



# American Journal of Bioscience and Bioinformatics (AJBB)

ISSN: 2995-0481 (ONLINE)

VOLUME 4 ISSUE 1 (2025)



PUBLISHED BY  
E-PALLI PUBLISHERS, DELAWARE, USA

## Epidemiological Determinants of Calf Morbidity and Mortality in Dire Dawa, Eastern Ethiopia

Sherif Mohammed<sup>1\*</sup>

### Article Information

**Received:** August 20, 2024**Accepted:** September 14, 2024**Published:** May 08, 2025

### Keywords

*Dire Dawa, Longitudinal Study, Morbidity, Mortality, Risk Factor*

### ABSTRACT

A longitudinal study was conducted on 40 calves from November 2016 to April 2017 in five purposively selected intensive dairy farms at Dire Dawa, Eastern Ethiopia, to estimate the incidence of dairy calf morbidity and mortality and determine potential determinant factors associated with calf morbidity and mortality. Patterns of calf morbidity and mortality were followed up to the end of their sixth month of age at individual level. In addition a herd level data on calf rearing practices was performed on the farm where experimental animals resided. Diseases condition/syndromes that were diagnosed in calves includes; diarrhoea, pneumonia, septicaemia condition, joint ill (arthritis), navel ill, congenital problems and bovine papillomatosis(warts). The most frequent diseases syndrome was diarrhoea 50% (n=20), followed by pneumonia 7.5% (n=3). The result of this study demonstrated that; the overall morbidity and mortality were 77.5% and 20%, respectively. The main cause of death was also diarrhea resulting in three out of eight deaths. Older calves above three months age were at lower risk of morbidity and mortality than younger calves of below three months. Among 16 potential risk factors assessed; birth condition ( $X^2=5.6$ ,  $p=0.018$ ), vigour status at birth ( $X^2=6$ ,  $p=0.013$ ), navel treatment ( $X^2=9$ ,  $p=0.003$ ), age at first colostrums ingestion ( $X^2=4$ ,  $p=0.044$ ), amount of milk feed daily ( $X^2=9.5$ ,  $p=0.002$ ), house cleanness ( $X^2=5.4$ ,  $p=0.02$ ), and ventilation ( $X^2=7$ ,  $p=0.008$ ) were significantly associated with calf morbidity. Whereas vigour status at birth ( $X^2=6$ ,  $p=0.011$ ), age at first colostrums ingestion ( $X^2=5$ ,  $p=0.024$ ), and experience of calf care taker ( $X^2=4.3$ ,  $p=0.038$ ) were significantly associated with calf mortality. In general calf morbidity and mortality found to be relatively high in study area and can have short term and long term detrimental effect on Dairy production by suppressing growth rate of the calves and replacement capacity of the herd. Therefore A sound dairy calf management practice, is needed to understand and exploit above mentioned calf health determinant factors. Moreover, further investigation is suggested to identify the specific causative agents incriminated for calf morbidity and mortality in dairy farms of the study area.

### INTRODUCTION

Dairy farming is a growing livestock production system in Ethiopia. It is primary source of income for urban and peri-urban poor communities. Because of better availability of milk market, most of the dairy farms are concentrated in urban and peri-urban areas of the country. Peri-urban and urban dairies are intensive production systems, which keep high grade cows and have improved management practices but this is usually associated with increased susceptibility to disease, poor survival rate and poor reproductive performance (ILCA, 1994; Eneyew *et al.*, 2000; Goshu and Singh, 2013).

The productivity of cattle depends largely on their reproductive performance and the survival of calves (Eneyew *et al.*, 2000). This means the foundation of successful dairy industry using improved breed is laid on the consistent calf crop production. The proper care and management of calf crop, particularly for the replacement heifers is very crucial for the dairy enterprise to grow and prosper (Roy, 1990). Heifer replacement markedly influences the ability of dairymen to increase production by allowing him to practice selective culling of low productive cows (Waltner-Toews *et al.*, 1986; Moran, 2011).

Calf morbidity and mortality are perennial problems for dairy producers worldwide (Heinrichs and Radostits, 2001). especially the tropics is not an ideal location for calf rearing as the high temperature and humidity introduce many potential disease problems to milk fed calves (Moran, 2011). According to Lorenz *et al.* (2011), it has short-term and long-term detrimental effects on performance of a dairy farm. They impair both growth rate and replacement capacity of the herd. Calf hood diseases have, therefore, a significant financial impact on dairies resulting from death loss, decreased lifetime productivity, treatment costs, genetic loss, and impaired future performance (Donovan *et al.*, 1998).

In the past, many epidemiological studies have been conducted worldwide to document the magnitude of calf morbidity and mortality with causes and associated risk factors. The problem is more acute in developing countries; calf mortality rates 0-1 year can go as high as 50 % in the tropics due to bad management, poor adaptation of exotic breeds to the prevailing tropical environment and endemic diseases (Radostitis *et al.*, 1994). In general, calf mortality in Ethiopia is range from 7 to 30.7% (Amoki, 2001; Lemma *et al.*, 2001; Shiferaw *et*

<sup>1</sup> Haramaya Universit, Ethiopia\* Corresponding author's e-mail: [Shariifarf@gmail.com](mailto:Shariifarf@gmail.com)

*al.*, 2002; Amuamuta *et al.*, 2006; Wudu *et al.*, 2008; Bekele *et al.*, 2009; Yeshwas *et al.*, 2014)

Calf diseases that cause morbidity and mortality are the results of complex interaction of the management practices and environment, infectious agents and the calf itself (Wudu, 2004; Klein-Jöbstl *et al.*, 2014). Diarrheal in neonatal period and pneumonia in older calves are known to be responsible for most of calf hood morbidity and mortality (Agerholm *et al.*, 1993; Olsson *et al.*, 1993; Sivula *et al.*, 1996b; Svensson *et al.*, 2006). Several environmental and management factors act as risk factors for the occurrence of calf morbidity and mortality (Bruning-Fann and Keneene, 1992).

There is an established fact that calf health and performance improvements in peri-urban and urban dairies farm can be achieved through development and application of sound dairy calf health and management practices. However, in developing and applying such intervention techniques, knowledge of descriptive epidemiology, risk factors associated with calf morbidity and mortality are required (Sivula *et al.*, 1996b; Radostitis, 2001). In this regard, there were published reports available from different parts of Ethiopia. To our knowledge, though there is no published information about dairy calf morbidity and mortality in the study area

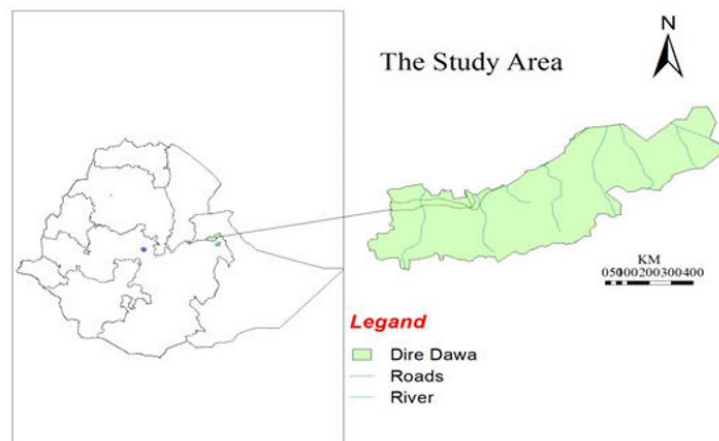
before. Therefore, this study was intended:

- To estimate the incidence of morbidity and mortality of dairy calves up to six months old in the study area, and
- To explore risk factors associated with calf morbidity and mortality in order to give effective advice and realistic recommendations to farmers

## MATERIALS AND METHODS

### Study Area Description

The study was conducted in Dire dawa administrative council, which is located about 518 km East of Addis Ababa. It is situated between 90° 3' N latitude 41° 05' 1' E longitudes (Tamado *et al.*, 2002). It shares a boundaries to the South, Southeast, and southwest with the Eastern Hararge zone of the Oromia regional state and to the North, East, and West with the Shinile zone of the Somali regional state. The total area of the administrative council is about 1977km<sup>2</sup>. The rain fall pattern is bi- modal with highest rainfall in July and August with average of 800mm. The monthly mean maximum temperature ranges from 28.1°C to 34.6°C recorded May and June respectively (Belay, 2002). In 2017 the total livestock population is estimated to be 52,421 cattle, 64,234 sheep, 205804 goats, 8202 camels, 18,348 equines and 102963 chickens (CSA, 2017).



**Figure 1:** Map of Dire Dawa administration

### Study Animal

The study animals used in this study were crossbred (Local Zebu × Holstein-Friesian) dairy calves of both sexes up to six months of age kept in the five purposively selected dairy farms found at DDAC.

### Study Design and Sampling Technique

A longitudinal study was conducted from November, 2016 to April, 2017. On 40 dairy calves at five selected dairy farms that are located in DDAC. Study farm were selected purposively based on the availability of calf and willingness and support of the owners. Data were collected on events associated with calf health problems and potential risk factors during the study period.

### Data Collection

Monitoring of dairy farms for calf morbidity and

mortality was carried out for 6 months from November, 2016 to April, 2017. 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 above the age of 24 hours. For the monitoring, all calves in the selected farms that were under three months of age at the beginning of the follow up period and those born on starts of study period (the first two weeks) were individually identified and monitored throughout the follow up period. The calves were withdrawn from the follow up when they completed their six months of age. In this way, each calf was monitored at least for three months unless censured due to deaths. Individual records and herd level data on calf rearing practices were prepared (Annex I and II respectively). These were used to record genealogy of the calf, events surrounding the

birth of the calf, routine management practices applied to the calf and health problem incidents that were observed during the monitoring. The calves were visited two times a week's up to the end of the study periods (up to six months). During the regular visits, clinical examination of calves for any health problem, observation of different calf management aspects like cleanness of the calf barn and feeding practices, asking calf attendants the occurrence of sickness between visits and recording of the information were the main activities.

Emergency visits were also being conducted whenever there are calls from farms owner/manager due to calf health problems.

**Data Management and Statistical Analysis**

Processing of data was done by computer software. All the collected data were stored, filtered in Microsoft excel spread sheet and transferred to SPSS version 16 for analysis. P- Value < 0.05 was considered as significant. The dependent variable (morbidity and mortality) and independent variables, such as farm attributes, farm management factors, calf factors both at herd level and calf level were considered. The association between dependent and independent variables was tested using Chi square test. Cumulative incidence of the calf health

problems was calculated as per the formula indicated in Thrusfield (2007)

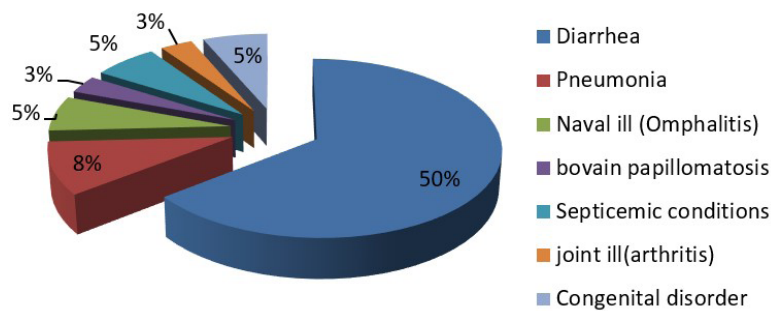
Number of animals developing disease during a time period  

$$\text{Cumulative incidence} = \frac{\text{Number of animals developing disease during a time period}}{\text{Number of animals at risk at the beginning of that time period}} * 100$$

The cumulative incidence of diseases was calculated as: the number of new cases over the total number of animals at the beginning of the study period.

**RESULTS**

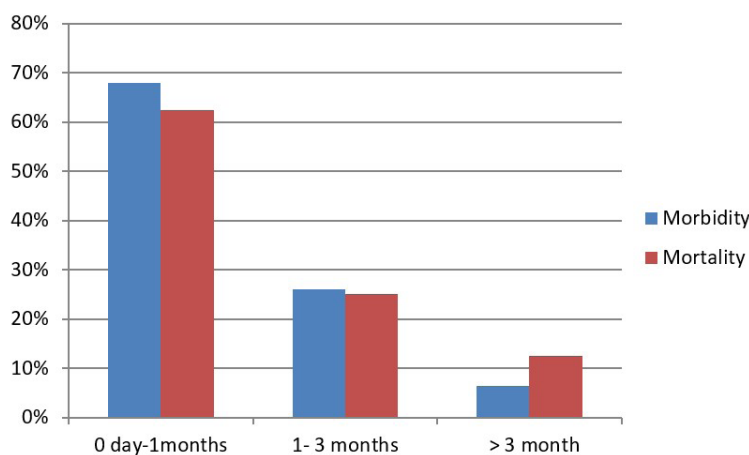
From a total of 40 calves recruited from five (5) selected urban dairy farms of DDAC, Male and female calves contributed 9 (22.5%) and 31 (77.5%), respectively. In this study, purchased calves were not included due to lack of complete calf information. Eight calves out of 40 were exited from the study cohort due to death before the end of the cohort period. The present six-month longitudinal observational study reveals that the cumulative incidence of morbidity and mortality were 77.5% and 20%, respectively. From the disease conditions encountered during the follow-up period, calf diarrhoea was the leading cause of calf morbidity with a cumulative incidence of 50%, followed by pneumonia (7.5%). The incidence of other disease conditions was low (Graph 1)



**Figure 2:** Cumulative incidence of disease conditions/syndromes encountered during the follow-up period

Among the causes of calf death recorded in the follow-up period, calf diarrhoea was the leading cause of calf mortality, accounting for three out of eight deaths. Two calves died from naval ill and the other three calves died from joint till (1),

congenital (1) and septicaemia of unidentified causes (1). The morbidity and mortality distribution by age (Graph 2) showed 0 day-1 months of age indicating higher morbidity and mortality of calves at neonatal age.



**Figure 3:** Distribution of calf morbidity and mortality by age

### Association of Potential Risk Variables with Incidence of Morbidity and Mortality

A total of four different potential risk factors (sex, birth condition, vigour status at birth, and parity of dam) were investigated for their association with the occurrence of calf morbidity and mortality. Among a factor related to calf,

vigour status at birth were significantly ( $p < 0.05$ ) associated with calf morbidity and mortality. Two factor (birth condition and vigour status at birth) were found significantly ( $p < 0.05$ ) associated with calf morbidity (Table 1).

Where as, vigour status were the only calf factor found statically significant ( $p < 0.05$ ) with calf mortality (Table 2)

**Table 1:** Association of risk factors with calf morbidity

Variable	Description	No. of calve (%)	No. Sick calves (%)	Df	X <sup>2</sup>	p-value
Sex	Male	9(22.5)	8(88.9)	1	0.86	0.35
	Female	31(77.5)	23(77.2)			
Birth condition	Normal	27(67.5)	18(67.7)	1	5.6	0.018
	Assisted	13(32.5)	12(100)			
Vigour status at birth	Good	21(52)	13(62)	1	6	0.013
	Poor	19(47)	18(94.7)			
Parity of dam	Primaries	12(30)	9(75)	1	0.6	0.8
	Multiparous	28(70)	22(79)			

X<sup>2</sup> = Chi-square; df = Degree of freedom; Significant at  $p < 0.05$

**Table 2:** Association of risk factors with calf mortality

Variable	Description	No. of calve (%)	No. calves died (%)	Df	X <sup>2</sup>	p-value
Sex	Male	9(22.5)	2(22)	1	0.36	0.85
	Female	31(77.5)	6(19)			
Birth condition	Normal	27(67.5)	4(14.8)	1	1.4	0.23
	Assisted	13(32.5)	4(31)			
Vigour status	Good	21(52)	1(4.8)	1	6	0.011
	Poor	19(47)	7(20)			
Parity of dam	Primparous	12(30)	1(8.3)	1	1.5	0.22
	Multiparous	28(70)	7(25)			

X<sup>2</sup> = Chi-square; df = Degree of freedom; Significant at  $p < 0.05$

### Association of Herd Level Calving Management and Care of the Newborn with Calf Morbidity and Mortality

A total of twelve (12) different potential risk factors (navel treatment, Age at first colostrums ingestion, Amount of milk fed daily, where calved, House cleanness, Calf housing condition, Ventilation, Owners education level, Farm as source of income, Ownership of the calf caretaker and Experience calf caretaker) were investigated for their association with the occurrence

of morbidity, and mortality of calves. Out of twelve determinants, age at first colostrum's ingestion were most important factors found significantly ( $p < 0.05$ ) associated with calf morbidity and mortality. Five (5) factors (navel treatment, Age at first colostrums ingestion, Amount of milk fed daily, House cleanness, and Ventilation,) were found significantly ( $p < 0.05$ ) associated with calf morbidity. Hundred percent calves fed less than or equal to four litters of milk per day (100%: n=18/18) were sick compared with calves feed four litters and above milk per day (Table 3).

**Table 3:** Association of herd level calving management and care of the new-born with calf morbidity

Variable	Description	N0. of calves(%)	No. Sick calves (%)	Df	X <sup>2</sup>	p-value
Navel treatment	Practiced	11(27.5)	5(45.5)	1	9	0.003
	Not practiced	29(72.5)	26(90)			
Age at first colostrum Ingestion	<6 hours	24(60)	16(66.70)	1	4	0.044
	> 6 hours	16(40)	15(93.8)			
Amount of milk fed daily	< 4 litter	18(45)	18(100)	1	9.5	0.002
	> 4 litter	22(55)	13(59.1)			
Where calved	Indoor	22(55)	17(77.3)	1	0.001	0.97
	Outdoor	18(45)	14(77.8)			

House cleanness	Clean	22(55)	14(63.6)	1	5.4	0.02
	Unclean	18(45)	17(94.4)			
Calf housing condition	Separate calf pen	24(60)	18(75)	1	0.2	0.6
	In the same barn	16(40)	13(81)			
Ventilation	Good	25(62.5)	16(64)	1	7	0.008
	Poor	15(37.5)	15(100)			
Owners education level	Primary and bellow	25(62.5)	19(76)	1	0.86	0.76
	Secondary and above	15(37.5)	12(80)			
Farm as source of income	Primary	19(47.5)	13(68.4)	1	1.7	0.19
	Secondary source	21(52.5)	18(85.7)			
Ownership of calf attendant	Owner	7(17.5)	4(57.1)	1	2	0.15
	Hired	33(82.5)	27(81.8)			
Sex of calf caretaker	Male	33(82.5)	24(72)	1	2	0.11
	Female	7(17.5)	7(100)			
Experience calf caretaker	< 5 years experience	17(42.5)	15(88.2)	1	1.95	0.16
	>5 years experience	23(57.5)	16(69.6)			

$X^2 = Chi-square; df = Degree of freedom; Significant at p < 0.05$

Where as Age at first colostrums ingestion, and Experience calf caretaker) were also found statistically significant ( $p < 0.05$ ) with calf mortality. Mortality was higher (37.5 %,  $n = 6/16$ ) in calves that feed colostrums after six hours of age and where calf attendants was less than five (5) years farm work experience(35.3%. $n=6/17$ ). (Table 4).

**Table 4:** Association of herd level calving management and care of the new-born with calf mortality

Variable	Description	N0.of calves (%)	No.calves died (%)	Df	X <sup>2</sup>	p-value
Navel treatment	Practiced	11(27.5)	1(9)	1	1.1	0.28
	Not practiced	29(72.5)	7(24)			
Age at first colostrum Ingestion	<6 hours	24(60)	2(8.3)	1	5	0.024
	> 6 hours	16(40)	6(37.5)			
Amount of milk fed daily	< 4 litter	18(45)	6(33.3)	1	3.6	0.057
	> 4 litter	22(55)	2(9)			
Where calved	Indoor	22(55)	3(13.6)	1	1.2	0.26
	Outdoor	18(45)	5(27.8)			
House cleanness	Clean	22(55)	2(9)	1	3.6	0.057
	Unclean	18(45)	6(33.3)			
Calf housing condition	Separate calf pen	24(60)	3(12.5)	1	2	0.15
	In the same barn	16(40)	5(31)			
Ventilation	Good	25(62.5)	3(12)	1	2.6	0.1
	Poor	15(37.5)	5(33.3)			
Owners education level	Primary and bellow	25(62.5)	4(16)	1	0.6	0.4
	secondary and above	15(37.5)	4(26.7)			
Farm as source of income	Primary	19(47.5)	2(10.5)	1	2	0.15
	secondary source	21(52.5)	6(28.6)			
Ownership of calf attendant	Owner	7(17.5)	1(14)	1	0.1	0.6
	Hired	33(82.5)	7(21)			
Sex of calf caretaker	Male	33(82.5)	6(18)	1	0.4	0.5
	Female	7(17.5)	2(26)			
Experience calf caretaker	< 5 years' experience	17(42.5)	6(35.3)	1	4.3	0.038
	>5 years' experience	23(57.5)	2(8.7)			

$X^2 = Chi-square; df = Degree of freedom; Significant at p < 0.05$

## DISCUSSION

In present investigation, the overall calf morbidity and mortality were 77.5% and 20%, respectively. This was higher than the 3 to 5% calf mortality that can be achieved through good calf management and above the economically tolerable level at least by the standard of the western production systems (Heinrichs and Radostits, 2001; Roy, 1990). This result is very close to the findings of Wudu *et al.* (2008), where the crude dairy calf morbidity was 62.0% and mortality 22.0%. and Asmare and Kiros, (2016) where overall morbidity was 66.7% and mortality 20%. The high mortality rate found in this study could be apparently associated with the high tropical temperatures and humidity that introduce specific climatic stresses that adversely affect calf and heifer feed intakes, growth rates and fertility.

In the present investigation, calf diarrhoea was found to be the predominant calf health problem with cumulative incidence of 50% followed by pneumonia (7.5%). diarrhoea was also the leading cause of mortality in the study herds. This finding is in agreement with the reports of Asmare and Kiros (2016), Wudu *et al.* (2008), Hussien (1998), Lemma *et al.* (2001), Wudu (2004) and Habtamu (2007) in Ethiopia, and many other studies elsewhere, which reported diarrhoea as the first most important health problems causing calf death (Olsson *et al.*, 1993; Debnath *et al.*, 1995 and Sivula *et al.*, 1996b; Gulliksen *et al.* (2009); Torstein *et al.*, 2011. On the other hand, this study is against the studies conducted by Agerholm *et al.* (1993), Shiferaw *et al.* (2002) and Gitau *et al.* (2010) which found pneumonia as the leading cause of calf mortality. Nevertheless calf diarrhoea as a leading health problem in growing dairy calves is a common finding, the high incidence in this study suggests the significance of poor hygiene of calf house observed during the study and very small percentage of farms were aware of the optimal time for colostrums feeding and this could greatly contributed to the high incidence of calf diarrhoea in those herds. This was supported by finding of Wudu *et al.* (2008), Amoki (2001), and Asmare and Kiros (2016), indicating a high percentage of failure of passive transfer of immunity in market oriented dairy farms. Low morbidity of calves was attributed to calf pneumonia (7%) in this study. this is very close to the finding of Wudu *et al.* (2008) and Yeshwas (2015), 4.9% and 8.6% incidence of calf pneumonia, respectively.

The low incidence of calf pneumonia in the present study may be because cases of pneumonia were not detected by herd attendants. Identification of early signs of calf pneumonia depends on good observational skills of the herd attendants. As Sivula *et al.* (1996a) have shown in their study, animal keeper diagnosis of pneumonia is only 56% sensitive.

The occurrence of other health problems of calves diagnosed less frequently were arthritis (2.5%), septicemic condition (5%), bovine papillomatosis (wart) (2.5%), navel ill (5%) and congenital death (5%). Except bovine papillomatosis (wart) this finding was slightly

consistent with various earlier reports from different parts of the world (Britney *et al.*, 1984; Olsson *et al.*, 1993; Virtala *et al.*, 1996; Shiferaw *et al.*, 2002, Wudu *et al.*, 2008; Yeshwas, 2015). Calves are easily infected by papillomavirus than adult animal. the virus may enters the cut or abraded skin easily. Thus 2.5% Wart case in present study might be tattoo or tagging pliers that were used before it has been disinfected, since infected animal may not have visible warts, but they may contaminate the equipment.

The five percent (5%) prevalence of congenital disorders was recorded in this study, which was congenital loss of sight. similar finding was reported by Wudu *et al.* (2008), and Yeshwas (2015) reported 5% and 1.1% prevalence of congenital problems, respectively. Some toxins and infection like bovine virus diarrhoea (BVD) virus can cause congenital cataract with consequences of blindness (Blowey, 1990). However, it is difficult to reason out these congenital problems.

### Determinants of Calf Morbidity and Mortality/Risk Factor Investigation

A total of 16 different potential risk factors were assessed to determine the magnitude of their association to occurrence of dairy calf morbidity and mortality in the followed up farms. Age was the important calf (host) factor found to affect morbidity and mortality of calf. In both cases (mortality and morbidity), younger calves under three months of age were at higher risk as compared to older calves (above three month of age). It has been shown that in the six months period, 62% (n = 5) of calves were died at neonatal age (0 day-1 months of age) followed by 25% (n = 2) 1-3 months and 12.5% (n = 1) at the age of above three months' this finding is supported by various authors. Olsson *et al.* (1993) reported that 65% and 75% of morbidity and mortality in three months of life occurred in the first month of age. Approximately 60-75% of the mortality in calves occurs in the first month of their life (Waltner-Toews *et al.*, 1986a; Heinrichs and Radostits, 2001; Svensson *et al.*, 2006; Wudu *et al.*, 2008; Gulliksen *et al.*, 2009a). The relatively higher risk of mortality in young calves observed in this study suggests the need of dairy producers give proper managerial attention to younger calves as compared to older ones.

It was also noted that more male calves were sick and died compared to female calves. This is probably because the female calves got more attention as they are future replacement of the herd and more male calves died probably because postnatal mortality for males and females had a very high genetic correlation, with direct heritability being highest for males (Hansen *et al.*, 2003). According to the findings of Swai *et al.* (2010), male animals in Tanga, Tanzania were three times more likely to die than females. Similar result was obtained by Bangar *et al.* (2013) in India.

Birth condition of calf was found significantly associated with calf morbidity and (non significant) high mortality

in this study. Assisted delivery (dystocia) of calves were at higher risk for mortality and morbidity than that of normally delivered calves. The present finding is found correspondent with (Asmare and Kiros, 2016; Quigley, 1997; Lombard *et al.*, 2007). They noted that calves that were born from cows with dystocia have a higher mortality. Thus, Newborn calves stressed due to dystocia are weak enough to adapt to life in the external environment. This stress to the calves probably reduced the immunoglobulin absorption efficiency and also delayed or decreased intake of colostrums. Hence, the longer calves are without adequate colostrums Ig, the more opportunity for the pathogens that provoke diarrhoea to invade the gut.

Vigour status at birth was also found significantly associated with calf morbidity and mortality. Poor vigour calves were at higher risk for morbidity and mortality than that of good vigour calves. This finding was found consistent with the report, vigour of the calf at birth is highly correlated to health and mortality (Heinrichs and Radostits, 2001; Vasseur *et al.*, 2009; Yeshwas, 2015; Besser *et al.*, 1990; Sivula *et al.*, 1996b; Vasseur *et al.*, 2009). Poor vigour at birth may result in delayed suckling or lower colostrums intake. This can be improved by focusing on management interventions, like providing timely birth assistances during difficult calving and better feeding and health management during pregnancy.

Based on the findings of analysis of risk factors, parity was the other variable found to be affect morbidity and mortality in calves born from Primiparous cows. This was probably because new infections are most common in older cows at early lactation and when the management is poor. In addition to this susceptibility of cows to mastitis high in multiparous cows compared to primiparous cows. This finding is in agreement with Sargent *et al.*, (2000); Asmare and Kiros (2016) and Radostits *et al.*, (2007), the risk of clinical mastitis increases with increasing parity. As Cows that are affected by either clinical or subclinical mastitis shed pathogenic micro-organisms through the milk, the calves that consumed that contaminated milk might be high probability of morbidity and mortality.

Chi-square analysis of morbidity and mortality in dairy calves with respect to navel treatment showed that navel untreated calves had significantly ( $p < 0.05$ ) high morbidity and non-significantly high mortality comparing to umbilicus disinfected calves. This finding is against the studies conducted by Asmare and Kiros (2016). who was found umbilicus disinfected calves were high risk of calf mortality. This was failed to show significant association between umbilicus disinfected calves and mortality. The increased morbidity and mortality of navel untreated calves might be attributable to the entrance of pathogenic microorganism from the contaminated calves environment through the umbilicus This is supported by Wudu *et al.*, (2008), that Navel infection is one of the disease conditions which has serious impact on the survival of calves. Early disinfection accelerated drying up of the umbilicus and reduces chance of infections. So that calf respiratory and enteric diseases and mortality are

decreased (Quigley, 1997).

In this study delay in first colostrums feeding (after six hours of age) had experienced increased mortality and morbidity. This observation was In agreement with other reports. Olsson *et al.* (1993).each hour of delay in colostrums ingestion in the first 12 hours of age increased the chance of a calf becoming ill by 10%. Wudu *et al.* (2008).On farms colostrums administration practice is the primary determinant of calf health. Asmare and Kiros (2016) the first milking colostrums have more immunoglobulin content than the second milking colostrums. The higher risk of morbidity and mortality related to delayed intake of first colostrums meal could be associated with failure of passive transfer (FPT) of cloistral immunity. The ability of the neonate to absorb immunoglobulin starts to decline progressively after 6 to 12 hours from birth (Radostits *et al.*, 2007). Cloistral Ig concentration also decreases by 3.7 %during each subsequent hour post-calving (Morin *et al.*, 2010). Therefore, to ensure adequate protection against disease, calves rely on the intake of an adequate amount of quality colostrums within a few hours of birth (Arthington *et al.*, 2000).

Morbidity in calves feed less than four litters of milk per day was significantly higher compared to calves feed four and above litters of milk per day. Although not significant, calf mortality was also higher in calves fed less than four litters of milk per day. This finding is in agreement with Rincker *et al.* (2006).who showed benefits of feeding calves larger amounts of milk than the traditional 10 to 12 % body weight per day. Milk is an excellent source of nutrition providing large amounts of crude protein, energy, vitamins and minerals for the calves especially at their early age of life, which are essential among others to maintain efficiency of their body defence mechanism (Asmare and kiros, 2016). Therefore, those calves that were fed less than four litters of milk per day probably suffered from hunger, as result the restricted diet and the stress caused by the hunger might have immunosuppressive effect making them vulnerable to diseases. But in this study, it has been observed that many calf attendant and owner were not aware of the importance of feeding greater than four litters of milk per day due to various unproved faith. They believed that the calf should not access to larger amounts of milk as it is the cause of diarrhoea.

cleanness of the calf house was found to be other risk factors associated significantly with morbidity of calves. The higher risk of morbidity associated with dirtiness of calf house seen in this study agrees with Shiferaw *et al.* (2002) who reported the effect of hygiene of the microenvironment of calves in the occurrence of calf mortality and morbidity in Holleta. Wudu *et al.*, (2008) also reported most of infectious agents are acquired by calves from the immediate unclean environment. Farmers frequently disposed of dung and waste materials in the vicinity of the animal housing which often resulted in unhygienic calf rearing conditions. It was also noted that

calve live with cow in the same barn had high risk of morbidity and mortality than separate calf pen. This was agreement with (Gulliksen et al, (2009b) that calves raised in cows barn had a higher incidence of diseases than those raised in tie stalls (individual pen).

From the study it was also found that less than five (5) years farm work experience of calf attendants was found to be significantly associated with calf mortality and non-significant with high calf morbidity. This was probably because taking care of sick calves required more work experience than caring for healthy calves.

## CONCLUSION

The calf morbidity and mortality found in this study were higher than economically tolerable and that can be achieved through good management and it have short-term and long-term detrimental effects on dairy production by suppressing growth rate of the calves and replacement capacity of the herd. Calf diarrhoea was the predominant calf health problem responsible for the majority of calf illnesses and deaths. It has also been found that, factors such as Age of calf, vigour status at birth, and age at first colostrums ingestion were the most important determinant factors of calf mortality and morbidity.

## RECOMMENDATIONS

To reduce calf morbidity and mortality in the study areas the following recommendations are forwarded

- Proper calf management procedures such as adequate intake of colostrum within the first six hours of life and good calf housing condition of farm should be ensured to improve calf health and performance.

- Creation of awareness among farm owner on the major causes of calf health problems and their respective preventive measures could be of great importance to maximize productivity and farm income.

- Additionally, further investigation is suggested to identify the specific causative agents responsible for calf morbidity and mortality in dairy farms of the study area.

## REFERENCES

- Agerholm, J. S., Bessa, A., Krogh, H. V., Christene, K., & Ronshoit, L. (1993). Abortion and calf mortality in Danish cattle herds. *Acta Veterinaria Scandinavica*, 34(4), 371–378.
- Amoki, O. T. (2001). *Management of dairy calves in Holleta area, central highlands of Ethiopia* (Master's thesis, Faculty of Veterinary Medicine, Addis Ababa University). Debre Zeit, Ethiopia.
- Amuamuta, A., Asseged, B., & Goshu, G. (2006). Mortality analysis of Fogera calves and their Friesian crosses in Andassa cattle breeding and improvement ranch, North western Ethiopia. *Revue de Médecine Vétérinaire*, 157(11), 525–529.
- Arthington, J. D., Quigley, J. D., & Cattell, M. B. (2000). Effect of dietary IgG source: Colostrum, serum, or milk-derived supplement on the efficiency of Ig absorption in newborn Holstein calves. *Journal of Dairy Science*, 83(7), 1463–1467.
- Asmare, A. A., & Kiros, A. W. (2016). Dairy calf morbidity and mortality and associated risk factors in Sodo town and its suburbs, Wolaita Zone, Ethiopia. *Slovak Journal of Animal Science*, 49(1), 44–56.
- Bangar, Y. K., Dohare, T. A., Kolekar, A., Wakchaure, D. V., & Singh, N. B. (2013). Analysis of morbidity and mortality rate in cattle in village areas of Pune division in Maharashtra State. *Veterinary World*, 6(8), 512–515.
- Bekele, M., Abduba, Y., Alemayehu, R., Fufa, A., Kassahun, A., & Kebede, A. (2009). Prevalence and incidence rates of calf morbidity and mortality and associated risk factors in smallholder dairy farms in Hawassa, Southern Ethiopia. *Ethiopian Veterinary Journal*, 13(1), 59–68.
- Belay, A. (2002). *Factors influencing loan repayment performance of rural women in Eastern Ethiopia: The case of Dire Dawa area* (Master's thesis, Alemaya University). Alemaya, Ethiopia.
- Besser, T. E., Szenio, O., & Gay, C. C. (1990). Decreased colostral immunoglobulin absorption in calves with postnatal respiratory acidosis. *Journal of the American Veterinary Medical Association*, 196(8), 1239–1243.
- Blowey, R. W. (1990). *Veterinary book for dairy farmers* (2nd ed.). IPS, Farming Press Ltd.
- Britney, J. B., Martin, S. W., Stone, J. B., & Curtis, R. A. (1984). Analysis of early calthood health status and subsequent dairy herd survivorship and productivity. *Preventive Veterinary Medicine*, 3(1), 45–52.
- Bruning-Fann, C., & Kaneene, J. B. (1992). Environmental and management risk factors associated with morbidity and mortality in prenatal and pre-weaning calves: A review from the epidemiological perspective. *Veterinary Bulletin*, 62, 399–403.
- Central Statistical Agency (CSA). (2017). *Agricultural sample survey: Report on livestock and livestock characteristics*. Addis Ababa, Ethiopia.
- Debnath, N. C., Taimur, M. J., & Gburr, E. C. (1995). A retrospective study of calf losses at the central dairy cattle breeding station in Bangladesh. *Preventive Veterinary Medicine*, 24(1), 43–53.
- Donovan, G. A., Dohoo, I. R., Montgomery, I. R., Bennett, D. M., & F. L. (1998). Calf and disease factors affecting growth in female Holstein calves in Florida, USA. *Preventive Veterinary Medicine*, 33(1), 1–10.
- Eneyew, N., Branng, E., & Rottoman, O. J. (2000). Reproductive performance and herd life of crossbred dairy cattle with different levels of European inheritance in Ethiopia. In *Proceedings of the 7th Conference of Ethiopian Society of Animal Production (ESAP)* (pp. 157–162). Ethiopian Society of Animal Production, Addis Ababa, Ethiopia.
- Gitau, G. K., Aleri, J. W., Mbutia, P. G., & Mulei, C. M. (2010). Causes of calf mortality in peri-urban areas of Nairobi, Kenya. *Tropical Animal Health and Production*, 42(8), 1643–1647.
- Goshu, G., & Singh, H. (2013). Lactation-specific and

- lifetime demographic parameters in a Holstein Friesian herd in the central highlands of Ethiopia. *Livestock Research for Rural Development*, 25(11), Article #200. Retrieved from <http://www.lrrd.org/lrrd25/11/gosh25200.htm>
- Gulliksen, S. M., Lie, K. I., Løken, T., & Østerås, O. (2009a). Calf mortality in Norwegian dairy herds. *Journal of Dairy Science*, 92(6), 2782–2795.
- Gulliksen, S. M., Jor, E., Lie, K. I., Hammes, I. S., & Løken, T. (2009b). Enteropathogens and risk factors for diarrhea in Norwegian dairy calves. *Journal of Dairy Science*, 92(10), 5057–5066.
- Habtamu, T. (2007). *Study on the causes of calf mortality at Aba Samuel dairy farm, North Gondar, Ethiopia* (Doctor of Veterinary Medicine thesis, Addis Ababa University, Faculty of Veterinary Medicine). Debre Zeit, Ethiopia.
- Hansen, M., Madsen, M., Jensen, P., Pedersen, J., Christensen, P., & L. G. (2003). Genetic parameters of postnatal mortality in Danish Holstein calves. *Journal of Dairy Science*, 86(6), 1807–1817.
- Heinrichs, A. J., & Radostits, O. M. (2001). Health and production management of dairy calves and replacement heifers. In O. M. Radostits (Ed.), *Food animal production medicine: Herd health* (pp. 333–395). W.B. Saunders Company.
- Hussien, N. (1998). *A study on calf mortality at Adamtulu Livestock Research Centre* (Proceedings of the 5th Conference of Ethiopian Society of Animal Science, pp. 157–162). Ethiopian Society of Animal Science, Addis Ababa, Ethiopia.
- ILCA. (1994). *Annual program report 1993/1994*. Addis Ababa, Ethiopia.
- Klein-Jöbstl, D., Iwersen, M., & Drillich, M. (2014). Farm characteristics and calf management practices on dairy farms with and without diarrhea: A case-control study to investigate risk factors for calf diarrhea. *Journal of Dairy Science*, 97(1), 1–10.
- Lemma, M., Kassa, T., & Tegegne, T. (2001). Clinically manifested major health problems of crossbred dairy herds in urban and peri-urban production systems in the central highlands of Ethiopia. *Tropical Animal Health and Production*, 33(2), 85–93.
- Lombard, J. E., Garry, F. B., Tomlinson, S. M., & Garber, L. P. (2007). Impacts of dystocia on health and survival of dairy calves. *Journal of Dairy Science*, 90(4), 1751–1760.
- Lorenz, M., Mee, I., Early, J. F., More, B., & S. J. (2011). Calf health from birth to weaning: I. General aspects of disease prevention. *Irish Veterinary Journal*, 64(1), 10.
- Moran, J. B. (2011). Factors affecting high mortality rates of dairy replacement calves and heifers in the tropics and strategies for their reduction. *Asian-Australasian Journal of Animal Sciences*, 24(9), 1318–1328.
- Morin, D. E., Nelson, D. E., Reid, S. V., Nagy, E. D., Dahl, D. W., Constable, G. E., & P. D. (2010). Effect of colostrum volume, interval between calving and first milking, and photoperiod on colostrum IgG concentrations in dairy cows. *Journal of the American Veterinary Medical Association*, 237(4), 420–428.
- Olsson, S. O., Viring, S., Emanuelsson, U., & Jacobsson, S. O. (1993). Calf diseases and mortality in Swedish dairy herds. *Acta Veterinaria Scandinavica*, 34(4), 263–269.
- Quigley, J. D. (1997). Replacement heifers, from birth to weaning. In *Proceedings of the Western Dairy Management Conference* (p. 96). Western Dairy Management Conference.
- Radostits, O. M., Leslie, K. E., & Fetrow, J. (1994). Health management of dairy calves and replacement heifers. In *Herd health* (2nd ed., pp. 183–214). W.B. Saunders Company.
- Radostits, O. M. (2001). *Herd health: Food animal production medicine* (3rd ed., pp. 333–390). W.B. Saunders Company.
- Radostits, O. M., Gay, C. C., Hinchcliff, K. W., & Constable, P. D. (2007). *Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs, and goats* (10th ed., pp. 127–160). Saunders, Edinburgh.
- Rincker, M. J., Davis, L., Vandehaar, M. J., Wolfe, C., Liesman, J., Chapin, L., & Nielsen, M. (2006). Effects of an intensified compared to a moderate feeding program during the pre-weaning phase on long-term growth, age at calving, and first lactation milk production. *Journal of Dairy Science*, 89(1), 438.
- Roy, J. H. B. (1990). *The calf: Management of health* (5th ed.). Butterworth, London.
- Sargent, G., Gillespie, J. M., Oberst, J. R., Phebus, R. D., Hyatt, R. K., Bohra, D. R., & Galland, J. C. (2000). Results of a longitudinal study of the prevalence of *Escherichia coli* O157 on cow-calf farms. *American Journal of Veterinary Research*, 61(11), 1375–1379.
- Shiferaw, Y., Yohannes, A., Yilma, Y., Gebrewold, A., & Gojjam, Y. (2002). Dairy husbandry and health management at Holleta. In *Proceedings of the 16th Conference of the Ethiopian Veterinary Association* (pp. 103–119). Ethiopian Veterinary Association, Addis Ababa, Ethiopia.
- Sivula, N. G., Ames, T. R., & Marsh, W. E. (1996a). Management practices and risk factors for morbidity and mortality in Minnesota dairy heifer calves. *Preventive Veterinary Medicine*, 27(2), 173–182.
- Sivula, N. J., Ames, T. R., Marsh, W. E., & Werdin, R. E. (1996b). Descriptive epidemiology of morbidity and mortality in Minnesota dairy heifer calves. *Preventive Veterinary Medicine*, 27(2), 155–171.
- Svensson, C., Linder, A., & Olsson, S. O. (2006). Mortality in Swedish dairy calves and replacement heifers. *Journal of Dairy Science*, 89(12), 4769–4777.
- Swai, E. S., Karimuribo, E. D., & Kambarage, D. M. R. (2010). Risk factors for smallholder dairy cattle mortality in Tanzania. *Journal of the South African Veterinary Association*, 81(4), 241–246.
- Tamado, T., Schutz, W., & Milberg, P. (2002). Germination

- ecology of the weed *Parthenium hysterophorus* in eastern Ethiopia. *Annals of Applied Biology*, 140(3), 263–270.
- Torsein, M., Lindberg, C., Hallén Sandgren, C., Persson Waller, K., Törnquist, M., & Svensson, C. (2011). Risk factors for calf mortality in large Swedish dairy herds. *Preventive Veterinary Medicine*, 99(2), 136–147.
- Thrusfield, M. (2007). Sample size determination. In *Veterinary Epidemiology* (3rd ed., pp. 185–189). Blackwell Science Limited.
- Vasseur, E., Rushen, J., & de Passillé, A. M. (2009). Does a calf's motivation to ingest colostrum depend on time since birth, calf vigor, or provision of heat? *Journal of Dairy Science*, 92(8), 3915–3921.
- Virtala, A. M., Mechor, G. D., Grohn, Y. T., & Erb, H. N. (1996). Morbidity from non-respiratory disease and mortality in dairy heifers during the first three months of life. *Journal of the American Veterinary Medical Association*, 208(12), 2043–2046.
- Waltner-Toews, D., Martin, S. W., Meek, A. H., & McMillan, I. (1986). Dairy calf management, morbidity, and mortality in Ontario Holstein herds. I. The data. *Preventive Veterinary Medicine*, 4(2), 103–124.
- Wudu, T. (2004). *Calf morbidity and mortality in dairy farms in Debre Zeit and its environs, Ethiopia* (Master's thesis, Faculty of Veterinary Medicine, Addis Ababa University). Addis Ababa, Ethiopia.
- Wudu, T., Kelay, B., Mekonnen, H. M., & Tesfu, K. (2008). Calf morbidity and mortality in smallholder dairy farms in Ada'a Liben district of Oromia, Ethiopia. *Tropical Animal Health and Production*, 40(6), 369–376.
- Yeshwas, F. (2015). *Epidemiological determinants and magnitude of calf morbidity and mortality in Bahir Dar milk shed, northwest Ethiopia* (Master's thesis, Faculty of Veterinary Medicine, Bishoftu University). Bishoftu, Ethiopia.
- Yeshwas, F., Hailu, M., Tewodros, B., Addisu, B., Mohammed, N., & Adebabay, K. (2014). Pre-weaning morbidity and mortality of crossbred calves in Bahir Dar Zuria and Gozamen districts of Amhara Region, Northwest Ethiopia. *Open Access Library Journal*. <https://doi.org/10.4236/oalib.1100600>