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Major causes of calf morbidity and mortality in smallholder dairy farms in Shashemene town, Ethiopia

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Abstract

A cross-sectional study was conducted from November 2014 up to April 2015 to determine the major causes of calf morbidity and mortality in smallholder dairy farms and associated potential risk factors in Shashemene. A total of 187 calves found in 46 farms were included in the present study. The overall crude morbidity and crude mortality rates were 27.8% and 6.4%, respectively. The most frequent disease syndrome was diarrhea with incidence rates of 28(15%) followed by pneumonia 8(4.3%), Gastrointestinal tract (GIT) disorder 8(4.3%) and septicemia 5(2.7%). In addition skin lesion, navel ill and unidentified cases were encountered. The main causes of deaths were diarrhea 6(3.2%), Septicemia 2(1.1%), GIT disorder 2(1.1%), pneumonia 1(0.5%) and other 1(0.5%). The most important risk factors associated with morbidity and mortality was housing hygiene, floor condition and calf size in farm. Out of 187 calves examined for GIT parasites; 63(33.3%) were positive for nematode eggs. Prevalence of helminthes parasite increased with increasing age, showing significantly higher prevalence ($P<0.05$) in calves above 2 months than in calves below 2 months of age. Besides, majority of the calves, 48(25.7%) were found positive for coccidian oocyst. In generally; diarrhea, pneumonia and septicemia were the major causes of calf incidence and mortality. As well as housing hygiene, floor condition, calf size in the farms, age and breed were identified major risk factors. Therefore, identifying major causes and improving management practices and breed should be given to emphasis by advisory of smallholder dairy farms.

Keywords: Calf, Dairy farm, Morbidity, Mortality, Shashamene

1. Introduction

In Sub-Saharan African countries, livestock plays a crucial role both in national economies and the livelihood of rural communities (Sibanda, 2014). It provides drought power, milk, and meat, input for crop production and soil fertility and raw material for industry. Various estimate shows that the livestock sector contributes 13-16% of total agricultural GDP (Yayneshet, 2010).

Domestic animals are mainly used as drought animals, source of milk, meat, hide and skin and as pack animals. Apart from this they also serve as a means of risk diversion and accumulation of wealth among the rural community (Yohannes, 2002; Gbodjo *et al*., 2014).

Ethiopia is one of the most populated countries in Africa, having an estimated population of 67.2million in July 2002 with annual growth rate of 2.9%. The dominate economic feature of the country is the agriculture sector of which livestock is a very important and essential component (MOA, 2013).The recent livestock population estimates that the country has about 52.1 million heads of cattle, 24.2 million sheep, 22.6 million goats and 44.9 million poultry (MOA, 2013) .This figure indicates a huge potential of the country in the sectors. In the high land areas of the country, livestock are raised together with crop cultivation for their livelihood where as in the low land or the pastoralists' subsistence is based mainly on livestock and livestock products (CACC, 2003).

Despite the huge number of cattle and their economic importance, the productivity is low due to the constraints of disease, nutrition, poor management, lack of marketing facilities and opportunity, inadequate animal health services, uncoordinated development programs between various levels of government institutions and/ or non-government organizations and poor performance of indigenous breeds. These constraints result in poor reproductive performance of dairy cattle (DACA, 2006). Consequently, national milk production remains among the lowest in the world even by African standard (Zegeye, 2003). However, there is a slow and gradual overall growth in milk production in Africa due to cross breeding programs that are being introduced in many tropical countries to increase milk production (Ndambi *et al*., 2007).

Diseases have numerous negative impacts on productivity and fertility of herds that is. losses due to mortality and morbidity, loss of weight, depressed growth, poor fertility performance, decrease physical power and the likes (Elsa *et al*., 2012). This results from complex interaction of the management practice, environment, infectious agent and the calf itself. Major causes of calf diseases and deaths were diarrhea, pneumonia, joint problems, umbilical diseases, trauma, congenital abnormalities, nutritional deficiencies, dystocia and other infections (Svensson *et a*l., 2003; Singla *et al.,* 2013; Wudu *et al.,* 2008). Calf losses were significantly reduced by introducing new techniques of management including on time colostrum feeding, housing, feeding and nutrition (Razzaque *et al.,* 2009).

Several factors affect the health and vigor of the calves immediately after birth (Abdullatief *et al.*,2014).The poor immune system and lack of previous exposure to infection and poor management make new born calves susceptible to infectious diseases (Darsema, 2008). Proper nutrition is fundamental for calf growth and for the general profitability of calf rearing enterprise. In young stock, a good nutritional strategy optimizes rumen development and growth while minimizing stress and disease. Livestock housing conditions greatly affects health and productivity (Bekele *et al.*, 2009). Cleanliness of the barn influences calf health, as calves housed in unclean barns are at higher risk of diseases than calves housed in clean barns (Wudu *et al.*, 2008).

The mode of passive transfer in neonates varies with the type of placentation and in the case of neonatal calves; it is based on an immediate postpartum ingestion of antibody rich colostrums (Tizard, 1995). The age of the calf is the most important factor affecting morbidity and mortality, approximately 75% of the mortality in dairy animals less than one year of age occurs in the first month of their life (Heinrichsand Radostits, 2001).

Failure of passive transfer in heifer calves is linked with decreased rate and efficiency of growth and decreased first and second lactation milk production (Faber, 2005). In developing parts of the world including Ethiopia there is a growing trend in the development of dairy farming which is becoming an important source of income particularly for stallholder farmers. However, this cannot be realized without the application of effective calf health and management practices as the future of any dairy farming production depends on the successful program of raising replacement animals (calves). With the above background, the objectives of the present study were:

- To assess the major causes of morbidity and mortality in calves
- To identify risk factors associated with morbidity and mortality in smallholder dairy farms in Shashemene

2. Materials and Methods

2.1. Study area

The study was conducted from November 2014 to April 2015 on purposely selected dairy farms in Shashemene town, Oromia Regional State, West Arsi Zone, and located 250 km south east of the capital Addis Ababa. It has latitude of 7° 11'33'' north and a longitude of 38° 35'33'' east. The area lies within the Rift Valley, with an altitude ranging from 1700 to 2600 metres above mean sea level (AMSL). It receives an annual rainfall of 700-950 mm, and has an annual temperature range of 12-27°C. Major crops grown around Shashemene area are cereals such as teff, barley, wheat, maize, sorghum, and root crops like potato and sweet potato and vegetables such as cabbage, spinach and onion as cash crops. Annual crops are predominant and rain fed agriculture is mainly practiced using draught power. Total human population of this area is 285,176. The kebeles in the woreda are categorized as Kolla (50%), Woinadega (29%) and Dega (21%). The Livestock's population. (Table 1).

Table 1: Livestock's population of West Arsi zone

Types of livestock's	2010	2011	2012
Cattle	3,390,756	3,510,328	3,629,900
Goats	317,272	312,027	322,332
Sheep	543,802	639,107	694,213
Horse	185,706	198,013	227,784
Mules	8,438	8,605	8,953
Donkeys	158,008	161,524	165,367
Camels	51	53	57
Poultry	198,020	245,890	NA

NA= Not Applicable
Source: Zonal Agricultural and rural development office

2.2. Study design

The study was cross-sectional and longitudinal prospective observational study that extended for six months from beginning of November 2014 to April 2015. The sampling units (calves) were identified individually and monitored throughout the study period. The questionnaire survey, clinical and laboratory examinations for parasite was conducted during the study period.

2.3. Data Collection

The data for this particular study was collected from 46 purposely selected dairy farms in Shashemene town based on the size of farm, the willingness of the farm owners to be part of this study. Accordingly, a total of 187 calves' from46 farms were considered.

2.3.1. Cross-sectional Study Based on Questionnaire

The owners and / or attendants of the included dairy farms were interviewed using structured and open ended questionnaires. The questions included the gender and education background of the responsible personnel, calf size in the farm, feeding and housing of the animals, disease incidence, and mortality as well as the breed, age and sex of calves were also included

2.3.2. Longitudinal Study

Monitoring of dairy farms for calf morbidity and mortality was carried out for 6 months from November, 2014 to April, 2015. For the purpose of this study, calf was defined as young cattle less than six months of age, morbidity as any sickness that has recognizable clinical manifestation and mortality as death of calves after birth to stay a few times. For the monitoring, all calves in the selected farms at the beginning of the follow up period and individual records were prepared. The calves were withdrawn from the follow up when they completed their 6 months of age.

Subsequently, a regular visit was made every three weeks to observe and record calf morbidity, mortality and possible causes. The main activities accomplished during the regular visits were:

- Clinical examination of calves for any health problem. This involved physical examination of calves and taking normal body parameters like body temperature, respiratory rate and pulse rate when abnormality was suspected.
- Observation on different calf management aspects like cleanness of the calf house and feeding practices.
- Asking calf attendants the occurrence of calf health problem incidents between the visits and recording of the history of the calf health problem that would enable the investigator suppose the possible cause and thus assist diagnosis.

Calf morbidities encountered during the monitoring period were categorized following disease conditions/syndromes based on their clinical signs (Wudu *et al.*, 2008). These were;

Diarrhoea: Any conditions characterized by passing of lose or watery feces with increased frequency, which could or could not be accompanied by other systemic signs like dehydration, decreased appetite or fever.

Pneumonia: When frequent coughing observed with or without respiratory discharges and fever.

Septicemic condition: Any condition characterized by depression, anorexia and fever with**o**ut any distinct involvement of specific body system.

Navel ill (omphalitis): Swelling of umbilical cord which is painful when palpated and with or without abscess formation

Joint ill (arthritis): Enlargement of joints usually with abscess formation in any one or all limbs, which could or could not be preceded by other disease condition.

2.3.3. Fecal Sample Collection

A fresh fecal sample was collected from the rectum of each calf using sterile disposable plastic gloves. The sample was placed in a labeled clean glass bottle container and was transported to the parasitology laboratory on the same day and was kept at 4°C in a refrigerator until processing within 48 hours of arrival. At the time of sampling, the name of the farm owner, date of sampling, age, sex, breed, tag number (if present) was recorded for each calf on a recording format and examine the infection rate of coccidia and internal parasites by using flotation technique at the Parasitology Laboratory, School of Veterinary Medicine, Hawassa University.

2.4. Data Analysis

Data collected from study sites were entered and stored in a Microsoft excel spread sheet program and coded for analysis. Statistical analysis was done using statistical program for social science version 20.0 (SPSS) statistical software. Data generated were analyzed using descriptive statistics. Pearson's chi square was used to evaluate the association between the prevalence of morbidity and mortality and different risk factors. As well as the association of parasitic infection with animal factors like age, sex and breed has been analyzed. P-value less than 0.05 (at 5% level of significance) was considered as significant in the analysis.

3. Results

3.1. Morbidity and Mortality

The study revealed that diarrhea was the most frequently observed clinical disorder (28 cases out of 187 calves) followed by GIT disturbance, pneumonia and septicemia (Table 2).

Table 2: Summary of diseases/syndromes that caused morbidity and mortality in dairy calves (N = 187)

Health Problems/syndrome	Morbidity case	Morbidity (%)	Mortality case	Crude Mortality (%)
Septicemia	5	2.7	2	1.1
Diarrhea	28	15	6	3.2
GIT Disturbance*	8	4.3	2	1.1
Pneumonia	8	4.3	1	0.5
Other*	3	1.6	1	0.5
Total	52	27.8	12	6.4

GIT Disturbance*include bloat, indigestion and any pain symptoms from GIT
Other* include navel ill, skin lesion, unidentified

3.2. Risk factors associated with Incidence of morbidity and mortality

Out of 46 farms visited, 24 (72.3%) morbidity and 13 (100%) mortality were recorded in farms with poor hygienic condition. (P=0.000). Considering floor type, morbidity and mortality record was 6(18.2%) and 1(7.7%), respectively in the concrete farms (Table 3).

Table 3: Potential risk factors associated with calf morbidity and mortality at farm level

	Morbidity				Mortality			
Factors coded	No of farm	Affected no (%)	χ^2-value	P-value	No of farm	Affected no (%)	χ^2-value	P-value
Education status								
0=non-educated	11	6(18.2)	3.61	0.164	11	3(23.1)	2.849	0.241
1=primary	30	22(66.7)			30	7(53.8)		
2=sec and above	5	5(15.1)			5	3(23.1)		
House hygiene								
0=poor	24	24(72.7)	19.769	0.000	24	13(100)	16.611	0.000
1=clean	22	9(27.3)			22	0(0)		
Floor condition:								
0=soil	31	27(81.8)	11.060	0.001	31	12(92.3)	5.119	0.024
1=concrete	15	6(18.2)			15	1(7.7)		
Calf size in farm								
0=less than 5	22	12(36.4)	6.148	0.013	22	2(15.4)	7.643	0.006
1= greater than 5	24	21(63.6)			24	11(84.6)		
Sex:								
0=female	22	14(42.4)	1.366	0.243	22	3(23.1)	4.448	0.035
1=male	24	19(57.6)			24	10(76.9)		

Generally, housing hygiene, floor condition and calf size in the farm seem to be the major factors for diseases incidences in the present study. Hence, calves house in soil floor were more often at risk than calves housed in the concrete floor. Similarly, calf size in farm and housing hygiene has been significantly associated (P <0.05) with dairy calf morbidity and mortality.

3.3. Prevalence of Gastrointestinal Nematodes and Coccidian Oocyst

In addition to other health problems, parasitic infection was the most prevalent in investigated smallholder dairy farms.

Out of 187examined calves, 4 (6.3%) and 9 (18.8%) calves aged less than 1month were positive for nematode parasites and positive for coccidian oocyst, respectively (Table 4).

Table 4: Prevalence of GIT nematodes and coccidian oocyst within different age groups

	Helminthes eggs				Coccidia Oocyst			
Calf age	No of examine	Positive (%)	χ^2-value	P-value	No of examine	Positive	χ^2-value	P-value
< 1month	73	4(6.3%)			73	9(18.8%)		
1-2 month	41	21(33.3%)		0.000	41	6(12.5%)	25.649	
3-4 month	39	20(31.7%)	42.688		39	20(41.7%)		0.000
> 4 month	34	18(28.6%)			34	13(27.1%)		

Considering breed as potential risk factor, 22 (34.9%) local, 34(54%) exotic and 7(11.1%) cross breeds were positive for nematode parasites. Table 5 below shows Breed of calves with significant effect on the occurrence of gastrointestinal nematodes and coccidian oocyst.

Table 5: Prevalence of GIT nematodes and coccidian oocyst within breed

	Helminthes eggs				Coccidia Oocyst			
Breed	No of examined	Positive (%)	χ^2-value	P-value	No of examined	Positive	χ^2-value	P-value
local	49	22(34.9)			49	19(39.6%)		
exotic	101	34(54%)	6.369	0.041	101	22(45.8%)	6.095	0.047
cross	37	7(11.1%)			37	7(14.6%)		

Based on sex, 18(37.5%) male and 30(62.5%) female calves were found infected with coccidian oocyst(Table 6).

Table 6: Prevalence of gastrointestinal nematodes and coccidian oocyst within sex

	Helminthes eggs				Coccidia Oocyst			
Calf sex	No of examines	Positive (%)	χ^2-value	P-value	No of examines	Positive (%)	χ^2-value	P-value
Male	81	25(39.7%)	0.511	0.475	81	18(37.5%)	6.889	0.346
female	106	38(60.3%)			106	30(62.5%)		

4. Discussion

The study showed that 6.4 (n=12) mortality and 27.8% (n=52) morbidity cases were recorded. In this study, the mortality rate found for 6 months has considerably agreed with the mortality rates reported for similar period by different studies in Ethiopia (Hussien, 1998; Amoki, 2001). However, it was lower than the 12% mean calf mortality rate in smallholder dairy production in Sub-saharan Africa (Otte and Chilonda, 2002) and from western world which were reported in the ranges of 9 to 13 % for Europe and similar to 6.3% for USA (Heinrichs and Radostits, 2001).

On the other hand, the present finding was much lower than the 25% and 50% reported by Sisay and Ebro, (1998) and Hassan, (1996) respectively. As well as the finding of the present study is lower than Terence (2001) who reported crude mortality rate of 14.2% during the first three months of life. On the other hand, low prevalence of 3.4% mortality was reported by Hailemariam *et al.,* (1993) from Abernossa Ranch, whereas, Wudu *et al.,* (2008) reported relatively higher overall crude mortality of 18% compared to the present findings.

Concerning the morbidity and mortality of calves, most previous reports from Ethiopia were based on studies in research stations and state farms with large herd sizes and usually holding high exotic blood level animals, apparently these were associated with increased risk of calf disease occurrence (Wudu *et al*, 2008). In the present study, the number of calves per farm was small and the farmers can easily monitor calves and take measures to avoid calf health problems improve managements and different methods used in diagnosis. Some authors reported calf morbidity based on producer diagnosis and treatments while others depended on veterinarian diagnosis (Wudu *et al*, 2008). This could be one of reasons to find relatively lower mortality rate than those mentioned above farms.

In the present investigation, calf diarrhea was found to be the predominant calf health problem with incidence rate of 15% followed by pneumonia and GIT disturbance (4.3%). Diarrhea was also the leading cause of mortality in the study herds. This finding is in agreement with the findings of (Wudu *et al.,* 2008) who reported calf diarrhea and pneumonia the predominant calf health problems in dairy calves at Ada'a district of Oromia region. However, the present finding was higher for diarrhea and pneumonia as compared to (Bekele *et al*., 2009) who recorded a prevalence of 10% and 0.7% for diarrhea and pneumonia respectively. On the other hand, there were studies which found pneumonia as the leading cause of calf mortality (Shiferaw *et al.,* 2002).These differences could be emanated from the difference in management and other factors such as; housing hygiene, ventilation, environment, age, season, herd size and others related factors. Furthermore, analysis of the potential risk factors was done for calf diarrhea and age of the calf, condition of birth and cleanness of the calf house were the factors. This was due to inadequate passive transfer of colostral immunity. Such calves either would lack vigor to suckle on time or will fail to absorb even if they managed to suckle. Calves from prolonged labor develop respiratory acidosis, which interferes with absorption of colostral immunoglobulin (Drewry *et al*., 1999).

Epidemiological investigation of nematodes in livestock using suitable and cost effective diagnostic methods was found to be important. In this study 33.3% were positive for nematode eggs and 25.7% were found positive for coccidian oocyst. This result was lower than (58.00%) prevalence Shirale *et al., (*2003) and 54% Adem and Anteneh, (2011) in Haramaya University. This difference is may be due to less contact with other animals, different management system or due to increase in awareness of the farmer to treat their animals with antihelmentic drugs. But the prevalence of gastrointestinal parasites in the current study is higher than 11% (Ashutosh *et al.,* 2011). This difference may occur due different area and managements.

Helminthes parasite prevalence was observed to increase with increasing age and showing significantly higher prevalence ($P < 0.05$) in calves above 2 months than in calves below 2 months. This was agreement with Wymann, (2005) reported that GIT parasite burden and diversity increased with age and at weaning and ends of first year of life, calves acquired the parasite spectrum similar to that of adult cattle. This could be due to the fact that as age increases, calves were given fresh grass as supplemental feed. Additionally, there was mixing of calves of different age groups, also there was close contact with adult animals. This could be possible means of acquiring parasitic infections. In majority of smallholder dairy farms, calves were commonly open grazed or tethered on natural pastures (Bekele *et al.,* 2009). The impact of parasitic burden should be taken into account in the veterinary heath care to dairy calves.

In the present study the risk factors were tested for their association with crude mortality and crude morbidity in smallholder farms. Among risk factors assessed; housing hygiene was found to be significantly associated with the incidence of disease problems having at (P=0.000). This significant association with disease problems found in present study was in agreement with other reports Bendali *et al.,* (1999); Shiferaw *et al.,* (2002) who documented the existence of significant association between higher risk of morbidity and dirtiness of calf barn. Similarly, a significant association of age at first colostrum feeding with calf morbidity was reported different researchers, Wudu *et al*., (2008) and higher risk of morbidity in late fed (after 6 hours) was related to failure of passive transfer of colostral immunity during this period (Wittum and Perino, 1995). Similarly, floor condition was significant associated at (P=0.024) this present study was agreement with (Bekele *et al.,* 2009).

Other risk factor for health problems was higher in male calves (17.1) than female calves (14.1%). This finding agrees with Bekele *et al*. (2009) finding who reported higher health problems in male calves than females particularly during the first months of their age. This could be due to less attention and management care given to the male calves as their role in the farms was considered not profitable in this study. So, it is important to know that the feeding and the general management, of male calves needs to be improved for animal welfare reasons as well as for more profitable utilization of beef from these calves for consumption.

5. Conclusion and Recommendations

The calf morbidity and mortality rates found in this study were higher than economically tolerable and that can be achieved through good management. Given the fact that the study farms raise their own replacement stock and have small herd size, higher rates calf morbidity and mortality will be great hindrance to improve productivity of dairy production through selection. Calf diarrhea and pneumonia were the predominant calf health problems of the farms involved in this study. Among the potential risk factors evaluated for their association with the occurrence of calf health problems; risk factors associated with diseases occurrences and deaths indicating, calf housing hygiene, floor conditions, farm size and sex as potential risk factors.

Based on the above conclusion the following recommendations are forwarded

- Greater attention should be given to risk factors associated with disease occurrences and deaths indicating such as; hygienic conditions and optimum time of colostrum feeding to minimize calf health problems and hence their mortality.

- More researches should be conducted to identify the causative agent of the major health problems identified in this research as this is crucial in formulating effective preventive and control strategies like use of vaccination or other methods.

- Extension services need to focus on awareness creation among dairy farm owners about good calf management's practices and their roles in productivity of dairy farming investments.

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