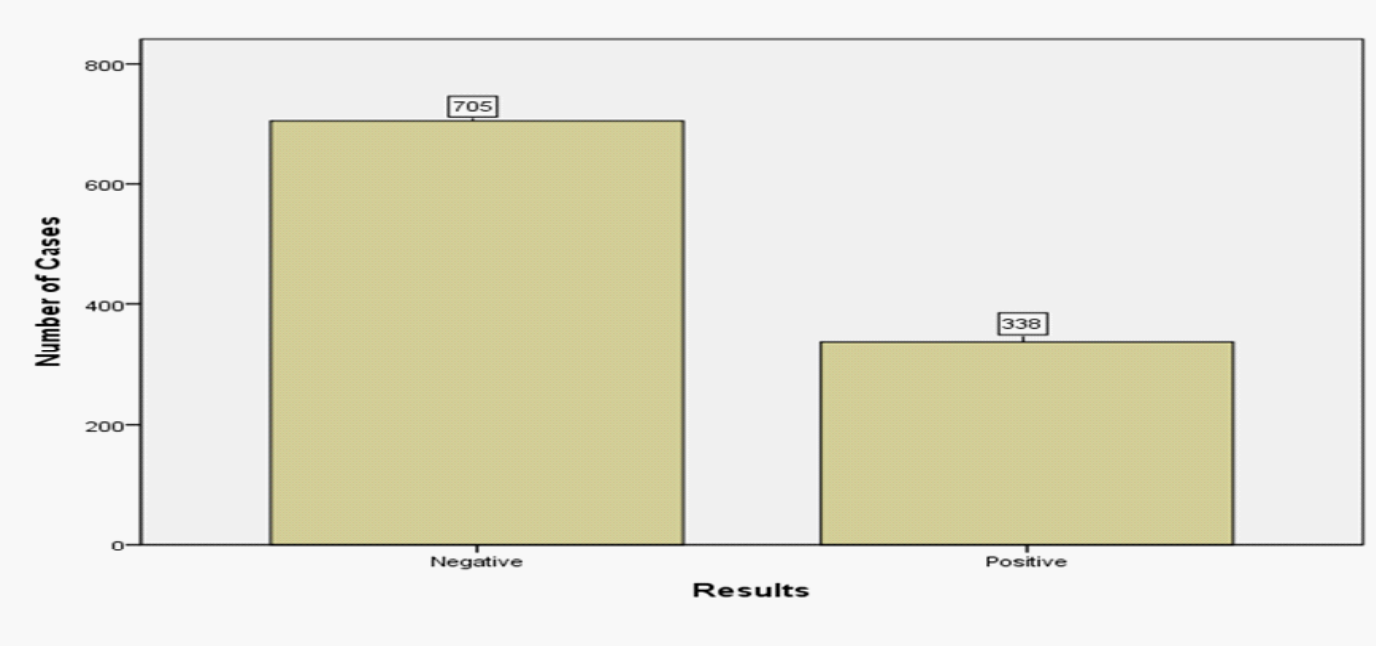

Fig. 2. Results for the brucella antigen test.

Figure 2 shows an overall result for the test for brucellosis. It shows that 338 persons testing for brucellosis using the antigen test were positive for the disease while 705 were negative. This give an overall prevalence of 32%.

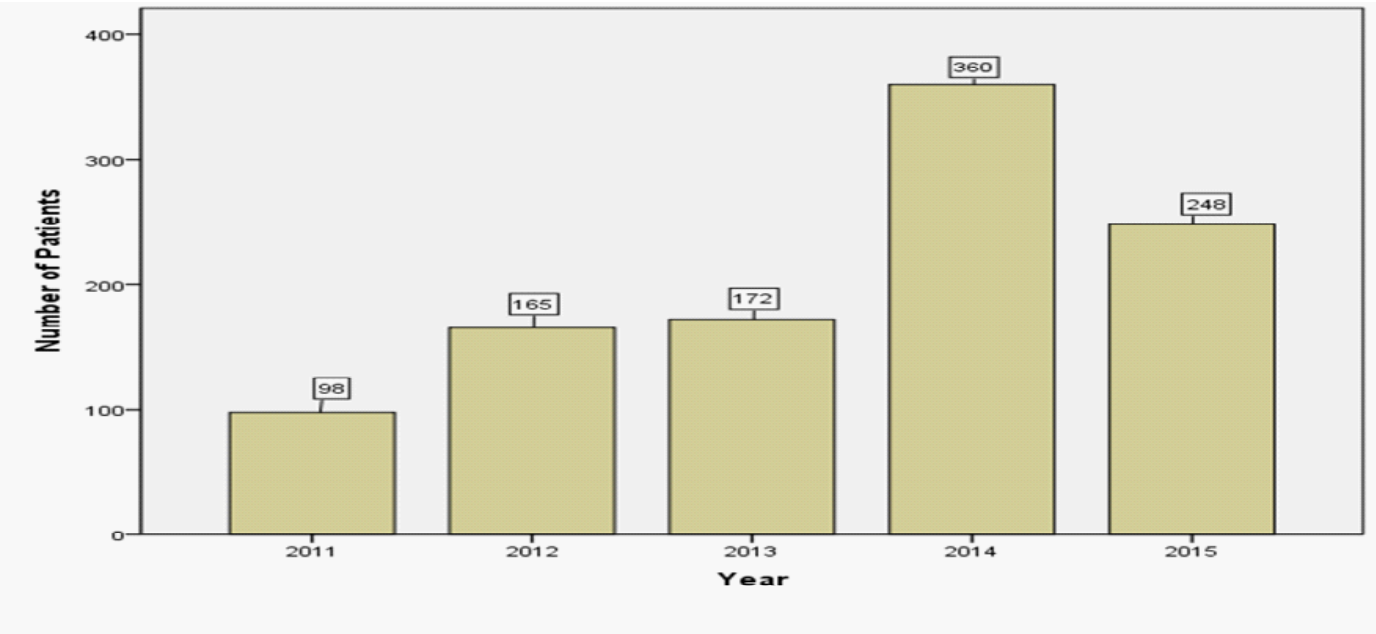

Fig. 3. The number of individuals going for brucellosis diagnosis at Chemundu Dispensary.

Figure 3 shows the number of people going to the dispensary to test for brucellosis annually over a five-year period.

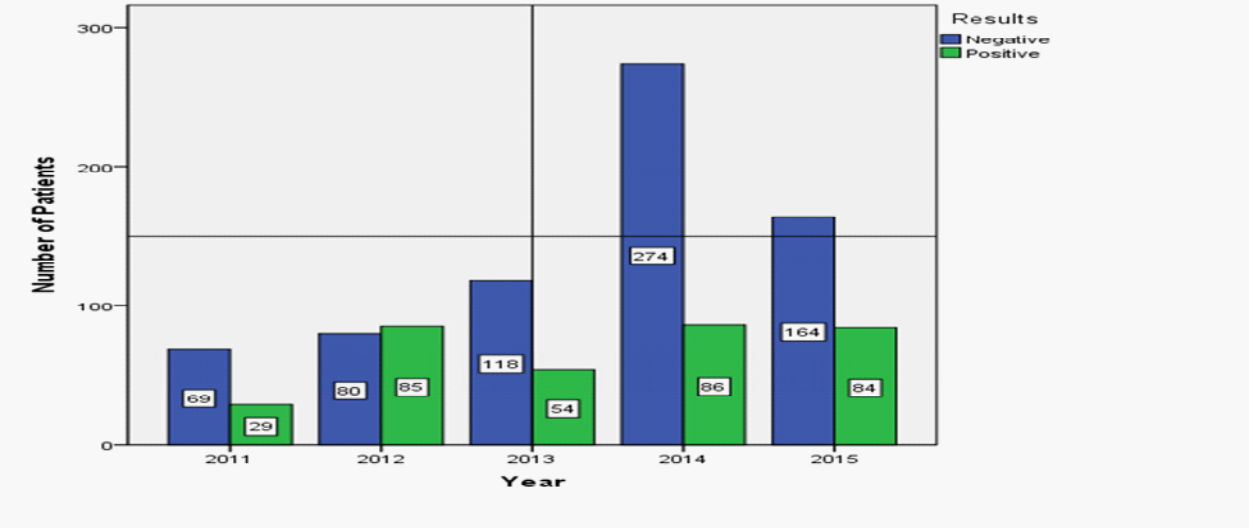

Fig. 4. The trend of brucellosis over the five year period according to cases.

From the year 2011 to 2012, there was a sharp increase in the cases of brucellosis from 29 to 85 cases. Then from 2012 to 2013 there was a significant drop from 85 to 54 cases. From 2013 to 2014, there was again an increase in the cases from 54 to 86, portraying a significant increase. Figure 4 reveals that the overall trend of brucellosis was steady in the last two years of the study, with only a decrease by 2 cases from 2014 to 2015.

Figure 5 clearly shows that more females were negative than males.

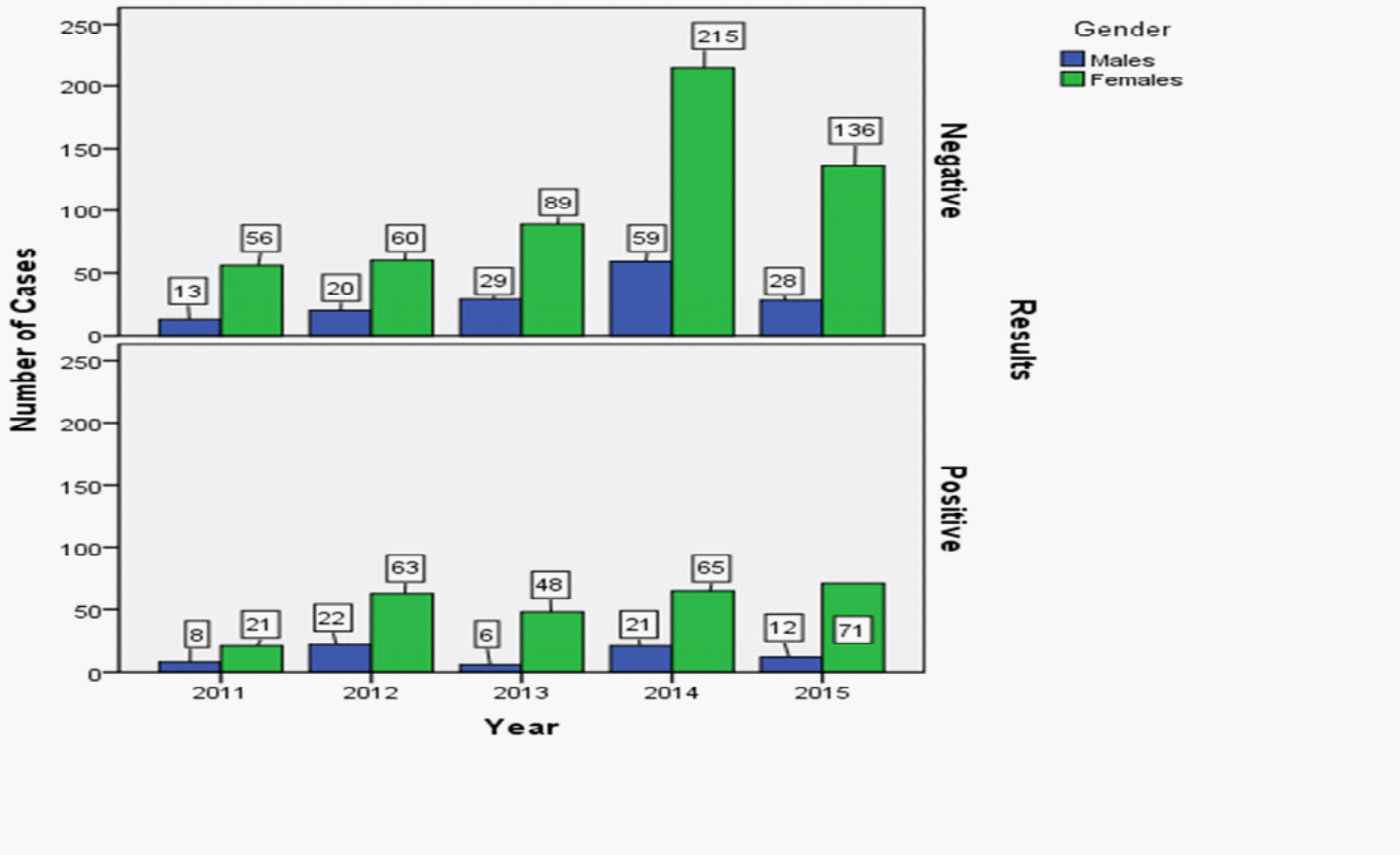

Fig. 5. Number of cases according to sex and year.

Table 1 contains villages in Chemundu Location where the patients were coming from to attend the dispensary. Some of the patient records did not indicate the names of the villages.

Discussion

The age-specific incidence was highest in persons between 60–69 years of age, and that in Germany, brucellosis has evolved into a food borne disease, and unpasteurized goat cheese is the most frequently reported vehicle of exposure in the study population (Al Dahouk et al., 2007). This study is in agreement with the current study.

Studies in Kenya have reported a prevalence range of between 5% - 45% in livestock as well as over 20% in humans in selected regions (Ogola et al., 2014). This was also in agreement with the current study. In most cases, the onset of disease was in August or September (31%) and another smaller peak occurred in June (Al Dahouk et al., 2007).

In brucellosis-endemic regions, the peak for human brucellosis is in June and July in Italy (De Massis et al., 2005). The highest incidence for the two studies show different months from the present study.

Annually, there are more than 500,000 new brucellosis cases worldwide. It is rare in most industrialized countries and more common in developing ones. The threat exists that brucellosis will expand globally as countries' borders become more porous" (Aloufi et al., 2016).

Table 1

Villages in the Study Area where People Traveled from to Attend the Chemundu Dispensary

SN	Village	SN	Village	SN	Village
1	Chemundu	17	Mogoon	33	Kapaskei
2	Masaba	18	Kaplenit	34	Kaptel
3	Kapkobis	19	Kapyagan	35	Kipsioror
4	Tilalwa	20	Mogoon	36	Sumbeiywo
5	Samoo	21	Cheplengu	37	Amai
6	Baraton	22	Kapkoros	38	Cheptol
7	Kapmoriongo	23	Kapino	39	Nandi Flame
8	Kapkechui	24	Kibirbei	40	Karlel
9	Kaptildil	25	Lelechwet	41	Chepkober
10	Kapsisiywo	26	Nukia	42	Kakarwet
11	Chepkoiyo	27	Kipchabo	43	kamakas
12	Biribiryet	28	Kaplolo	44	Chepsogor
13	Kaputie	29	Segut	45	Kapsasur
14	Kimondi	30	Sironoi	46	Kipkosgei
15	Kombe	31	Kapalgong	47	NS= Not specified
16	Kapkomon	32	Kaptobongen		

There was a greater number of cases in the 15–44 years age group than in any other age group; Males had a significantly greater incidence rates than females. Most cases were reported during spring and summer seasons (Aloufi et al., 2016). Males were consistently, disproportionately afflicted (71%) and incidence was highest in the 15 to 19 age group (Kracalik et al., 2015). The prevalence was highest among males and the elderly - above 60 years in Central Uganda (Tumwine, Matovu, Kabasa, Owiny, & Majalija, 2015).

Studies in Nigeria found that Seroprevalence of Human Brucellosis among abattoir-workers in Abuja was high. In addition, males appeared to be more at risk of infection with brucellosis. Butchering is a male-dominated activity and this may have accounted for this finding (Aworh et al., 2013).

Conclusion and Recommendations

There were more women than men who reported to Chemundu Dispensary. There was a general rising trend from 2011 to 2014. The year 2014 had the highest number of cases of brucellosis. Women had a higher prevalence rate as compared to males. In the study area, the trend of brucellosis can be described as re-emerging. More cases of brucellosis occurred during the rainy season compared to the drier months of the year.

It is important to establish factors associated with the spread of brucellosis in the study area. The factors associated with the spread of brucellosis in the study area will assist researchers to understand the changing trends of the disease over a period of time. Seasonal distribution of the disease can be studied to associate disease occurrence with climatic conditions.

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