SOCIO-MEDICAL FACTORS ASSOCIATED WITH THE PREVALENCE OF BRUCELLOSIS AMONG THE NOMADS IN MAIKONA DIVISION OF MARSABIT DISTRICT, KENYA.

BY

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DECLARATION

This thesis is my original work and has not been submitted to any other University or for any other award.

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We confirm that the candidate under our supervision carried out the work reported in this thesis.

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DEFINITION OF TERMS

Common container	**A single container into which several animals are milked or are used for storing milk. Special traditional guards are used in the study area.**
Endemic	**The habitual presence of a disease in a specific geographical area.**
Incidence	**The number of new cases of a disease that occur during a specified period of time in a population that is at risk of that disease.**
Prevalence	**The number of infected persons (both the new and old cases) present in the population at a specified time.**

ABBREVIATIONS AND ACRONYMES

ANOVA	**Analysis Of Variance**
C.C. F	**Christian Children's Fund**
C.E.C	**Community Education Concern**
C.O.R.Ps	**Community's Own Resource Persons**
F.H.I:	**Food for the Hungry International**
G.O.K	**Government of Kenya**
IgG	**Immunoglobulin G**
M.P.F	**Ministry of Finance and Planning**
M.O.H	**Ministry of Health**
N.G.Os	**Non-Governmental Organizations**
N.L.T.P	**National Leprosy and Tuberculosis Programme**
P.I.S.P	**Pastoralists Integrated Shelter Programme**
R.B.P.T	**Rose Bengal Plate Test**
T.B	**Tuberculosis**
T.B.As	**Traditional Birth attendants**
U.S.A	**United States of America**

ABSTRACT

It is a common disease among pastoralists and nomadic herdsmen in developing countries, who are continually exposed to potentially infected animals. In Africa the disease incidence is largely unknown because many cases are missed out due to lack of diagnostic facilities. Human brucellosis has been known in East Africa since 1910 when Bruce described the disease known as *"muhinyo"* (crippler) in Uganda and the Maasai name *"nange'da"* has a similar meaning. The disease is reported to be wide spread in Kenya. The Ministry of Health report shows that the cases range from as low as 100 to as high as 1000 each year. Human beings are infected by all species of *Brucella*. *Brucella melitensis* is more infective and virulent than *Brucella abortus* with *Brucella suis* being intermediate. The aim of this study was to determine the socio-medical factors underlying the disease prevalence among the nomads in Bubisa sub-location of Maikona Division of Marsabit District. Descriptive cross-sectional study design was used and 400 respondents were selected following systematic random sampling method. Interview schedule for households, key informants and focus group discussions were used for data collection. Odds ratio and chi-square test was used for testing relationship between variables. A majority of the subjects (75.8%) had no formal education, with the main occupation being livestock rearing (78.2%) and the average household size being 5-6 persons. Statistical test showed that women are more susceptible to infection than men in this community (Cross products odds ratio=1.62, χ^2=4.02, df=1 and (p)<0.05). Most informants (73.3%) had knowledge on the prevalence of brucellosis in the area, locally referred to as*"dukub annani"*(the disease of the milk). A substantial number of households interviewed (31.8%) had experienced at least a case of human brucellosis in the last one year. Consumption of raw milk without boiling (38.5%) is among the risk factors reported to contribute to disease prevalence in the area. Statistically significant relationship was established between consumption of raw milk and the household prevalence of brucellosis (Cross product odds ratio=1.64 and χ^2=4.30,df=1 (p)<0.05). Similarly, a significant relationship was observed between household prevalence of brucellosis and drinking of animal blood (Cross product odds ratio=1.64 and χ^2=4.30,df=1(p) <0.05). Households with large livestock population reported more cases of the disease. Majority of reported cases (62.2%) were from households with livestock population of more than 100 as compared to 19.7% and 17.3% reported by households with a livestock population of 50-100 and 0-49, respectively. A large majority 347 (86.8%) reported that one container is used for milking and milk storage, a statistically significant relationship was found to exist between the household prevalence of brucellosis and milk harvesting (Cross products odds ratio=3.87, χ^2=17.60, df = 1 (p) <0.05). Thorough health education especially on the mode of transmission of brucellosis and the main risk factors such as consumption of raw milk, consumption of animal blood and failure to seek treatment from health institutions needs to be emphasized. Accessibility and affordability of treatment services is a matter that needs to be addressed by the health department. It is also important to note that some people opted for traditional treatment instead of modern treatment because of inaccessibility (12%) and un-affordability (13.7%).

CHAPTER ONE:

INTRODUCTION

1.1 Background

Brucellosis is an infectious disease primarily of domestic and wild animals caused by bacteria of the genus *Brucella*. It is transmissible to humans through direct contact with infected animal products. It constitutes a major health problem in many parts of the world. Brucellosis is a multisystem disease with a broad spectrum of manifestation (Sevin*c et al.,* 2000).

The true incidence of human brucellosis is unknown. Reported incidences in endemic-disease areas varies widely, from <0.01 to >200 per100,000 population. While some areas, such as Peru, Kuwait, and parts of Saudi Arabia, have a high incidence of acute infections, the low incidence reported in other known brucellosis endemic areas may reflect low levels of surveillance and reporting. Other factors such as methods of food preparation, pasteurization of dairy products, and direct contact with infected animals also influence risk to the population (Mantur *et al.*,1996).

Brucellosis is prevalent in all major livestock production systems in Sub-Saharan Africa. Yet its presence is often unrecognized through lack of awareness by both the health care staff and veterinarians and absence of accessible laboratory diagnostic facilities. As a consequence, brucellosis remains a largely neglected disease with little attention to control and prevent except in South Africa where a successful control policy of vaccination combined with test and slaughter has been initiated (McDermott *et al.*, 2002).

The incidence of brucellosis is highest in pastoral production systems where large numbers of animals mix. Bovine brucellosis seems to be more common than ovine brucellosis. However, this may be an artifact reflecting the serological testing of livestock species. Much less is

known on the prevalence in humans and of the effect on health in this region of the world. Provision of improved diagnostics is essential to enable such investigation to be undertaken (Muriuki *et al.*,1997).

Brucella has a low infectious dose (10 organisms of *B. melitensis* are sufficient to cause infection in humans), making infection a genuine risk to those occupationally exposed such as farmers, veterinarians and butchers and to the public through the consumption of contaminated unprocessed milk, milk products and meats (Henk *et al.*,2004). In the pastoralist areas, there is a higher incidence of brucellosis, which must be considered with suspicion, alongside widespread causes of flu-like symptoms such as malaria (Maichomo *et al.*, 1998). About 80% of the residents of Marsabit district where the study was conducted are pastoralists who derive their livelihood from livestock or livestock based industries (Ministry of Planning and Finance., 2002-2008).

Human brucellosis is rarely caused by consumption of infected meat but humans may acquire the disease readily by percutaneous infection. Even imperceptible lesions of the skin may serve as portals of entry and there is a marked predisposition to brucellosis among the occupational handlers of animals and meat in areas where the disease is enzootic (Schwale., 1969).

Temperature, humidity and pH of the environment influence the survival of *Brucella melitensis* as well as *B.abortus*. Bruccellae are sensitive to direct disinfections and pasteurization. In optimal conditions *Brucellae* survives in tap water, damp aborted fetuses, uterine exudates and in frozen tissues (Daves *et al.*, 1975).

Most Mediterranean countries have large numbers of flocks of sheep and goats infected with *B. melitensis*. *Brucella melitensis* is also prevalent in developing countries of South-West

Asia, parts of Latin America and Africa where it constitutes a serious human health hazard (Yantzis., 1985). *Brucella melitensis* is a zoonotic disease causing debilitating illness in humans. Symptoms of acute brucellosis caused by *Brucella melitensis* are flu-like and highly non-specific. Chronic brucellosis is an insidious disease with vague symptoms that might be confused with other diseases affecting various organ systems (Serter *et al.*, 1991). The organism responsible for brucellosis is a small Gram-negative *coccobacillus*, which is non-motile, non-encapsulated and non-spore-forming. In infected tissues it normally occurs singly or in small groups (Corbel.,1978).

Ideally, effective control of brucellosis should be through a combination of improved diagnosis, vaccination and treatment, together with measures to increase awareness, and improved farm sanitation and food hygiene. Collectively, these will increase the effect of control measures and lessen the burden of disease. An integrated disease education and community participation program may assist the achievement of this goal. Traditional beliefs and habits may interfere with disease prevention and prohibit its acceptance due to lacunae in disease and health knowledge. Awareness of the cause of this disease and knowledge of measures for prevention and resulting benefits of this can be provided through such a program, creating a positive attitude towards disease prevention. A disease education and community participation program will promote involvement, encourage acceptance thereby increasing the efficacy of control measures (Henk *et al.*, 2004).

1.2 Problem statement

Human brucellosis causes physical and psychological suffering due to infection, hospitalization, the cost of drugs and loss of income due to illness. The country incurs huge

costs generated by prophylactic measures taken to control brucellosis and provision of testing and treatment facilities. There is no doubt that outbreak of brucellosis especially *Brucella melitensis* causes significant loss of income to the farmers.

Zoonotic diseases like brucellosis are not only of veterinary importance but may also severely affect human health, contributing to morbidity and reduction of working capacity with concomitant loss of income. Brucellosis has been reported from almost all countries of Africa. A recent study identified brucellosis in sub-Saharan Africa as a major priority for control and prevention.

Human brucellosis has been poorly studied in Africa. Seroprevalence of 3.8% has been reported in nomadic pastoralists from Chad. Slaughter house workers in Djibouti had a prevalence of 6.5% and the high risk groups in Eritrea showed a seroprevalence of 3.0% to 7.1% while in Eastern Nigeria 5.2% were seropositive.

The disease is reported to be wide spread in Kenya. Ministry of Health report shows that reported cases range from as low as 100 to as high as 1000 cases each year (Juma *et al.*, 1996). According to the Bubisa Dispensary report (2004 and 2005) which serves the Sub-Location where the study was carried out, a total of 84 people were treated for brucellosis in 2003 and in 2004 this number increased to 108. This indicates an increasing trend of the disease in the community and is relatively high as compared to national figures.

The consumption of unpasteurized milk by many people in the community is a major risk factor.

There is little awareness in this community about this risk factor. The large livestock population is a potential source of infection among the Gabbra community. Many people have

large flocks of goats and sheep, which is a potential source of *Brucella melitensis*, a highly virulent form of *Brucella* infection.

Lack of appropriate medical care makes it difficult for cases to be diagnosed and treated. Health facilities especially those in rural areas need to be equipped for tackling this problem. According to Marsabit district development plan (2002-2008), the average distance to the health facility is 80 km and the percentage of households with access to the health facilities is 50%.

Poor reporting system on cases of the disease and unavailability of necessary information to the stakeholders such as the health workers, veterinarians, community's own resource persons (C.O.R.P_s) and the community indicate that there is a long way to go in curbing this problem.

1.3 Justification of the study

This study was designed to determine the socio-medical factors underlying the prevalence of the disease in the community the aim of improving community awareness on the subject. This will assist in controlling and preventing the disease from spreading and thereby improving their health status.

Although human brucellosis is a notifiable disease in many countries, official figures do not fully reflect the number of people infected each year and the true incidence has been estimated to be between 10 and 25 times higher than what the reported figures indicate. Cases often remain unrecognized because of the inaccurate diagnosis, and are thus treated as other diseases or as "fever of unknown origin". This therefore justifies the need for this study which intends to determine the disease prevalence in the study area.

It is also important to note that there are many non governmental organizations (N.G.Os) working in the area, most of which have programs that address community health problems. Such organizations include Food for the Hungry International (F.H.I), Christian Children's Fund (C.C.F), Farm Africa, Community Education Concern (C.E.C) and Pastoralist integrated Shelter Programme (P.I.S.P). These organizations may utilize the findings of this study in implementation of their programs on health.

Although this disease is becoming an increasing community health problem, there is lack of knowledge especially on modes of disease transmission. Therefore, the finding will be useful to many stakeholders, especially, Ministries of Health and Livestock Development in understanding the various socio-medical underlying factors and in doing disease surveillance. These findings will improve the disease surveillance and encourage collaboration and participation of health workers, veterinarians, the local administration and the community in reducing the disease burden.

1.4 Research questions

i. What is the relationship between conducting physical operation to assist the livestock during deliveries and the household prevalence of brucellosis

ii. What factors influence the disease prevalence in the study area

iii. What percentage of the population boils their milk before consumption

1.5 Hypothesis

i. There is no relationship between conducting physical operations to assist the livestock during deliveries and the household disease prevalence

ii. There is no relationship between milk treatment and household prevalence of brucellosis

iii. There is no relationship between consumption of raw animal blood and the household prevalence of brucellosis

1.6 Objectives of the study

1.6.1 General objective

To determine the socio-medical factors underlying the prevalence of brucellosis in Maikona Division of Marsabit district.

1.6.2 Specific objectives

i. To determine socio-cultural factors associated with the prevalence of the disease.

ii. To assess community awareness and the health seeking behaviour.

iii. To assess animal and animal products handling practices.

iv. To determine the role played by health workers and veterinarians in controlling the disease.

CHAPTER TWO:

LITERATURE REVIEW

2.1 The epidemiology of the disease

The disease "Malta fever" or "undulant fever" was prevalent in the island of Malta and various other places along the Mediterranean coast, but at first with only a local significance. However, as transport and communication became available between different parts of the world, the disease spread from its original home. David Bruce first discovered the causative organism in 1889 from a fatal case of the disease. It was first called *Micrococcus melitensis* and subsequently named *Brucella melitensis* after its discoverer (Wenning., 1986).

The disease occurs world wide, especially in the Mediterranean countries of Europe, North and East Africa, Middle Eastern countries, India, Central Asia, Mexico and central and southern America. The source of infection and the responsible organism vary according to geographical area. Brucellosis is predominantly an occupational disease of those working with infected animals or their tissues, especially farm workers, veterinarians and abattoir workers; hence it is more frequent among males. Sporadic cases and outbreaks occur among customers of raw milk and milk products (especially unpasteurized soft cheese) from cows, sheep and goats (Chin., 2000).

Brucellosis imposes a serious public health and socio-economic problem in many Mediterranean countries. With an incidence greater than 20 per 100000 inhabitants, this disease is the most common zoonosis in the Republic of Macedonia (Bosilkovski *et al.*, 2004). According to the statistical data of Ministry of Health of Turkey between 1987 and

1997, the disease showed increasing morbidity and mortality rate. Averages of 3,568 patients were hospitalized annually in this period, and 25 died of brucellosis (Ahmet *et al.*, 2001).

In the U.S.A there are fewer than 200 reported cases of brucellosis per year. However, W.H.O reports that, there are about 500,000 cases of brucellosis annually worldwide of which majority are cases of *Brucella melitensis*. However, there was a decrease in the incidence of the disease in the U.S.A during the previous several decades from quite a common infection to less than 200 reported cases. This decrease is as a result of extensive program of testing and immunization of cattle by United States department of agriculture. It is a requirement that all cattle in the U.S.A have to be immunized with living self-attenuated strains of *Brucella abortus* (strain 19). However, active immunizations of humans have not been done in the U.S.A although some Eastern European countries have immunized some high risk groups of individuals (Volk *et al.,* 1989).

Most of the 200 cases that occur annually in the United States are associated with the handling of swine carcasses (Atlas., 1995).

A study on the prevalence of human brucellosis was conducted in Saudi Arabia where a sample of 4900 subjects was randomly selected from house to house survey. Investigation included interview, clinical examination and blood sampling for antibody titre determination. A total of 4794 completed the study. The result of laboratory test indicated that a significant proportion of the population (19.2%) had serological evidence of exposure to *Brucella* antigen and 2.3% had active disease. Direct contact with animals and consumption of raw products of animal origin were identified as the main risk factors (Alballa., 1995).

Similarly, a study on knowledge, attitude and practice in Saudi Arabian community towards problem of brucellosis revealed that out of 337 patients examined for knowledge on methods

and means of transmission of the disease, 309 (92%) were ignorant while 28 (8%) appeared to have some knowledge about the source, type of animal contact and prevention of illness. None of the 337 subjects was able to link the disease with microbial infections. The common practice associated with the occurrence includes; consumption of raw milk, unpasteurized animal products like butter and cheese, close animal contact and slaughter and disposal of animal wastes (Bilal *et al.,* 1991).

The changing trends in the epidemiology of brucellosis were noted in a study done in California in1994. From 1974 through 1992, a total of 426 cases of human brucellosis were reported in California, of which 98% were laboratory confirmed. *Brucella melitensis* was identified in 185 cases. Hispanics accounted for 81% of the cases from 1983 to 1992 compared with 65% the previous decade. Slaughterhouse cases decreased from 25% during 1973-1982 to less than 3% during the following decade. Changes in the case distribution were characterized by a decreasing incidence in the Central Valley and an increasing incidence in the San Francisco Bay area and the South Coast Range. Hispanics are more likely infected through consumption of infected milk and cheese in Mexico during 1983-1992 than during the previous 10 years. Between 1973 and 1992, human brucellosis in California evolved from an occupational to a food borne illness (Chomel *et al.,* 1994).

Humans working in the meat industry may contract the disease percutaneously, conjuctivally or by nasal mucous membrane infection. Many became infected with brucellosis when handling aborted fetuses or healthy calves born to infected cows, performing gynaecological operations or when handling Rev. 1 vaccine (Schnurrenberger *et al.*, 1975). Human beings can be infected with all species of *Brucella.* When milk is contaminated with *Brucella abortus*, cases are usually sporadic but when it is infected with *Brucella melitensis* or *Brucella*

suis, outbreaks are often of epidemic proportions. When *Brucella melitensis* occurs, human disease is always recognized and the same applies to *Brucella suis* in U.S.A (Stableforth *et al.*, 1994).

The infective dose for *Brucella melitensis* is very small. Immunity conferred by recovery is unreliable and the person who has recovered may still be susceptible to second infection and may remain a passive carrier of the bacteria for life (Wenning., 1986).

Brucella species particularly *Brucella melitensis* and *Brucella suis* are potential agents of bioterrorism. On match 25th 1999, a 38 year-old woman from New Hampshire was admitted to the hospital after infection with brucellosis. On interview, the family members reported no history of traditional risk factors for Brucella exposure but reported that the patient's illness might have been caused by exposure to "laboratory flasks" and "cultures" kept in the apartment by her boyfriend who was a student of marine biology. On investigation this equipment tested positive for Brucella antibodies. On suspicion of bioterrorism, the hospital authorities reported the case to the local law enforcement agency. Although the investigation did not show evidence of bioterrorism, the safe resolution of the case illustrates the value of the integrated clinical, public health and law enforcement on bioterrorism preparedness and response (C.D.C., 2000).

In 1992, the North Carolina department of Environment, Health and Natural Resource received 18 cases report of brucellosis from a county health department. All patients had potential exposure to the killing floor of one pork processing plant. A subsequent survey of 156 killing floor workers of this plant found out that 30 (19%) had evidence of recent exposure to brucellosis. This data shows that a significant exposure to *Brucella* is occurring among parking plant workers in North Carolina and suggest that some of 38000 production

workers in pork processing plant in the U.S.A are at risk of contracting swine brucellosis (Trout *et al.*,1995).

2.2 Disease burden in Africa and in Kenya

Brucellosis remains an endemic disease in many regions of the world, with morbidity much more prevalent in developing countries. Infection is most prevalent in areas in which people are exposed to animals that are carriers of different *Brucella* species (Trujillo *et al.*, 1994). In Africa, the disease incidence is largely unknown because many cases may be missed due to lack of laboratory/diagnostic facilities. The disease is common in savannah areas where there are large herds of cattle and goats. The infection in animals cause repeated abortions, presenting an economic problem, particularly for cattle owners (Nordberg., 1999).

Brucellosis is a common disease among pastoralists and nomadic herdsmen in developing countries who are continuously exposed to potentially infectious animals. In developed countries, it is an occupational risk for butchers, wool sorters, livestock farmers and veterinarians. Human brucellosis has been known in East Africa since 1910 when Bruce described the disease called "*Muhinyo*" (Crippler) in Uganda. The Maasai name "*Nange'da*" has a similar meaning (Muriuki *et al.*, 1997). Human brucellosis is a disease reported to be wide spread in Kenya. The M.O.H (1991) reported cases range from as low as 100 cases to as high as over 1000 each year (Juma *et al.*, 1996).

2.3 Mechanisms of disease transmission

The mode of infection remained obscure until 1905 when a number of milking goats purchased from the island of Malta were shipped to the U.S.A. During the voyage, most of the

crew members drunk goat's milk and several of them developed a typical Malta fever. On investigation Mohler and Harts (1905) found out that the goats were infected with *Brucella melitensis*. All the Maltese goats and their offsprings' were put under quarantine on arrival in the U.S.A and were later destroyed (Wenning., 1986).

In 1922 Zammit showed that more than 50% of the goats of Malta were infected and about 10% were discharging the organisms in milk and that there were several healthy carriers who harboured the organisms in their blood (Wenning., 1986).

Transmission occurs through contact with tissues, blood, urine, vaginal discharge, aborted fetuses and especially placentas through the break in the skin. It can also occur by ingestion of raw milk and dairy products such as unpasteurized cheese or butter from infected animals. Air borne infection of animals occur in pens and stables and of human in laboratories and abattoirs. A small number of cases occur from accidental self-inoculation of strain 19 Brucella vaccine (Chin., 2000).

Human infection with *Brucella* species can occur if milk or milk products enter damaged skin or eye. Nomadic herdsmen who drink animal blood are also susceptible to infection (Chelsbrough., 1989). Milk products prepared from un-heated and un-fermented or slightly fermented milk are also recognized as a common source of infection in most countries. Other sources of infection are meat products whether kept fresh in a refrigerator (infective up to three weeks) or preserved by pickling. Contact infection through milk handling, especially during hand milking can also occur (Stableforth *et al.*, 1994).

Infection from mother to child does not play any large part in human brucellosis. It has however been shown by both Burnet (1926) and Renoux (1953) that the human mother can

excrete Brucella organisms in milk and transmission from mother to child in one way or another is by no means rare in heavily infected areas (Stableforth *et al.*, 1994).

2.4 Disease manifestation and complications

The disease commences as a blood stream infection and the clinical manifestations are gradual in onset and variable. The symptoms in the order of frequency includes sweating, weakness, headache, anorexia, pain in the limbs and back, constipation, rigors and joint pains. The spleen may be palpable. The temperature characteristically shows undulations, during which febrile and afebrile periods alternate over a period of a week or so (Christopher *et al.*, 2002). Acute brucellosis is non-specific. Chronic infection often causes skeletal, genitourinary or pulmonary disease (Heppner *et al.*, 1993).

Hip joint involvement is one of the most common osteoarticular manifestations of human brucellosis. The frequency ranges within a scope of 18-60% among the patients with oestioarticular brucellosis (Mousa *et al.*, 1987).

During the course of illness arthritis is common. One joint is usually affected at a time, the pain and swelling subsiding after a few days and then appearing elsewhere. The joints most often affected are the hip, knee, shoulder, ankle and wrist, but occasionally the small joints of the fingers and toes or of the spine may be involved (Houston., 1970).

There is no evidence of communicability from person to person. The incubation period is highly variable and difficult to ascertain. It usually ranges from 5-60 days (Chin., 2000).

Even in the absence of the systemic symptoms, the possible relapse of brucellosis as an abscess formation in the testis should be considered as a rare cause of testicular mass in patients who live in endemic regions (Kocak *et al., 2004).*

A study on cutaneous finding encountered in brucellosis revealed that out of 103 serologically and clinically confirmed cases of brucellosis, 14 (13.59%) had cutaneous findings probably related to brucellosis. These findings were more frequent in females (11cases) than in males. The cutaneous findings observed in Brucellosis can be multiple and are due to direct inoculation, hypersensitivity phenomena, deposition of immune complexes and direct invasion by organisms reaching the skin (Ahmet *et al.*, 2001).

Brucellosis in pregnancy is a rare entity. It has been associated with increased risk of spontaneous abortion in animals and possibly in humans. Among six patients with brucellosis in pregnancy, one requested termination of pregnancy in the first trimester, one had spontaneous abortion at twelve weeks that could not be directly associated to brucellosis and four continued with their pregnancy with no significant increase in maternal or neonatal morbidity or mortality (Seoud *et al.*, 2001).

2.5 Diagnoses and management

Laboratory diagnosis is made by appropriate isolation of infectious agents; *Brucella abortus* (bovine), *Brucella melitensis* (goats and sheep), *Brucella suis* (swine) and *Brucella canis* (dogs) from blood, bone marrow or other tissues or from discharges of patients. Test measuring IgG antibody may be useful particularly in chronic cases since active infection is associated with a titre rise. Specific serological techniques are needed for *Brucella canis* antibodies, which do not cross-react with the other species (Chin., 2000). The protean nature of brucellosis makes it difficult to diagnose clinically and given its extent in pastoralist communities, denies a sizeable number of deserving patients a proper treatment (Muriuki *et al.*, 1997).

In a study aimed at determining the tolerance and efficacy of human brucellosis vaccine, 576 subjects with no previous or current infection were observed. A total of 271 subjects were vaccinated with brucellosis vaccine and 305 with tetanus vaccine, the latter group serving as a comparative control group. The vaccinated persons were monitored monthly for at least 9 months. Although brucellosis vaccine caused some unpleasant side effects in 25% of the vaccinated persons, it appears to be safe for large scale use in prevention programs. In addition the result indicates that the intradermal reaction test is safe and sensitive for large scale use (Hadjichristodoulou *et al.*,1994)

Combination of refampicin (600-900mg daily) or streptomycin (1gm daily) and doxycycline (200mg daily) for at least 6 weeks is the treatment of choice. Tetracycline should be avoided in children less than seven years old to avoid tooth staining. Cotrimoxazole is also effective but relapses are common in 30% the patients (Chin., 2000). Up to 10% of patients with systemic brucellosis relapse after antimicrobial therapy. Relapse may occur due to intracellular localization of the organism that protects the bacteria from certain antibiotics and host defense mechanisms, inadequate treatment or continuation of patient occupation (Kocac *et al.*, 2004).

According to study done in Narok District of Kenya to assess the Rose Bengal Plate Test (R.B.P.T) for diagnosis of human brucellosis, the test as currently conducted in rural dispensaries added no value at all to diagnostic process. This is unfortunate both because, the treatment of brucellosis is long and costly and thus treatment decision should be supported by high degree of diagnostic probability and brucellosis should be treated as early as possible to avoid chronic and destructive pathology in joints and other locations (Maichomo *et al.*, 1998).

2.6 Prevention and control

Infection in man is associated with the prevalence of the disease in animals. Therefore, if the disease is to be eradicated or properly controlled in animals, infection to man will no longer be possible. From the public health point of view, the campaign against brucellosis in animals must therefore be regarded also as one against undulant fever in man (Wenning., 1986).

The search for infection among livestock by serological test and by ELISA or ring test in cows milk and elimination of infected animals by segregation and /or slaughter is an effective control measure. Infection among swine usually requires slaughter of the herds. In areas of high prevalence, immunize young goats and sheep with live attenuated Rev-1 strain of *Brucella melitensis* and calves and sometimes adult animals with strain 19 *Brucella abortus* (Chin., 2000). Since 1996, the recombinant RB51 vaccine has largely replaced the use of strain 19 for immunization of cattle against *Brucella abortus*. RB51 vaccine appears to be less virulent for humans than strain 19 (Chin., 2000).

Pasteurization of milk before use and using only pasteurized milk for preparation of cheese or butter is an essential precaution in prevention of infection to humans. In the areas where the disease is prevalent among livestock, there is need to provide facilities for serological testing of patients with fever who do not respond to antimalarials (Nordberg., 1999). Another appropriate preventive measure is to educate the public on the risk factors such as drinking unpasteurized milk or eating products made from unpasteurized milk such as cheese and butter and handling carcasses and products of potentially infected animals. There is need to create awareness on proper operation of abattoirs to reduce exposure especially through appropriate ventilation (Chin., 2000).

A study was done in Israel to determine whether active screening of a population at risk would enhance the detection rate of brucellosis and improve treatment. During a one month period all 98 individuals sharing risk factors with 4 diagnosed symptomatic case of brucellosis in one Bedouin town were approached and 86 underwent screening. Symptomatic brucellosis was found in 8 (9%) of the screened population and an additional 5 (6%) asymptomatic individuals were found to be seropositive. This 13 were followed for 12 months. All symptomatic cases were treated and cured. Out of five asymptomatic seropositive individuals, two of them showed a further elevation of brucella antibody titers. One became symptomatic, was treated and was cured. This screening program provided 53% of all reported cases from the Bedouin town during the entire year of the study. Screening the population at risk increased the detection rate of brucellosis and improved the treatment (Abramson *et al.,* 1991).

For disease prevention, vaccination of humans with a special clone of strain 19 of *Brucella* was widely done among those working in contact with sheep infected with *Brucella melitensis* in the former U.S.S.R. Out of 200,000 people vaccinated from 1947-1951, usually 2-3 months before exposure, the reported morbidity rate was only 0.5% as compared to a rate of 12.3% in unvaccinated workers (Stableforth *et al.*, 1994).

A control program of human brucellosis was initiated in Campania in 1988 in the province of Caserta of Italy. The actions performed included gathering and analyising data on the size of live stock population as an actual or potential source of infection to humans, epidemiological surveillance of human cases, census on dairies and public health measures taken by regional council. The result improved the disease surveillance as the program implementation has provided a clear picture of the situation with a better understanding of factors affecting the

disease occurrence. The problems identified by project management includes, difficulties in maintenance of sufficient collaboration between veterinarians and physicians, scarce participation of local and regional administration and reduced availability of financial resources (Palombino *et al.*, 1992).

CHAPTER THREE:

MATERIALS AND METHODS

3.1 Study area

The study was conducted in Bubisa Sub location, Maikona Division of Marsabit District. According to Marsabit District Development plan (2002-2008), Marsabit District is one of the thirteen districts that form the Eastern Province of Kenya. It covers an area of 66000 km^2. Maikona division forms one of the seven divisions of the district and has 5 locations. It has least population density of 1 person per km^2, largely attributed to harsh climatic conditions. The major ethnic community is the Gabbra who are predominantly pastoralists. The district has a birth rate of 54/1000, death rate of 20/1000, doctor patient ratio of 1:63825 and two hospitals. The average distance to health facility is 80 km and percentage of households with access to health facility is 50%.

3.2 Inclusion criteria

The study included all those residing in the area for the last six months. Household heads or any adult above the age of 18 years was interviewed.

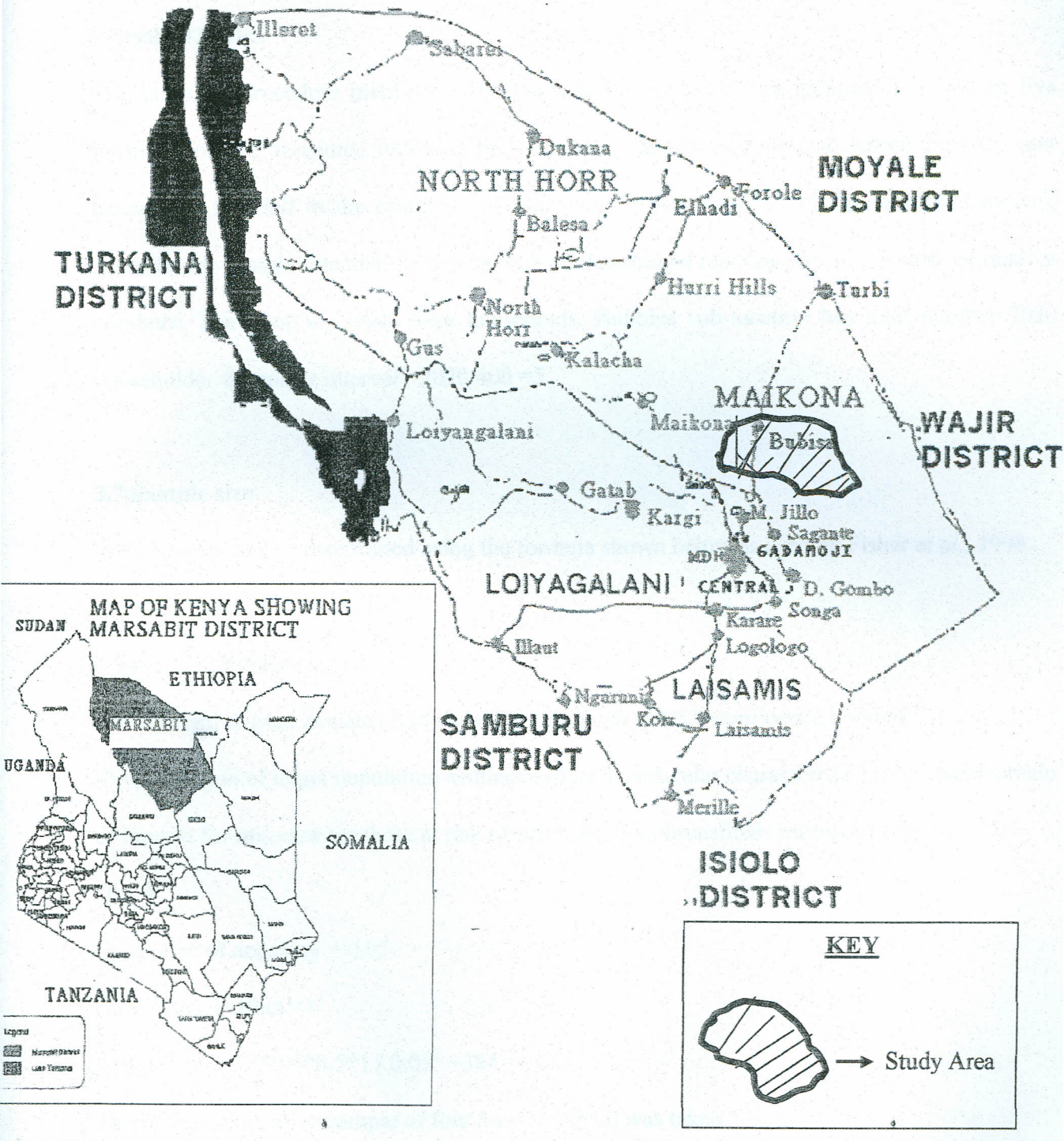
3.3 Exclusion criteria

The study excluded those who have not been residing in the area for the last six months and those who declined to participate.

3.4 Ethical considerations

Permission was obtained from Kenyatta University and the Ministry of Education. Further clearance was obtained from provincial administration and Informed consent was obtained from the study subjects before the research commenced.

Figure 1: **Map of the study area (inset map of Kenya showing position of Marsabit District).**



3.6 Study design and sampling method

The study was of a descriptive cross sectional type aimed at describing various factors underlying the prevalence of brucellosis in Bubbisa sub-location of Maikona Division of Marsabit District.

The sampling procedure involved purposive sampling to select one location from among five locations of the divisions, followed by systematic random sampling to select the particular households that fell in the sample. Sampling interval was obtained by dividing the sampling frame by the sample size and the first household determined randomly by use of table of random numbers. The sampling units were households. Bubbisa sub-location has total number 2020 households. Sampling interval =2020/400 =5

3.7 Sample size

The sample size was determined using the formula shown below as used by Fisher et *al.*, 1998.

$N=Z^2PQD / d^2$

Where, N= sample size,

Z= standard normal deviate (1.96) which corresponds to 95% confidence interval

P= proportion of target population estimated to have particular characteristics. The characteristic of interest for this case are those at risk of suffering from brucellosis estimated at 50 %(0.5).

Q=1-P

d= degree of accuracy = 0.05

D= designed effect =1

Thus $N = 1.96^2*0.5*0.5*1 / 0.05^2 =384 \approx 400$

Therefore a population sample of four hundred (400) was taken.

3.8 Data collection methods

Household interview schedule, focus group discussions and interview of key informants were used in data collection. Both independent and dependent variables were obtained by using these instruments. The tools were pretested in the neighboring Turbi sub-location. Research assistants were identified and one day training was conducted for them on how to administer the household interview schedule. Two focus-group discussions were conducted. In a typical Gabbra village, traditional huts are arranged in a single file running from north to south, with all the huts facing west. This arrangement made the process sampling and data collection much easier and involved starting at one end and following a suitable predetermined sampling interval.

3.9 Data management and analysis

All the collected data were coded and entered into a computer for analysis by using the Epi-info software package. Chi-square test of association and cross products odds ratio was used for assessing relationship between variables. All variables were measured at 95% level of confidence. The independent variables included respondents age, sex, marital status, highest educational level attained, occupation and household size. The dependent variables include knowledge on prevalence of brucellosis in the area, knowledge on the mode of transmission, precautions taken to avoid infection, respondents' knowledge on signs and symptoms of infection by the disease, vulnerable group and household prevalence of the disease in the last one year. Others included type of treatment sought, relapse of disease among those who sought conventional treatment, practice of conducting physical operation to assist the animals during delivery, methods of ensuring milk safety, consumption of animal blood, household livestock population and household livestock species. Only those clinically diagnosed and laboratory confirmed were considered as cases of brucellosis. The analyzed data was then presented inform of tables, pie charts and bar graphs.

CHAPTER FOUR
RESULTS

4.1 Socio-demographic characteristics of the study subjects

The socio-demographic characteristics of the study population are summarized in (table 1). The majority of the respondents were females 257 (61.7%) as males constituted only (38.3%). Most of the people interviewed were married 268 (67%) with the majority having had no formal education (75.8%).The main occupation of the study population was livestock rearing (78.2%) while the average household size was 5-6 persons. The mean age of the respondents was between the ages of 18-30 (40.0%). (Table 1)

Table 1: Socio-demographic information

	Number of respondents	Percentage
Sex		
Male	153	38.30%
Female	247	61.70%
Marital status		
Married	268	67.00%
Single	76	19.00%
Widowed	38	9.50%
Divorced	18	4.50%
Highest academic level		
None	303	75.80%
Primary	31	7.80%
Secondary	53	13.30%
Tertiary	13	3.30%
Occupation		
Livestock rearing	312	78.20%
Salaried	20	5.00%
No job	67	16.80%
Household size		
1-2 persons	34	8.50%
3-4 persons	107	26.70%
5-6 persons	155	38.70%
7-8 persons	85	21.30%
Over 9 persons	19	4.80%
Age of respondent		
18-30 years	160	40.00%
31-43 years	112	28.00%
44-56 years	70	17.50%
57-69 years	32	8.0%
70 and above	26	6.50%

4.2 Socio-cultural factors associated with the prevalence of brucellosis

4.2.1 Household livestock population

The findings of the study show that majority of the households have large livestock population. When the respondents were asked about their household livestock population irrespective of the types, it was established that majority of the households had more than 100 livestock. However, Chi-square test showed that there was no significant relationship between household livestock population and the household prevalence of brucellosis. (Table 2)

Table 2: Household Livestock Population Irrespective of Types

Household livestock population	Frequency	Percentage
1-49	82	20.50%
50-100	94	23.50%
More than 100	224	56.00%
Total	400	100.00%

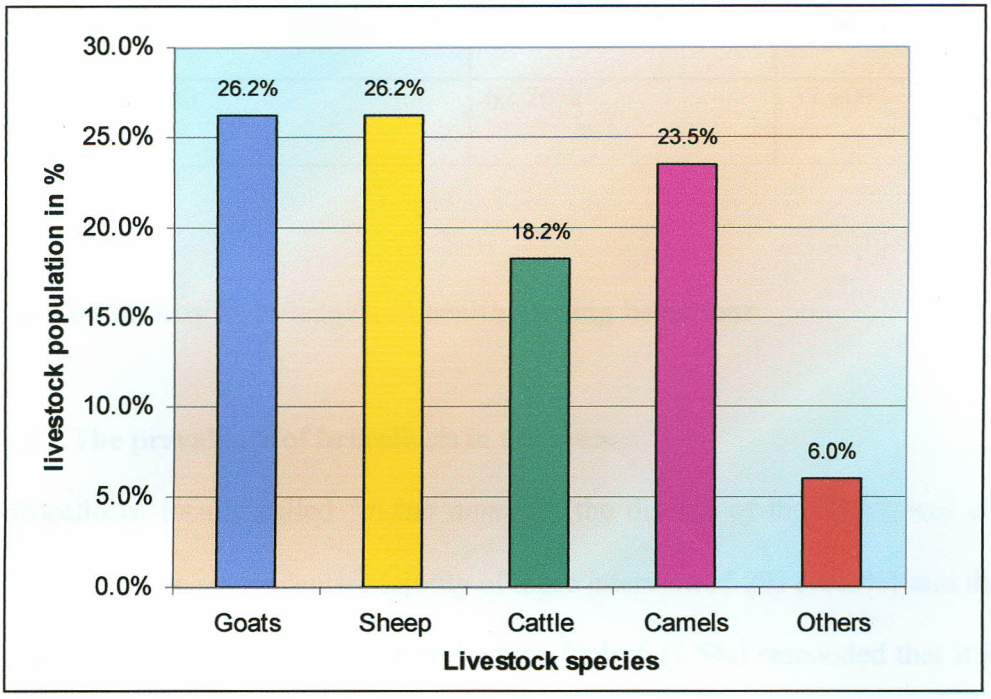
(χ^2 =3.0 df=1 and p>0.05).

4.2.2 Household Livestock Types

Most of the households had different types of livestock. Goats, sheep and camels constituted the main livestock types reared by this community. It was also established that there was no particular association with a particular livestock types and the disease prevalence in the community. The Gabbra community traditionally prefers rearing of camel, goats and sheep although rearing of cattle is on increase as well. All the animal types reared in the area do harbor

the causative organism of brucellosis and keeping all the types only increases the risk of infection. (Figure 2)

Figure 2: Household livestock types (Multiple answers)



Other animals mentioned were donkeys and chicken.

4.2.3 Household livestock population and prevalence of brucellosis

Large livestock population contributed to the prevalence of the disease in this community. The findings of the study has established that 62.2% of the households with a livestock population of more than one hundred (100) had at least someone who suffered from brucellosis in the last one year as compared to 19.7% and 17.3% for those with a population of 50-100 and 0-49, respectively. (Table 3)

Table 3: Household livestock population and the household prevalence of brucellosis

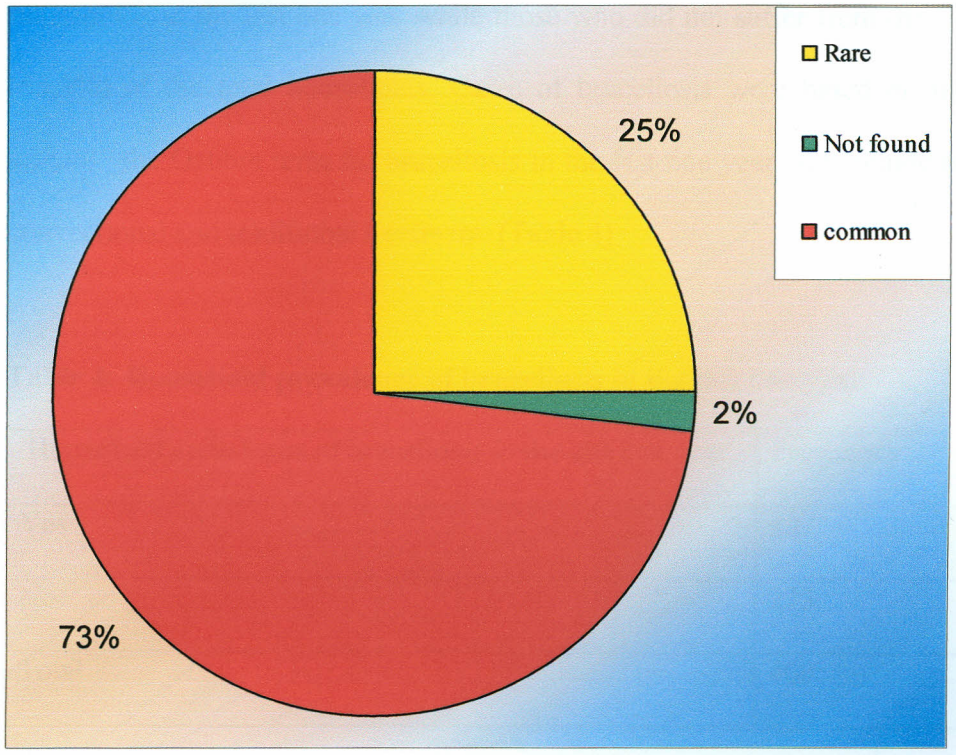
Household livestock population	Household prevalence of brucellosis		Total	P value
	Yes	No		
0-49	17.30%	82.70%	100%	0.35
50-100	19.70%	80.30%	100%	0.27
More than 100	62.20%	37.80%	100%	0.08

4.3 Community knowledge and health seeking behaviour

4.3.1 The prevalence of brucellosis in the area

Brucellosis, locally called "*dukub annani*" (the disease of the milk), was considered a health problem by the respondents. Majority of those interviewed 293 (73.3%) said that it was common, while 101 (25.3%) considered it to be rare. Only 6 (1.5%) responded that it is not found in the area of study. (Figure 3)

Figure 3: Responses on prevalence of disease in the area



Bubisa dispensary which serves as a catchment area for the whole of the Bubisa Sub Location, reported treated cases at 84 for year 2004 while in 2005 the cases increased to 108. It is important to note that this figures reflect only those who were laboratory confirmed and have been treated at the dispensary. There are those who seek treatment elsewhere, especially from the private clinics and other health institutions in addition to those who seek traditional treatment. Therefore, the number of people suffering from the disease is higher than the reported figures. This shows a relatively high prevalence as compared to the reported national figures of 100 to 1000 cases. It also indicates an increase in disease trend in the area.

4.3.2 Household prevalence of brucellosis in the last one year

A substantial number of household interviewed 127 (31.8%) had cases of brucellosis in their households in the last one year while those who did not suffer from the disease constituted 273 (68.3%) of the total households. Cases of brucellosis were based on those who had "*dukub annani*" the Gabbra term for brucellosis in the last one year and include both those who sought convectional and traditional treatment. (Table 4)

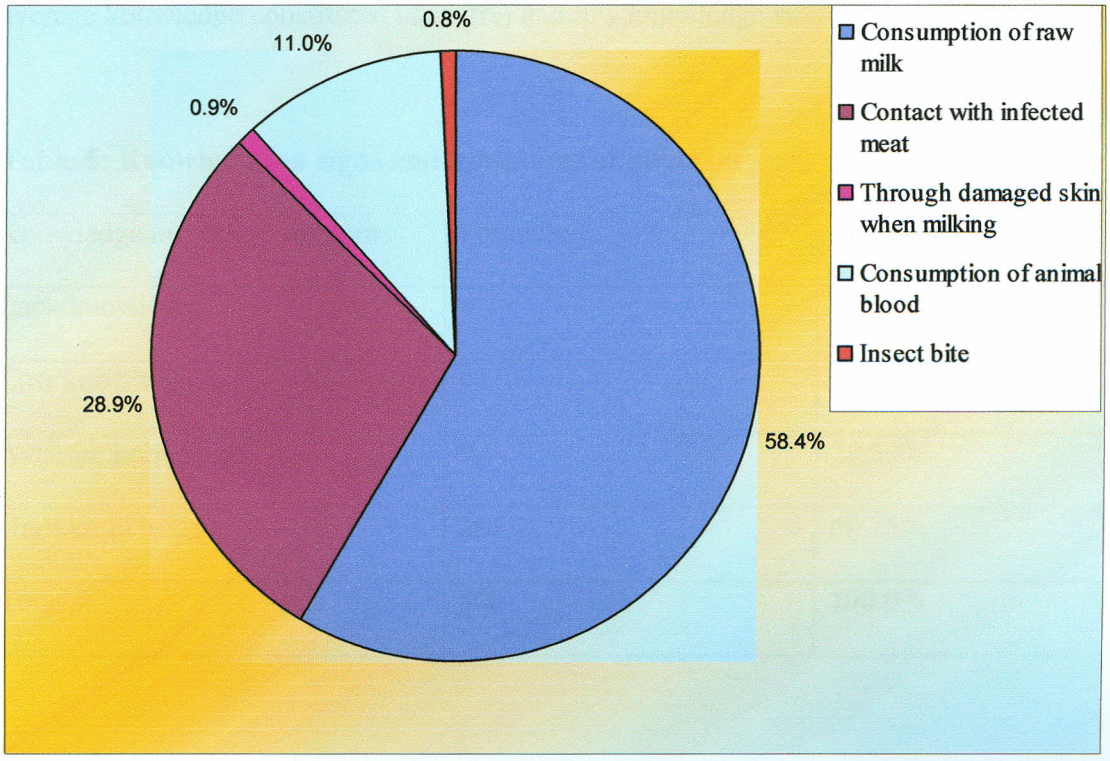
Table 4: Household prevalence of brucellosis in the last one year

Household prevalence of brucellosis in the last one year	Frequency	Percentage
Yes	127	31.80%
No	273	68.30%
Total	400	100.00%

4.3.3 Mode of transmission by brucellosis

Respondents gave multiple responses on the mode of infection by the disease. Many respondents said that consumption of raw milk and contact with infected meat was the main modes of infection for brucellosis as indicated by 378 (58.4%) and 187 (28.9%) of the responses. There were also others who responded that, consumption of animal blood, entry of germs through the damaged skin when milking and insect bite constituted the modes of transmission as indicated by 71(11.0%),6 (0.9 %) and 5 (0.8 %) respectively.(Figure 4)

Figure 4: Mode of transmission



4.3.4 Respondent's knowledge on the signs and symptoms of infection

The study showed that many people had some knowledge on the signs and symptoms of brucellosis. Multiple responses were given as signs and symptoms of infection. Among the commonest responses given were joint pains 383 (24.0%) and pains in the limbs and the back 377 (23.6%). Other responses included weakness 298 (18.6%), head –ache 251(15.7%) and anorexia 185 (11.6%). However, for measurement of knowledge an appropriate scale was established where one response on signs/symptoms indicates lack of knowledge, two responses meaning little knowledge, three showing average knowledge and four or more responses indicating high level of knowledge on signs/symptoms. When this scale was used the result

showed that majority of the people (66.25%) had high knowledge on signs and symptoms, average knowledge constituted (22.50%) and low knowledge was (10.25%). (Table 5)

Table 5: Knowledge on signs and symptoms of infection

Knowledge on signs/symptoms	Frequency	Percentage
Lack knowledge	4	1.0%
Low knowledge	41	10.25%
Average knowledge	90	22.50%
High knowledge	265	66.25%
Total	400	100.0%

4.3.5 Vulnerable group to infection by the disease.

Majority of the respondents reported that all groups were vulnerable to infection 334 (83.5%). However, 46 (11.5%) of those interviewed responded that women were more vulnerable while only 20 (5.0 %) said that children were more vulnerable. None of the respondents said that men are also vulnerable. Statistical test showed that women are more susceptible to infection than men in this community (Cross products odds ratio=1.62, χ^2=4.02, df=1 and (p)<0.05).

4.3.6 Type of treatment sought for those affected by the disease.

Out of 127 household affected, those who obtained treatment from the health facility were 72 (56.7%) while 55 (43.3 %) sought treatment from the traditional healers. This indicates that there are many people in this community who still prefer traditional treatment for brucellosis.

4.3.7 Relapse of disease for those who sought conventional/modern treatment.

A large number of respondents reported the relapse of the disease even for those who opted for conventional treatment. From a total of 72 people who sought conventional treatment, 28 (38.9 %) had relapse while 44 (61.1 %) said that there was no relapse (Only those who are laboratory diagnosed and put on treatment were considered). (Table 6)

Table 6: Relapse of brucellosis among those who sought conventional treatment

Disease relapse for patients who sought modern treatment	Frequency	Percentage
Yes	28	38.90%
No	44	61.10%
Total	72	100.00%

4.3.8 Reasons reported for disease relapse for those who sought modern treatment

Multiple answers were given by respondents as reasons for disease relapse. About 20 (29%) said that the treatment was not effective, 26 (39%) said that it was due to the failure of patients to complete the treatment and 22 (32%) gave continuation of risk behaviors such as continued close contact with livestock, consumption of raw milk and blood and contact with infected meat. (Figure 5)

Table 7: Prevention of infection while handling carcasses

Methods used to prevent infection while handling carcasses	Frequency	Percentage
Washing of hands after slaughter	124	80.00%
Wearing of gloves	24	15.50%
Do nothing	7	4.50%
Total	155	100.00%

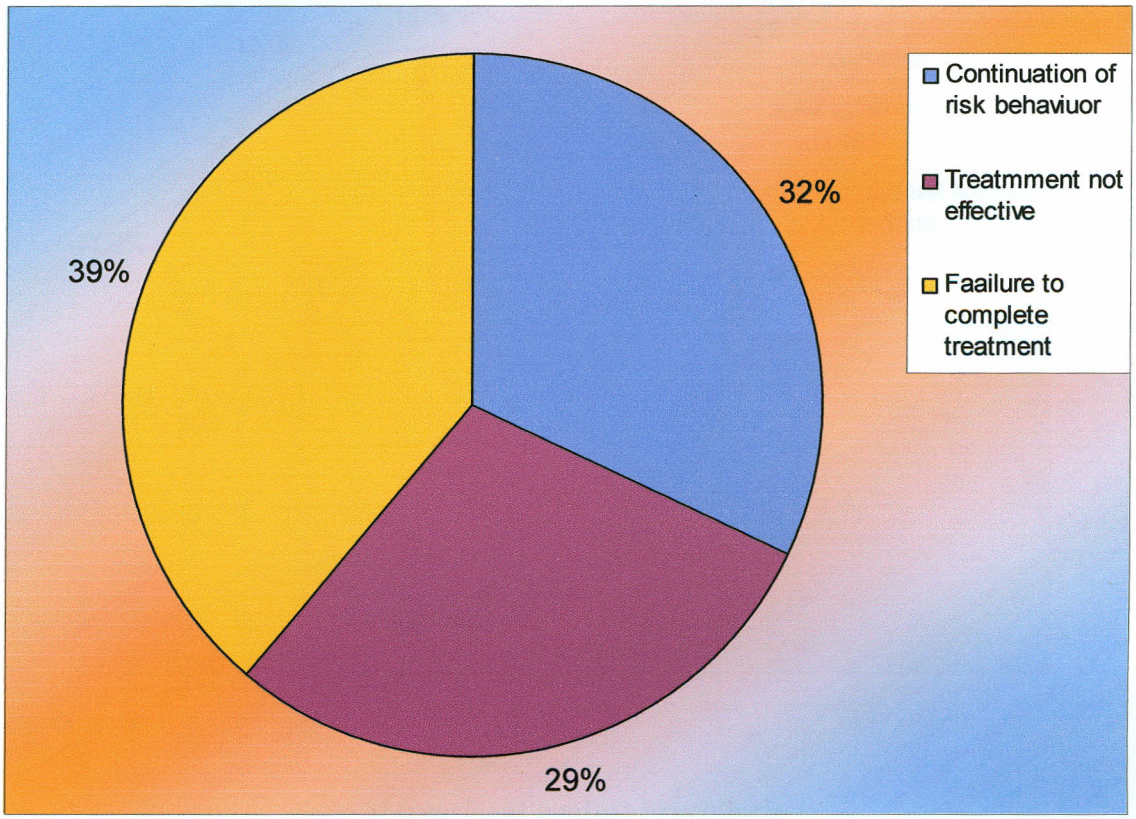
4.3.10 Assessment of knowledge on whether the disease is preventable

Slightly more than half of those interviewed said that the disease is preventable 213 (53.3 %) while 187 (46.8 %) responded that it is not preventable. This, therefore, indicates that nearly (1/2) of the population are not aware that infection by brucellosis can be prevented.

4.3.11 Precautions taken by the community to avoid infection by the disease.

The respondents gave multiple precautions that they take to avoid getting brucellosis. The precautions taken by the community in order to prevent infection by the disease included boiling of milk before consumption 208 (72.2%), avoid contact with carcasses 43 (14.9%) and avoid handling of fetus and after-births 34 (11.8%). Those who responded that they did nothing to avoid infection by the disease were only 3 (1.0 %). (Figure 6)

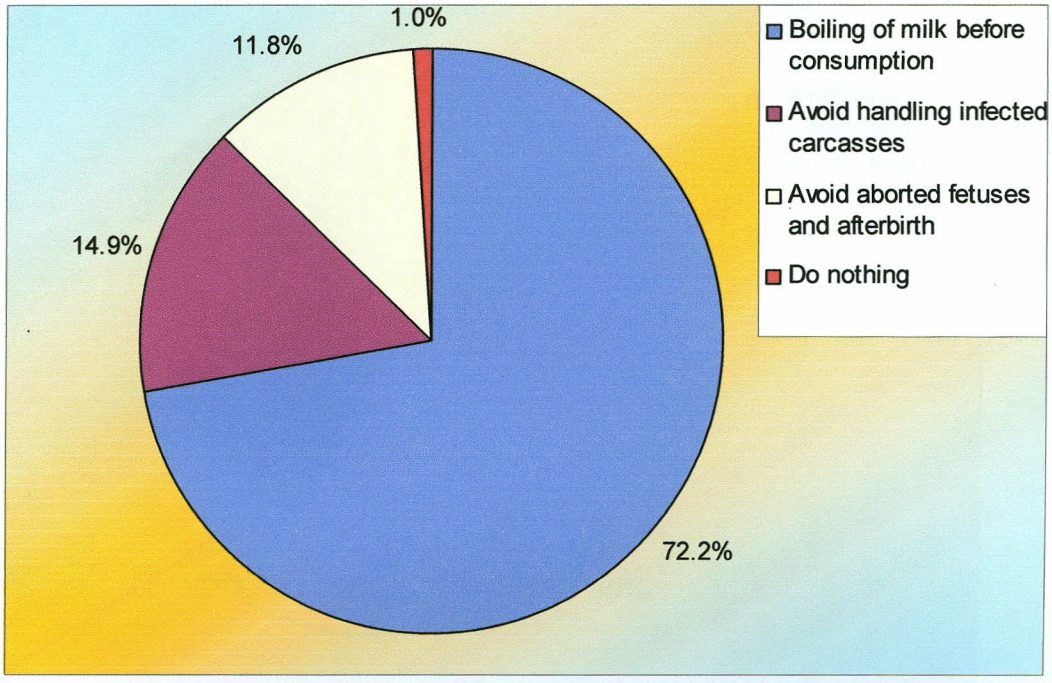
Figure 5: Reasons reported for disease relapse



4.3.9 Ways of preventing infections while handling carcasses.

For those respondents who had knowledge that the disease was transmissible through carcass handling, ways of preventing infection while handling carcasses, was asked. 124 (80.0%) said it is by washing of hands after slaughter.24 (15.5%) said that wearing of gloves while handling carcasses and 7 (4.5%) said that they did nothing to prevent infection by this mode of infection. (Table 7)

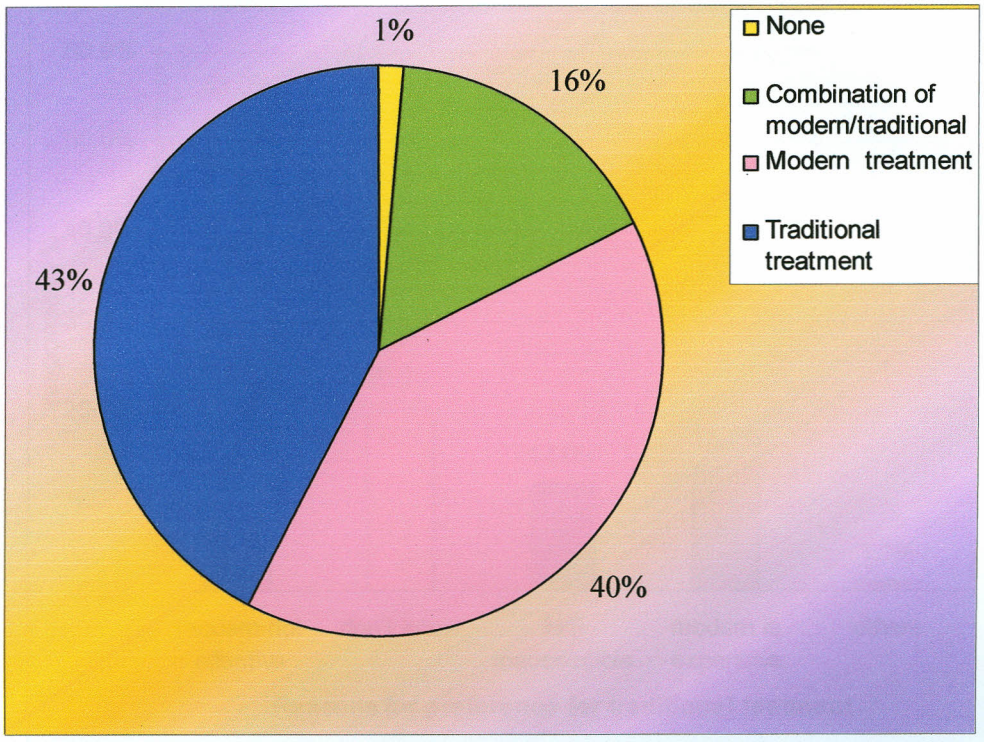
Figure 6: Ways of avoiding infection



4.3.12 The preferred mode of treatment against brucellosis

A sizeable number of the respondents expressed their preference for traditional mode of treatment whose effectiveness cannot be ascertained (42.5%) as compared to those who sought modern/conventional treatment (39.8%). (Figure 7)

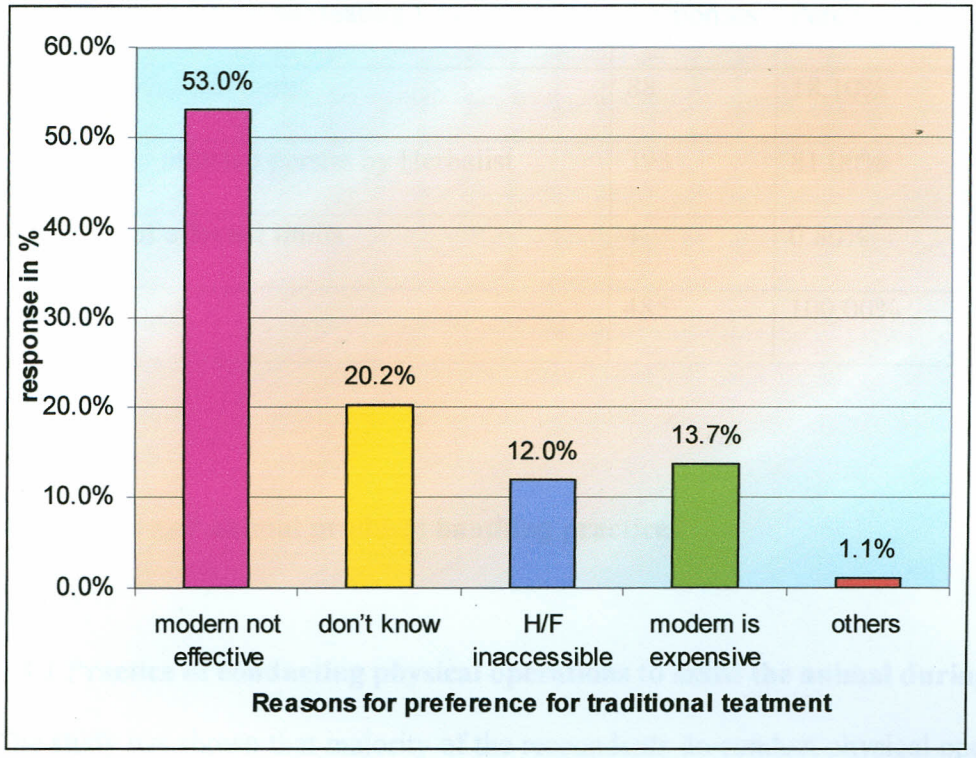
Figure 7: Preferred mode of treatment against brucellosis



4.3.13: Reasons for preferred mode of treatment

Slightly more than a half of those interviewed (53%), responded that modern treatment was not effective. In addition, it was evident that there were other reasons for the preference for traditional mode of treatment. These reasons included; health facilities being inaccessible and modern treatment being expensive as indicated by 12.0% and 13.7%, respectively. It is also important to note that 20.2% responded that they did not know/had no particular reason for preferring traditional treatment to modern treatment. (Figure 8)

Figure 8: Reasons for preferred for mode of treatment



4.3.14 Traditional methods used for treating brucellosis

There are certain specific methods that are traditionally used in the treatment of brucellosis. There are people who used more than one method of treatment. Majority of the respondents 393 (81.0%) used spitting on an infected person by medicine men while 88 (18.1%) used traditional herbs and 4 (0.8%) said massage of infected limbs by medicine men was used. Therefore, the study showed that majority of the respondents used spitting on infected person and traditional herbs as common methods for treating brucellosis in this community. (Table 8)

Table 8: Traditional methods for treatment of brucellosis (Multiple responses)

Traditional methods of treating Brucellosis	Responses	Percentage
Use of traditional herbs	88	18.10%
Spitting on infected person by Herbalist	393	81.00%
Massage of affected limbs	4	0.80%
Total	485	100.00%

4.4 Animal and animal products handling practices

4.4.1 Practice of conducting physical operations to assist the animal during delivery

The study has shown that majority of the respondents do conduct physical operation to assist the animal during delivery 333 (83.3%) whereas only 67 (16.8%) said that they do not assist the livestock during delivery. A significant relationship exists between conducting physical operation to assist the livestock during deliveries and the household prevalence (A cross product odds ratio=1.59 χ^2=1.88, df=1 and $p<0.05$). The null hypothesis that states that, there is no relationship between conducting physical operation to assist the livestock during deliveries and the household disease prevalence is therefore rejected. Any respondent who suffered from "*dukub annani*", the Gabbra word for brucellosis in the last one year, who at least knew three signs or symptoms of the disease or was subjected to 21 daily injections of streptomycin was considered as a case). (Table 9)

Table 9: Comparing physical operations during animal delivery and the household experience of Brucellosis.

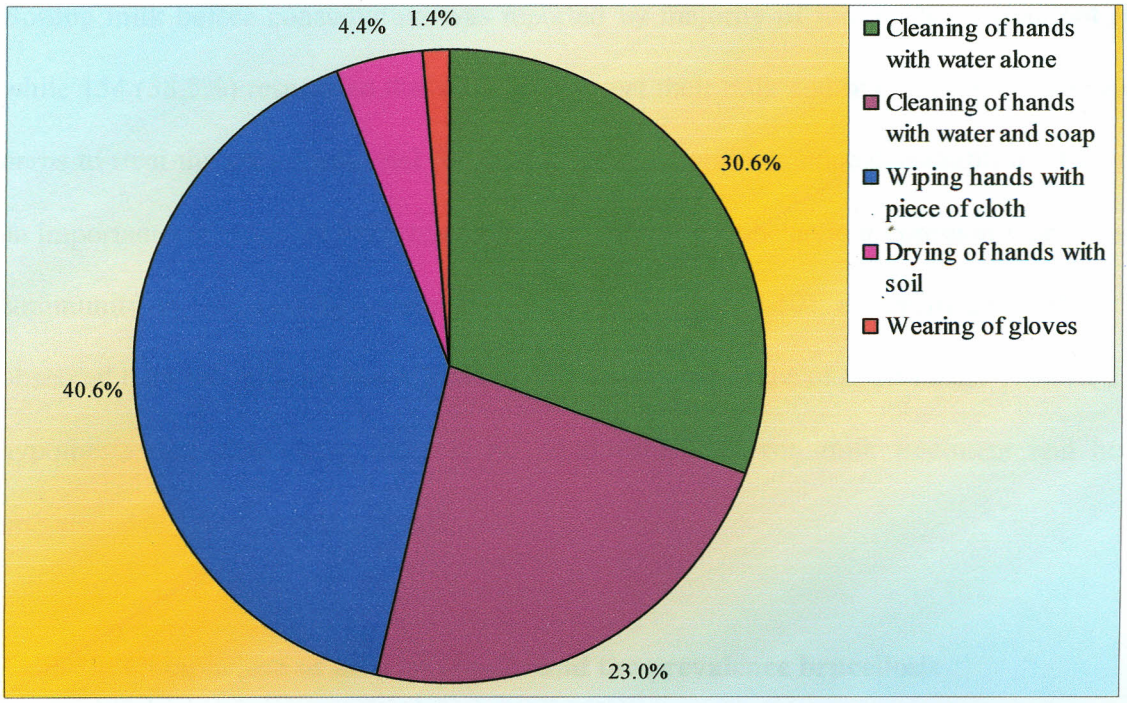
	Household experience of Brucellosis			
		Yes	No	Total
Whether had conducted Physical operation during delivery	Yes	111	222	333
	No	16	51	67
	Total	127	273	400

(A cross product odds ratio=1.59, χ^2=1.88, df=1 and p>0.05).

4.4.2 Precautions taken to avoid infection while conducting animal deliveries.

Different and multiple responses were given by the community as a means of preventing infection while conducting livestock deliveries. Among the commonest responses were wiping of hand with apiece of cloth 292 (40.4%), hand washing with water alone 220 (30.5%) and cleaning of hands with water and soap 165 (22.9%). (Figure 9)

Figure 9: Precautionary measures while conducting animal deliveries



4.4.3 Method (s) of milking used by the community.

The finding of the study showed that only one method of milking was used in this community. All the respondents 400 (100%) said that they used hand milking. This implies that in case of injuries, the *Brucella* organisms contained in the milk obtained from infected animals can penetrate through the abrasion. As overwhelming majority 347 (86.8%) reported that one container is used for milking and milk storage, a statistically significant relationship was found to exist between the household prevalence of brucellosis and milk harvesting (Cross products odds ratio=3.87, χ^2=17.60, df = 1 (p) <0.05).

4.4.4 Methods of ensuring milk safety before consumption

Boiling milk before consumption was reported by majority of those interviewed 244 (61.0%), while 154 (38.5%) responded that they do not treat their milk and only 2 (0.5%) used traditional herbs to treat the containers used for milk storage. Therefore, since consumption of raw milk is an important source of *Brucella* transmission, perhaps, this behaviour commonly predisposes the community to infection by Brucellosis. Using table (table 10), a significant relationship was observed between milk treatment and the household prevalence of brucellosis. Therefore the null hypothesis that states that, there is no relationship between milk treatment and household prevalence of brucellosis is rejected.

Table10: Comparison of milk treatment and the prevalence brucellosis

Treatment of milk	Disease experience status		
	Yes	No	Total
Treated	88	158	246
Not treated	39	115	154
Total	127	273	400

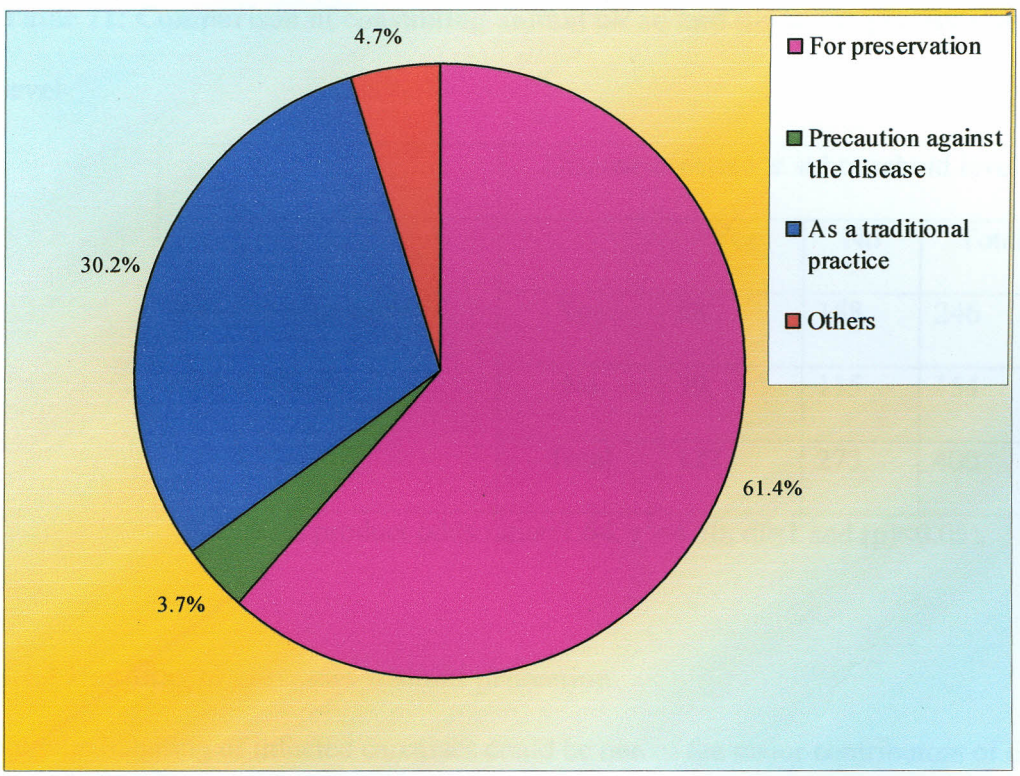
(Cross product odds ratio=1.64 and χ^2=4.30,df=1 (p) <0.05).

4.4.5 Practice of milk fermentation before consumption

Majority of the respondents said that they consume fermented milk 396 (99.0%) and only 4 (1.0%) responded that they do not. This practice however, does not substantially reduce the risk of transmission of brucellosis because traditional fermentation was usually done before milk is boiled. Raw fermented milk lowers the pH of milk from about 6.8 to 4.5 and *Brucella abortus*

are mildly affected by acidity at this level. More than a half 250 (64.1%) of respondents said that it is done for preservation, 123 (30.2%) did it as a traditional practice handed over from generations while 19 (4.7%) said that it was a precautionary measure against brucellosis. (Figure 10)

Figure 10: Reasons for milk fermentation



4.4.6 Consumption of raw animal blood

According to the finding of this study majority of the people interviewed said they drink raw animal blood 246 (61.5%) while 154 (38.5%) said that they do not. There was a significant relationship between the consumption of raw animal blood and the disease prevalence (Cross product odds ratio=1.64, χ^2=4.30, df=1 and (p)<0.05). The null hypothesis which states that,

there is no relationship between consumption of raw animal blood and the household prevalence of brucellosis is therefore rejected. The respondents gave multiple responses as reasons for drinking animal blood. From a total of 246 respondents who consumed animal blood, most of the responses 207(61.5%) was for food while 97 (38.5%) of the responses were for treatment against snake bite. (Table 11)

Table 11: Comparison of consuming animal blood and disease experience at household level

		Disease experience at household level		
		Yes	No	Total
Whether consumed animal blood	Yes	88	158	246
	No	39	115	154
	Total	127	273	400

(Cross product odds ratio=1.64, χ^2=4.30, df=1 and (p)<0.05).

4.4.7 Handling of carcasses without protection.

Regular handling of infected carcasses could be one of the major contributors of disease prevalence in this community. The study results has shown that more than half 245(61.3%) of those interviewed did handle carcasses without any protection. Whereas 155(38.8%) said that they did not handle carcasses without protection.

4.5 Roles played by health workers and veterinarians

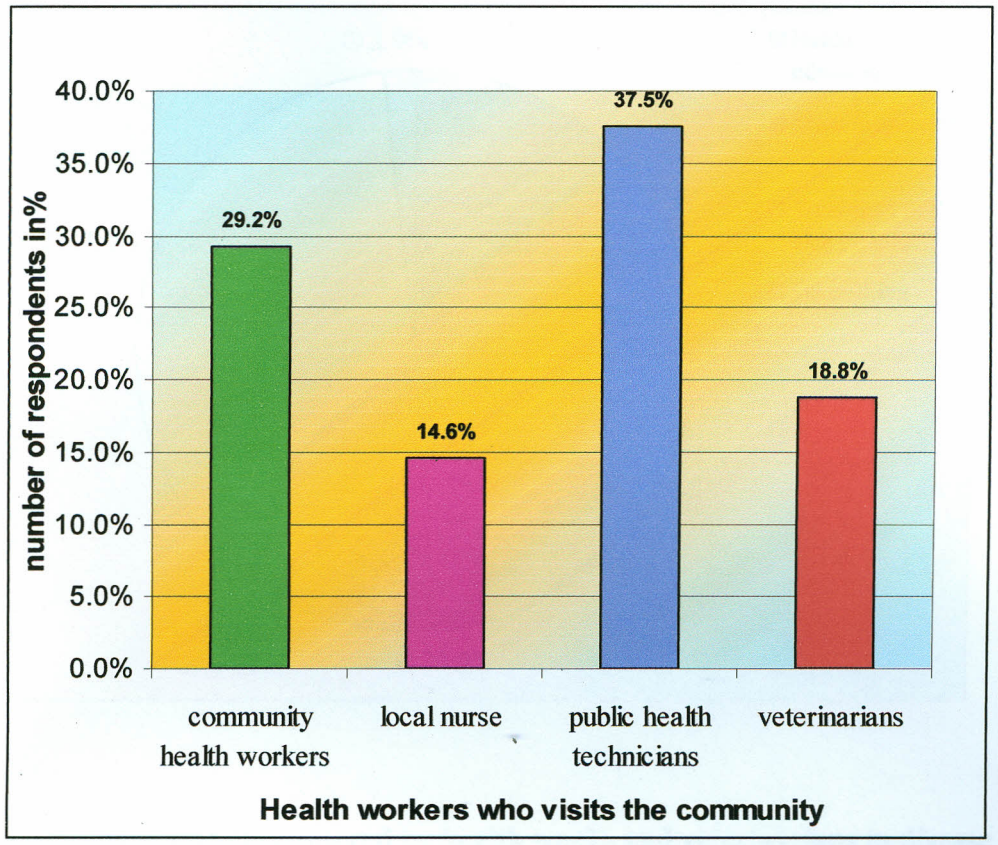
4.5.1 Home visits by health workers and veterinarians to create awareness and assess disease burden in the area

According to the study findings, majority of respondents 352 (88.0%) said that there were no visits by both the health workers and veterinarians in the study area for the purpose of creating awareness or assessment of disease burden both among the humans and the livestock whereas only 48(12.0%) said that they were visited.

4.5.2 Who visits the community to create awareness and assess disease burden

Among the visits made, majority were by public health technicians 18 (37.5%), followed by community health workers 14 (29.2%), veterinarians 9 (18.8%) and finally local nurse 7 (14.6%). (Figure 11)

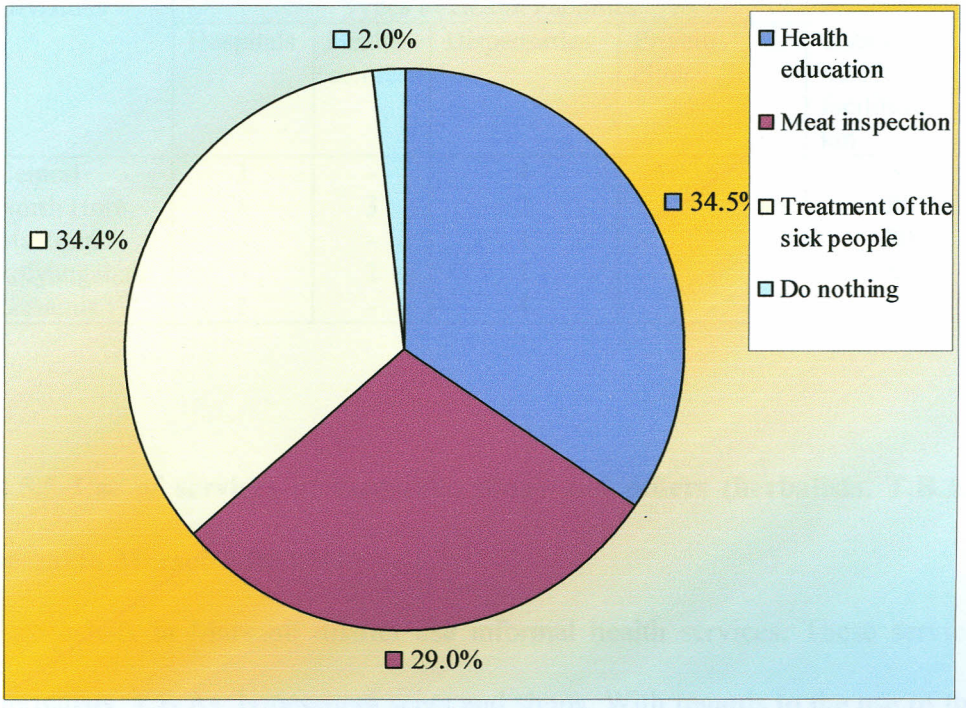
Figure 11: Who make regular visits to the community?



4.5.3 Activities of health workers and veterinarians in disease control and prevention.

The duties undertaken includes: health education 238 (34.5%), meat inspection 200 (29.0%) and treatment of the sick persons 237 34.4%). However, a few respondents indicated that they did nothing 14 (2%). Here, multiple responses were given for the roles played by health workers and veterinarians. (Figure 12)

Figure 12: Types of duties carried out by Health workers/Veterinarians



4.5.4 Challenges encountered by health works and veterinarians in disease control and prevention

Pastoralists are inaccessible to health services due to their unavailability. There are only two hospitals, which are found along the highway and in areas that are more central, where transportation and access is relatively easy. It is also noteworthy that the private providers have concentrated their services in the central Division.

In Marsabit District the average distance to health facility is about 60 km. The pastoralists divisions of Maikona, Norh-horr, Loiyangalani and Laisamis have the longest distances to the health facilities. Similarly, Maikona, North-horr, and Loyangalani Divisions have the lowest medical personnel population ratio. (Table 12)

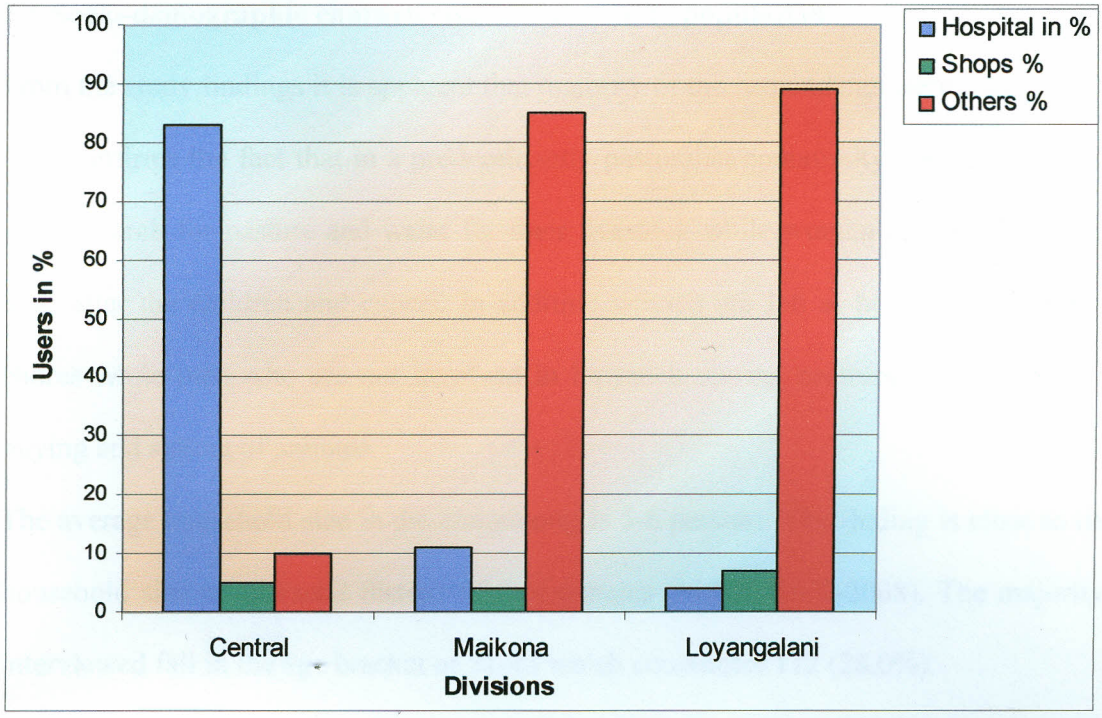
Table 12: Health facilities characteristics and health staff ratios

Divisions	Types of Health Facilities				Average distance to health facilities in km	Medical personnel/population ratio
	Hospitals	Health centres	Dispensaries	Private clinics		
Central	1	-	4	5	9	1:124
North Horr	-	3	2	-	80	1:1993
Maikona	-	-	4	-	80	1:1090
Loiyangalani	-	2	1	-	82	1:1367
Laisamis	1	-	4	-	60	1:1240

4.5.5 Use of services of hospitals, shops and others (herbalists, T.B.As, bonesetters and seers) in Marsabit District.

Pastoralists in Marsabit district use informal health services. These services are provided by herbalists, T.B.As, bonesetters seers and shops. With regards to the use of these informal health services, brucellosis is not exceptional. Figure 12 below, demonstrates the use of hospital and informal care (shops and others) in three Divisions of Marsabit District; Central, Maikona and Loiyangalani. There is a striking contrast between Central Division with 83% of the population using hospital services when ill and Maikona and Loiyangalani Divisions with 85% and 89% of the population, respectively, resorting to other services. The traditional herbalists and the T.B.As are easily accessible and are among the most popular in the group of traditional health care providers.(Figure 13)

Figure 13: Use of hospitals, shops and other services (herbalists, T.B.As, bonesetters and seers) in three Divisions of Marsabit District



CHAPTER FIVE

DISCUSION

5.1 Socio-demographic characteristics of the study population

From the study findings it is apparent that majority of the respondents were females 247(61.7%). This confirms the fact that in a predominantly pastoralist community, men are always involved in the search for pasture and water for their livestock while women are mostly left at home to look after the children and calves. In addition women are left at home to undertake domestic chores while men who are not involved in livestock rearing perform other duties such as the buying and selling of animals.

The average household size in the community is 5-6 persons. The finding is close to the average household size of Marsabit district of four persons (M.P.F, 2002-2008). The majority of those interviewed fall in the age bracket of 31-43 which constitutes 112 (28.0%).

Majority of the respondents were married 268 (67.0 %). Those who were single constituted 76 (19.0 %), widows/widowers were 38 (9.5 %) and those divorced were 18 (4.5 %).The occupation of most of the respondents was livestock rearing 312 (78.2%) and this is similar to the ideas of Muriuki *et al* (1997) who said that brucellosis is a common disease among pastoralists and nomadic herdsmen in developing countries who are continuously exposed to potentially infectious animals. Most of the research participants did not have formal education 303 (76%). This high illiteracy level, explains the reasons as to why a significant number 187 (46.8%) said that the disease cannot be prevented. Similarly more than half (61%) did not associate improper handling of carcasses with the transmission of the disease.

5.2 Socio -cultural factors associated with disease prevalence

5.2.1 Household livestock population and species

Majority of the respondents 224 (56.0 %) had livestock (irrespective of species) of more than 100. This shows that majority of the people in this community have large livestock population which is perhaps a predisposing factor to the disease prevalence in the area. In addition numerous social activities are reported all year round where sheep and goats are slaughtered during such occasions. Hence many more people are exposed to infection. It is important to note that goats and sheep are the most commonly reared livestock in this community. *Brucella melitensis* which is the most virulent form of *Brucella* infection is acquired through contact with goats and their products. Therefore, goat and sheep rearing is a predisposing factor to infection by the disease in the Gabbra community. This situation is similar to the finding of a study done in Saudi Arabia by Alballa (1995) which established that direct contact with animals and consumption of raw products of animal origin was identified as the main risk factors.

5.3 Community knowledge and health seeking behaviour

From among those interviewed, 127 (31.8%) had a household member who had suffered from brucellosis in the last one year. This indicates that there is high prevalence of this health problem in the community, although not all of them are laboratory confirmed since some of them sought traditional mode of treatment. Out of a total of 127 patients who suffered from brucellosis, 55 (43.3 %) sought treatment from the health facility while 72 (56.7 %) went to traditional healers. In addition, the relapse of the disease among those who were laboratory confirmed was 19 (34.5%). This shows a high relapse rate of the disease even among those who had been diagnosed and treated. Other findings however established that among the main reasons for such

a relapse include failure to complete treatment 26 (38.2 %) and continuation of risk behaviour after treatment 22(32.4%) This finding is similar to that of Kocac *et al* (2004) who stipulated that up to 10% of Patients of brucellosis relapse after microbial therapy. He further argued that relapse may be due to intracellular localization of the organism that protects the bacteria from certain antibiotics, host defense mechanism, inadequate treatment or continuation of patient occupation. Many patients who move far away from the health facilities because of nomadic lifestyle find daily treatments through injections which usually run for a long course (three weeks) difficult to adhere to. Compliance with the completion of the dose of oral medication is also difficult, all of which results to high defaulter rate and there increases the disease relapse rate.

The study findings has shown that many people 170 (42.5%) preferred traditional to modern mode of treatment. Another 66 (16.5%) respondents used combination of conventional and traditional treatment. It was also established that modern medicine is perceived as not effective 97 (53.0%). More importantly, the health facilities are inaccessible 22 (12.0%) while 13.7% said that modern treatment is expensive.

5.4 Animal and animal products handling practices

Many people in this community, 333 (83.3%) do physical operation to assist the animal during delivery. This involves handling of new borns, after births, or even stillbirths. These physical contacts with body fluids predispose the residents to infection. Among the animals that require physical handling to be assisted in delivery includes camels and occasionally goats and sheep. From the study findings 331 (82.2 %) of those interviewed responded that they commonly assist the animals in delivery by physically handling the newborns. This is in agreement with the ideas of Chin (2000) who said that transmission from animals to man occurs through Contact with

tissues, blood, urine, vaginal discharge, aborted fetuses and specially placentas through a break in the skin.

Many people in the community keep large numbers of livestock and especially goats and sheep. During the day, while they are grazing away from home several goats and sheep may give birth and those who were looking after them may at times be forced to carry three to four or even more newborns from the grazing areas to the homesteads. This shows that there is a lot of contact between the newborns and those who are looking after the animals especially for the goats and the sheep. Schrrenberger *et al* (1975) documented that human beings can be infected when handling aborted fetuses or healthy calves born to infected cows or when performing gynecological operations. Therefore, being in constant contact with the newborns some of which are born to infected animals could be the source of infection.

Similarly, when the respondents' knowledge was assessed on the precautions they take in order to avoid infection, multiple and varied responses were obtained in which, 292 (40.4%) said that they wiped their hands with a piece of cloth after conducting animal deliveries, 32 (4.4) dried their hands with soil. These indicate that many people do not take the appropriate precautions to protect themselves while conducting physical operations on animals.

Hand milking is the only milking method used in the community. All the 400 (100%) respondents said that they used hand milking for all the livestock. This method is risky as Schwale (1969) notes that, human brucellosis is rarely caused by infected meat but man may acquire the disease readily by percutaneous infection. Even imperceptible lesions on the skin may serve as portal of entry and there is marked predisposition of brucellosis among occupational handlers of animals. In addition Stableforth *et al* (1994) argued that human

infection with *Brucella* species can occur if milk or milk products enter damaged skin or eyes. Contact infection through milk handling, especially during hand milking can occur.

Milk treatment through boiling could have been an essential measure in preventing infection by brucellosis. The study has been established that 154 (38.5%) do not treat their milk before consumption. Evidence from focus group discussions (one of the males and other of the females), suggest that boiling is against the local customs. Many participants argued that it is a taboo to boil milk from their livestock. Boiling of milk is also said to consume energy and there is scarcity of firewood for this purpose, in addition to it consuming time.

Consumption of animal blood is an important predisposing factor to infection by brucellosis. The study has shown that 245 (61.2 %) of those interviewed said they consumed animal blood either as food or treatment against snake bites. The traditional treatment of snakebite is consumption of camel blood for a period of at least two weeks. This is perhaps one of the major risk factors to infection by brucellosis as argued by Monica Chelsbrough (1989) that nomadic herdsmen who drink animal blood are susceptible to infection. On comparing household prevalence of brucellosis and drinking of raw animal blood, a statistically significant relationship was established (Cross product odds ratio=1.64 and χ^2=4.30,df=1 (p) <0.05).

Brucellosis can also be transmitted to human beings though carcass handling. Schnurrenberger *et al* (1975) argued that humans working in the meat industry may contract the disease percutaneously, conjuctivaly or by nasal mucous membrane infection. However, out of a sample of 400 respondents, 245 (61.3%) said that the disease could be acquired through improper handling of carcasses. With regards to prevention, about 4.5% said they did nothing to protect themselves. Although 80.0% of the respondents washed their hands after slaughter, this practice

does not prevent infection by brucellosis and therefore, many people can be exposed to *Brucella* organisms through carcass handling.

5.5 Role played and challenges encountered by health workers in control and prevention of brucellosis

Interview of 10 key informants (6 health workers and 4 veterinarians) revealed that brucellosis is among the major health problems in the area. The disease remains one of the most ignored, poorly reported and studied health problem in the area. Two of veterinary officers interviewed said that the disease is prevalent in livestock and at times occurs as out-break especially after the rainy seasons and sometimes causes wide spread abortions among the livestock. Their idea is in agreement with that of McDermott *et al* (2002) who stated that brucellosis is prevalent in all major livestock production systems in Sub-Saharan Africa.

The activities undertaken by the health workers and the veterinarians are limited because of lack of resources and the expansiveness of the area involved. However, health education on the modes of disease transmission and control and prevention and limited disease surveillance activities are carried out by both the health workers and the veterinarians.

According to those interviewed, there are no appropriate policies and progammes put in place by G.O.K to control brucellosis in the area or even in the entire country. Most of the informants interviewed proposed the need for a control programme similar to National Leprosy and Tuberculosis Programme (N.L.T.P) used for T.B control or National Aids Control Programme (NASCOP) for H.I.V/AIDS. In line with this ideas, Palombino *et al* (1902), documented the successes of a control programme of human brucellosis initiated in Camponia in 1988 in a Province Caserta in Italy whose actions included: gathering and analyzing data on size of

livestock population as an actual or potential source of infection to man, epidemiological surveillance of human cases, census on dairies and public health measures taken by regional council.

Those interviewed, reported various contributing factors to disease prevalence in the area of study. Such factors include; inaccessibility of health services, lack of enough and well qualified personnel, poor health seeking behaviour among the pastoralists, high illiteracy level and scarcity of resources.

Pastoralists are inaccessible to health services due to their unavailability. There are only two hospitals, which are found along the highway and in areas that are more central, where transportation and access is relatively easy. It is also noteworthy that the private providers have concentrated their services in the central Division. In addition the hospital does not have adequate services as a referral point. In most instances the hospital is not often different from those smaller units it is supposed to support.

In Marsabit District the average distance to health facility is about 60 km. The pastoralists divisions of Maikona, Norh-horr, Loiyangalani and Laisamis have the longest distances to the health facilities. Therefore, patients suffering from brucellosis do not visit these facilities until they are very sick or have developed life threatening complications. Because of lack of means of transportation, patients of brucellosis with painful and swollen knee and hip joints and who can no longer walk are transported by camels, donkeys or even by people (on peoples back) to the health facilities.

North-horr, Loyangalani and Maikona Divisions have the lowest medical personnel population ratio. The personnel are insufficient and lack appropriate skills and motivation. There is high turnover of those with proper skills who prefer to transfer from the district or resign to join

institutions where they are well paid. Lack of incentives, poor pay, poor management and lack of resources are some of the major factors contributing to the problem of the disease in the area. In addition, health workers have a tendency to show little attention to unsophisticated and simple looking, poor pastoralists, who always seem ignorant and strange. This behavior forces some of them to shy away and eventually withdraw. Therefore, since brucellosis is not a very fatal disease, coupled with high illiteracy level and the believe that the disease can be treated by traditional herbalists, pastoralists are reluctant to seek health care in hospitals and dispensaries unless their health condition worsens.

In addition, lack of appropriate collaboration between health workers and the veterinarians and particularly in failing to exchange surveillance data, conducting combined health education campaigns and in soliciting for resources, makes it difficult for the disease to be controlled effectively.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

In the resource poor countries like Kenya, control measures provided that they are adapted to the local situation and integrated together with improved diagnostics, could provide immediate cost-effective benefits. In the study area, major gaps exist in knowledge on the modes of disease transmission and appropriate means of control and prevention.

The study findings have shown that a substantial number of respondents (31.8%) had at least a case of human brucellosis in their household in the last one year. Although seroprevalence of human brucellosis is poorly studied in Kenya, this prevalence rate is relatively high as compared to the rates reported in the East and Central African region where seroprevalence of 3.8% has been reported in the nomadic pastoralists in Chad, 6.5% among slaughter house workers in Djibouti and in the neighboring Eritria this rate is reported to be 5.2%.

A large proportion of those who were infected obtained treatment from traditional healers whose effectiveness could not be established. In addition, the relapse of the disease among those conventionally treated appears to be high (38.9%).

It has also been established that various socio-cultural practices of the community predisposes them to infection by the disease. The Gabbra word *"dukub annani"* (the disease of the milk) is a clear indication of recognition of the association of the disease with the milk obtained from their livestock. The study findings have shown that majority of the households (56%) have large livestock population of more than 100, irrespective of species. In addition large livestock population appears to contribute to the high prevalence of the disease in the community. This

phenomenon is exhibited in the findings where 62% of the respondents had disease incidence in their households for those with livestock population of more than 100 as compared to 19.7% and 17.3% for those with livestock population of 50-100 and 0-59, respectively.

The pastoralists' survival is intertwined with the existence of their livestock. Most pastoralists consider their livestock not only a property but also a means of survival. Therefore, they constantly handle their animals and animal products. Many people in the community (82%) do physical operations to assist the animals during delivery. This involves handling of new borns, afterbirths or even stillbirths. Although milk treatment through boiling is an essential precaution in control of brucellosis, many people (38.5%) were found not to treat their milk. There was a statistically significant relationship between the two (Cross product odds ratio=1.64 and χ^2=4.30,df=1 (p) <0.05).

The risk of infection acquired through consumption of animal blood cannot be underestimated. Majority of those interviewed (61.2%) consumed animal blood. A statistically significant relationship was found to exist between consumption of animal blood and prevalence of brucellosis (cross products odds ratio=1.64 and χ^2 (p) < 0.05).

6.2 Recommendations

6.2.1 Recommendations to control the disease

Inter-sectoral collaboration between the health personnel in the ministry of health and the department of veterinary services is necessary if brucellosis has to be controlled. Infection in man is associated with the prevalence of the disease in animals. The Gabbra word for brucellosis *"dukub annani"* which means the disease of the milk shows that the local community has the

recognition of the relationship between milk and brucellosis and this signifies the prevalence of disease in animals. Therefore, if the disease has to be eradicated or controlled in animals, infection in man will no longer be there. Therefore campaign against brucellosis in animals shall be viewed as one against brucellosis in man. This phenomenon calls for common participation by both the veterinary department and health department since both have important roles to play. There is need for intensive programme of testing and vaccinating all livestock in the area. Such program should be initiated by the ministry of Live stock Development in collaboration with the local non-governmental organizations which have programmes on animal health. This intervention is necessary because brucellosis is a common disease among pastoralists and nomadic herdsmen in developing countries who are continuously being exposed to potentially infected animals. Immunization of young goats and sheep with live attenuated rev-1 strain of *Brucella Mellitensis* and calves and even adult animals with strain 19 *Brucella abortus* is effective in control of brucellosis in animals.

Thorough health education especially on the mode of transmission of brucellosis and the main risk factors such as consumption of raw milk, consumption of animal blood and failure to seek treatment from health institutions needs to be emphasized. Although many people in the study area seem to recognize that the disease is transmitted through consumption of raw milk, a substantial number of respondents (38.5%) did not boil their milk before consumption. Many people in the study area (61.5%) consume animal blood and have no knowledge that the disease is transmitted through consumption of animal blood. There is need to create awareness in the community on the mode of transmission through carcass handling, contact with infected tissues, blood, aborted fetuses and placentas through a break in the skin. This is apparent in the study

findings where majority of the respondents (61.3%) did not know that the disease is transmitted through carcass handling and thus there exists knowledge gap on the modes of disease transmission.

Accessibility and affordability of treatment services is a matter that needs to be addressed by the health department. In the study area, it was established that many people opted for traditional treatment instead of modern treatment because of inaccessibility (12%) and un-affordability (13.7%). Therefore, there is need to equip rural health facilities in the pastoralist areas with the necessary testing and treatment facilities. In addition there is need for laboratory staff to be posted in these local health facilities namely dispensaries and health centers.

6.2.2 Suggestion for further research

There is need for further studies on the effectiveness of traditional modes of treatment against brucellosis. The study findings showed that nearly half of the respondents (47%) preferred traditional modes of treatment to modern treatment. Most of the respondents argued that the traditional treatment is effective. Among such traditional treatment are spitting on the infected person by the medicine men, massage of the affected limbs and the use of traditional herb locally known as "*qumbi*". However, the effectiveness of such traditional treatments could not be ascertained

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APPENDIX 1

Household interview guide

This interview guide is strictly for learning and shall not be used for any other purpose. The information obtained shall be treated with utmost confidentiality.

Serial Number_____

Division_____

Location_____

Socio-demographic information

1 Sex of the respondent.

a) Male
b) Female

2 Marital status of the respondents

a) Married
b) Single
c) Widow/widower
d) Divorced

3 Respondents highest academic level attained

a) None
b) Primary
c) Secondary
d) Tertiary

4 Respondent's occupation.

a) Livestock rearing
b) Salaried
c) No job
d) Others specify_____

5 Household size_____

6 Age of the respondent_____

Disease awareness and health seeking behaviour

7 How common is brucellosis in this area?

a) Common
b) Rare
c) Not found

8 How can one get the disease? (Multiple answers)

a) Consumption of untreated (raw) milk
b) Contact with infected animals
c) Contact with infected meat
d) Through damaged skin when handling milk
e) Consumption of animal blood
f) Witchcraft
g) Insect bite
h) Others specify_____

9 Can you prevent the disease?

a) Yes
b) No

10 If yes in question 8 above, what precaution do you take to avoid getting the disease? (Multiple answers).

a) Boiling of milk before consumption
b) Avoid handling of carcasses
c) Avoid handling of aborted fetuses and afterbirth
d) Do nothing

11 What are signs of brucellosis? (Multiple answers).

a) Sweating
b) Weakness
c) Headache
d) Anorexia
e) Pain in the limbs and the back
f) Constipation
g) Joint pains

h) Any other specify_____

12 Which is the vulnerable group to the disease?

a) Men
b) Women
c) Children
d) All

13 Has any one in your household suffered from brucellosis in the last one year?

a) Yes
b) No

14 If yes in question 13, where did you seek treatment?

a) From the health facility
b) From traditional healers
c) No treatment sort
d) Others specify_____

15 For those who sort conventional treatment, was there a relapse of the disease?

a) Yes
b) No

16 If yes in question 15 above, why?

a) The treatment was not effective
b) Failure to complete the treatment
c) Continuation of risk behavior
d) Others specify_____

17 Do health workers or veterinarians usually visit you?

a) Yes
b) No.

18 If yes in question 17 above, who visits you?

a) Public health technician
b) Veterinarians
c) Local nurse
d) Community health workers (C.H.Ws)
e) Others specify_____

19 What role do the health workers or veterinarians play in controlling the disease? (Multiple answers).

a) Health education
b) Meat inspection
c) Treatment of the sick
d) Others specify_____

Socio-cultural risk factors

20 How many livestock do you have? (Irrespective of species).

a) 1-49
b) 50-100
c) More than 100

21 Which species of livestock do you have? (Multiple answers).

a) Goats
b) Sheep
c) Cattle
d) Camel
e) Others specify_____

22 Which treatment is suitable for Brucellosis infected person?

a) Modern/Conventional treatment
b) Traditional treatment
c) Combination of modern and traditional treatment
d) None
e) Others specify_____

23 If traditional treatment is suitable in question 22 above, why?

a) Modern treatment is expensive
b) Health facilities are inaccessible
c) Modern treatment is not effective
d) Don't know
e) Others specify_____

24 What are the traditional methods for treating Brucellosis? (Multiple answers).

a) Use of traditional herbs

b) Spitting on infected persons by medicine men
c) Massage of the affected limbs
d) Others specify_____

Animal and animal products handling practices

25 Do you conduct physical operations to assist the animal during delivery?

a) Yes
b) No

26 If yes in question 25 above, what precautions do you take to avoid infection with Brucellosis? (Multiple answers).

a) Cleaning of hands with water
b) Cleaning of hands with water and soap
c) Drying the hands with soil
d) Wiping the hands with a piece of cloth
e) Wearing of gloves
f) Do nothing
g) Others specify_____

27 What method(s) of milking do you use?

a) Hand milking
b) Machine milking
c) Any other specify_____

28 How do you ensure that your milk is safe before consumption?

a) Boiling
b) Use traditional herbs
c) Do not treat
d) Others specify_____

29 Do you ferment your milk before consumption?

a) Yes
b) No

30 If yes in question 29 above, why?

a) For preservation
b) Precaution against diseases

c) As a traditional practice

d) Others specify_____

31 Does any one in your household drink animal blood?

a) Yes

b) No

32 If yes in question 31 above, why? (Multiple answers)

a) For food

b) Treatment against snakebite

c) Others specify_____

33 Do you milk several animals into the same container?

a) Yes

b) No

34 If yes in question 33 above, why?

a) For convenience

b) Shortage of containers

c) Others specify_____

35 Can you get infected by handling carcasses of infected animals?

a) Yes

b) No

36 If yes in question 35 above how can you prevent infection when handling carcasses?

a) Washing hand after slaughtering

b) Wearing of gloves

c) Do nothing

d) Others specify_____

APPENDIX 2

Focus group discussion

1 What are the modes of transmission of the disease?

2 Why don't you boil your milk before consumption?

3 Do you reconstitute fermented milk with fresh milk and if so why?

4 Why don't you drink milk from aborted camels?

5 Do you believe that traditional treatment is effective and what does it involve?

6 How do you know that someone is suffering from brucellosis (what are the signs and symptoms?).

7 For how long does someone drink animal blood for snakebite treatment?

8 Which animal species do you think is associated with brucellosis?

9 Do you vaccinate your animals against brucellosis?

10 What are the health workers and veterinarians doing in controlling the disease?

APPENDIX 3

Interview guide for key person's informant

1. Is brucellosis a major health problem in this area?

2. If yes, what are the major contributing factors to the prevalence of the disease?

3. What activities do you undertake in the control and prevention of brucellosis in this area?

4. Do you as health workers and veterinarians work in collaboration with other stakeholders such as the N.G.Os?

5. Are there government policies in control and prevention of brucellosis?

6. Does the government have specific programmes in control and prevention of brucellosis?

7. What do you think the government should do in control of human brucellosis in this area?

APPENDIX IV
COPY OF PERMIT LETTER

REPUBLIC OF KENYA

MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

Telegrams: EDUCATION", Nairobi

FAX No.
Telephone: 334411
NAIROBI
When replying please quote

JOGOO HOUSE
HARAMBEE AVENUE
P. O. Box 30040
NAIROBI

MOEST 13/001/35C 148/2

20th April, 2005

Mamo Abudo Qido
Kenyatta University
P.O. BOX 43844
NAIROBI

Dear Sir

RE: RESEARACH AUTHORISATION

Following your application for authority to conduct research on "A study on Socio-Medical factors associated with prevalence of Brocellosis among the Nomads".

I am pleased to inform you that you have been authorised to carry out research in Makona Division in Marsabit District for a period ending 30th September, 2005.

You are advised to report to the District Commissioner, the District Education Officer and the Medical Officer of Health Marsabit District before commencing your study. Upon completion of the research project, this Office expects you to avail two copies of your research findings.

Yours faithfully

M. O. ONDIEKI
FOR: PERMANENT SECRETARY