



Effect of Passive Transfer of Immunity on Morbidity and Mortality of Calves in Pastoral Production System in Gursum District, Somali Regional State, Ethiopia

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ABSTRACT

A longitudinal study was conducted from November 2018 to May 2019 in Gursum pastoral production system, to determine passive immunity status in newborn calves and to identify possible management factors that have contribution for the failure of passive transfer of immunity in cattle calves. The study further attempted to determine calf morbidity and mortality in relation with failure of passive transfer of immunity. From all calves belonging to the 150 households, each selected calf was individually ear-tagged and monitored on weekly basis for clinical health problems up to an age of three months. Mean total protein concentration of serum samples determined using spectrophotometer was 5.800 mg/dL and ranged from 2.76 to 8.34 mg/dL. The overall failure of passive transfer of immunity and adequate passive transfer of immunity status found in this study were 32.66% and 67.34%, respectively. Risk factors such as calf sex, dam parity, birth site, mothering instinct and age at first colostrum ingestion were found to have statistically significant effects ($P=0.004$ to 0.032). Similarly, morbidity and mortality prevalence were significantly associated with serum total protein. Accordingly, 59.6%, and 5.1% of morbidity in complete failure and adequate transfer of passive immunity was found, respectively. On the other hand, 22.4% and 1.9% of mortality in complete failure and adequate transfer of passive immunity were observed, respectively. The incidence of morbidity and mortality was apparently higher in calves having complete failure than calves having adequate passive transfer. In this study, the highest proportion of failure of passive transfer of immunity might be due to improper calf and colostrum management practice and absence of regular care for pregnant cows. Hence improving knowledge of pastoralists concerning calf and colostrum management practice as well caring for pregnant cows and regular observation of pregnant cows would significantly reduce young stock mortality associated with failure of passive transfer of immunity.

Keywords: Calves, Immunity, Pastoral System, Passive Transfer, Serum total protein.

1. Introduction

The agricultural sector is a corner stone of the economic and social life of the people in Ethiopia (Asresie et al., 2015). Livestock production, as one component of agriculture, covers 40 percent of agricultural output and it also plays an important role in the national economy (Yami and Sileshi, 2001). Ministry of Finance and Economic Development's (MOFED) estimates placed livestock's contribution at about 25% of total agricultural GDP (Behnke and Metaferia, 2013).

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Livestock in Ethiopia is characterized by high mortality. Annual direct losses from ruminant mortality are generally estimated at about 8–10% of the cattle herd, 14–16% of the sheep flock, and 11–13% of the goat flock (Fentie et al., 2016). The development of Ethiopian Livestock Masterplan (LMP) indicated the presence of very high young stock mortality in the country and planned to reduce the challenge, by implementing health intervention, vaccinations and parasite control programs through private and government veterinary service (Plan, 2015). Pre-weaning mortality of young stock appeared to be one of the major constraints of livestock production in all major production systems of Ethiopia, hampering the development of replacement stock. Regardless of species and production system, a high loss of young stock was reported during the first one month of life extending up to the third month of age (Fentie et al., 2016).

The greatest factor contributing to mortality of pre-weaned calves is the failure of passive transfer (FPT), associated with 39 to 50% of pre-weaned calf mortality (Margerson et al., 2005). This high morbidity and mortality occur in calves because calves are born with no immunity against disease, so must depend on their dam to provide passive immunity through colostrum (Alberghina et al., 2010). This has to do with one significant aspect of placentation and fetal

growth in bovine. The syndesmo chorial placenta of bovine forms a syncytium between the maternal endometrium and the fetal trophoctoderm separating the maternal and fetal blood supplies and preventing the transfer of immunoglobulin in to the fetus (Salazar, 2008). Consequently, calves are born agammaglobulinemic, rendering ingestion and absorption of adequate amount of colostrum immunoglobulins essential for establishing passive immunity (Weaver et al., 2000).

Bovine colostrum is concentrated with essential proteins called immunoglobulins (Ig) (Arthington, 2001). The primary immunoglobulin in bovine colostrum is IgG1, which is derived from maternal serum IgG (Sasaki et al., 1977). This bovine IgG provides the major component of passive immunity to the new-born calf (Lascelles, 1963). Passive immunity is that which is received passively from an outside source; conversely, active immunity is derived from the calves' own body (Arthington, 2001). Inadequate ingestion or absorption of colostrum Igs leads to a secondary immunodeficiency condition termed Failure of Passive Transfer (FPT) that predisposes ruminant neonates to the development of bacterial septicemia and common neonatal diseases (Weaver et al., 2000; Barrington and Parish, 2002).

It has been estimated that as many as 35% to 40% of dairy calves in developed countries suffer from FPT, which indicates that many calves have inadequate immunity and are more likely to get sick (Lang, 2008). To ensure adequate passive transfer of immunity, a calf must ingest 2.5 liters of colostrum in the first 6 hours of life and four liters within the first 12 hours (Margerison et al., 2005). Active uptake of large molecules, such as IgG, ceases after 24–36 hours in neonatal calves (Staley and Bush, 1985), and for this reason, timely provision of an adequate mass of absorbable Ig from maternal colostrum (MC), particularly IgG, is essential to minimize the risk of failure of passive transfer of immunity in new-born, which is vital for the defense against morbidity and mortality of calves due to infectious diseases (Godden et al., 2008). Non-infectious factors, such as insufficient uptake of colostrum, poor sanitation, stress and cold weather could cause calves morbidity. Due to its poor immune capability, a newborn calf is vulnerable to infectious diseases (Doepel and Bartier, 2014). The main risk factors increasing the exposure to infection and further lowering the defense mechanism within the calf in early life are: poor hygiene and overcrowding in the calving facility, high relative humidity, low temperature of the incoming air, contamination of the incoming air, inadequate ventilation, close proximity to adult cows, mixing of different age groups and poor stockmanship. Therefore, the objectives of the present study were to:

- Determine the level of failure of passive transfer of immunity in calves.
- Determine the morbidity and mortality rates in calves due to FPT
- Identify potential animal and management related risk factors associated with FPT

2. Materials and Methods

2.1. Study Area

The study was conducted in Gursum district of Somali regional state Ethiopia. The district is one of the districts in the Somali Region of Ethiopia, Part of the Fafam Zone; Gursum is bordered on the south by Goljano, on the west by the Babile and Oromia Region, on the north by Tuliguled, on the east by Shabelay district. This district is about 600 km from Addis Ababa with a coordinate of 9° 19' 60.00" N Latitude and 42° 34' 59.99" East longitude. The district has an elevation of 1,609 meters above sea level and characterized by a semi-arid climate with an average daily temperature of 20°C to 35°C. The District has 27 kebeles of which 2 are urban, while the rests are pastoral and agro-pastoral, which hold large numbers of livestock population. The livestock populations of the Gursum District are composed of cattle, 307,102, goats, 87,562 sheep, 37,065, camels 92,061 and 2,200 of donkeys' (Gursum district livestock bureau, 2017).

2.2. Study Design

A longitudinal study was conducted from November 2018 to May 2019 in Gursum pastoral production system to determine the level of failure of passive transfer of immunity in calves. As a study area, Gursum district was purposively selected due to large animal population and for easy access. Among the 27 kebeles of the district, three kebeles namely Dhagahle, Bombas and Elbahay were selected using simple random sampling method. One hundred fifty (150) households (50 households from each of selected kebele) were selected purposely based on the availability of newborn calves between one to seven days of age.

2.3. Study Population and Sample Size

The study population was all the calves belonging to the pre-selected 150 households with in the age 1 day to less than 12 months. During the study period (November to May), all newly born calves and having 24 hours of age in the study area were included in the study population. Blood samples were collected from one hundred fifty (150) calves belonging to the aforementioned pre-selected 150 households in the study area, purposely based on the age of the calves (24 hours to 7 days) to determine the amount of passive maternal immunity that had been obtained from colostrum; While the older (above 7 days to 12 month) were studied for morbidity and mortality in relation to calf history.

2.4. Method of Sample Collection

Blood samples were collected through jugular venipuncture into a labeled sterile plain vacutainer tube (without anticoagulant). For collecting whole blood, firstly calf was restrained by hand, and then by pressing thumb or finger in the groove at the base of the neck flow of blood in the vein was stopped to create pressure before blood collection was performed. After collection of the whole blood, the blood was allowed to clot overnight at room temperature and then serum was harvested carefully. Serum was transferred into a sterile cryo-vial tube and then the serum was labeled.

Serum samples were maintained in ice box while handling and transported to Jigjiga university veterinary microbiology laboratory and stored at -20°C , until the sample collection process was completed from the study area, and when sample collection was completed, the samples were packed into an ice box and transported to Biochemistry laboratory at faculty of Veterinary Medicine, Addis Ababa University and stored at -20°C until laboratory analysis was performed.

After completing blood sample collection from each individual calf, both the cow and the calf's retrospective data like (Calve ID, date of birth, sex of calve, birth time, birth site, dam parity, age at first colostrum ingestion, presence or absence of attendant, mothering instinct and vaccination history) was collected on predesigned registry format.

2.5. Laboratory Procedure

Failure of transfer of passive immunity test was conducted using spectrophotometer total protein concentration test. The threshold of serum Total protein concentrations; classified as having FPT if serum Total protein was < 5.5 mg/dL and adequate passive transfer of immunity if the serum Total protein concentration was > 5.5 mg/dL (Holloway et al., 2002).

2.6. Questionnaire Survey

A predesigned structured questionnaire survey was conducted on the 150 households (HH) that were previously selected. key informants were personally interviewed on various aspects of animal husbandry, newborn and young calf management including neonatal cares provided, feeding conditions, health management and other parameters related to calf health. Responses were recorded and later on reviewed for its relation with calf's immunity status as well as morbidity and mortality.

2.7. Follow-Up Study

All selected household's calves were closely monitored on a regular basis. Management, health, nutrition, and various aspects of the husbandry were recorded on a predesigned data registry format. Blood sample were collected in cases of morbid calves as well as serum samples that were required to determine the level of immunity in each calf.

Blood samples were collected from the calves aged 24 hours to seven days. Serum was harvested and stored at -20 degrees until analysis. Failure of passive transfer of immunity (FPT) were designated from the serum total protein (STP). Results of the STP were evaluated against the incidence of morbidity and mortality in calves and level of colostrum supplementation.

2.8. Data Analysis

All data were entered into Microsoft Excel data sheet and later analyzed using a STATA Version 11. First the data were summarized using descriptive statistics (means and percentages). Five risk factors (Calf sex, parity number, birth site, age at first colostrum ingestion and mothering instinct) were considered for their association with Serum total Protein concentration in blood serum, morbidity and

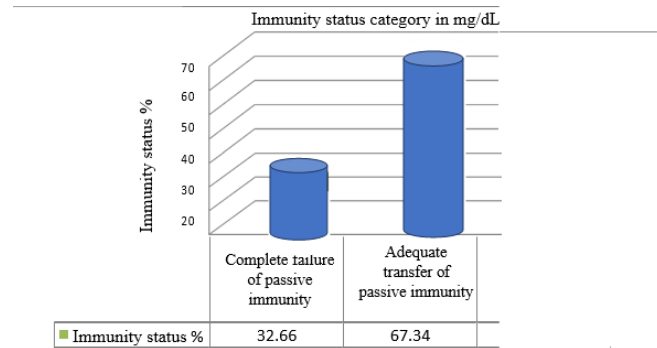


Figure 1: Level of calf immunity status in the study area

mortality of calves. Chi-square (X^2) tests were used to analyze the presence of associations between variables. P-values were held at $p < 0.05$ to determine the presence of significant differences.

3. Results

A total of 150 samples, (87 males and 63 females) were collected from the study area. Age at sampling ranged from one to seven days. The mean total protein concentration of the serum samples, determined with spectrophotometer, was 5.800 mg/dL. Serum Total protein concentration from those 150 calves ranged from 2.76 to 8.34 mg/dL. Descriptive statistics of passive immunity transfer and serum total protein concentration in calves under different category are presented in (Figure 1).

Based on serum Total protein concentration threshold, 32.66% calves were considered to have FPT and the rest 67.34% were considered to have adequate passive immunity.

3.1. Association Between Factors and FPT

Sexes of calve, cow parity, birth time, birth site, age at first colostrum ingestion and mothering instincts were considered as risk factors to FPT. And all of these factors were found to be significantly associated with the failure of passive transfer of immunity. Male calves had lower average serum total protein concentrations than female calves. In the same way, low agammaglobulinemia were observed on those calves born from heifers, birth site (when calves born out in the field), age at first colostrum ingestion, birth condition (when experienced dystocia) dam mothering instinct, were also found to be- significantly associated with FPT; whereas birth time was not significantly associated with serum total protein concentration.

3.2. Calve Morbidity and Mortality

Morbidity and mortality rates of calves were significantly associated with serum Total protein concentration ($X^2 = 30.7698$; ($P = 0.000$), rate $X^2 = 17.5835$, ($P = 0.000$); respectively). Other risk factors such as sex of the calve, cow parity, birth site, mothering instinct, and time at first colostrum ingestion were found to highly influence morbidity and mortality condition in calves ($P < 0.032$ to

Table 1: Association between variables and FPT condition in calves

Variables	Variable	No	Immunity level		X ²	P-Value
			FPTI %	APTII%		
Sex	Male	87	59.42	30.21	8.0530	0.032
	Female	63	40.58	69.79		
Cow parity	One parity	17	48.03	7.1	25.4719	0.013
	More than one	133	51.97	92.9		
Birth time	Daytime	93	95.8	68.40	4.5341	0.128
	Night time	57	4.2	31.6		
Birth site	At home	97	50.9	90.01	13.2951	0.004
	Out in the field	53	49.1	9.99		
Age at first colostrum ingestion	<6 hours	103	64.54	91.2	31.0231	0.004
	>= 6 hours	47	35.46	8.8		
Mothering instinct	Good	132	73.2	89.99	11.4521	0.008
	Poor	18	26.80	10.01		

Table 2: Association between immunity status, morbidity and mortality in calves

Variables	Variable	No	Immunity Status		X ²	P value
			FPTI%	APTII%		
Morbidity	Diseased	27	55.1	5.54	30.7698	0.000
	Not diseased	123	44.8	94.46		
Mortality	Died	11	22.4	1.99	17.5835	0.000
	Not died	139	77.5	98.1		

Table 3: Mean and Standard Deviation value of serum total protein for calves under morbidity and mortality condition

Variables	Variable Category	No	Serum Total Protein	
			Mean	SD
Morbidity	Diseased	27	3.5955	0.90211
	Not diseased	123	2.2058	1.38103
Mortality	Died	11	3.0663	0.63819
	Not died	139	5.7681	1.41596

0.004). The ability of calves surviving under morbidity and mortality highly depend upon their serum total Protein concentration (Table: 2). Calves with small serum total Protein concentration were more vulnerable to disease and death.

Calves with FPTI are more likely to get disease and die before weaning. Morbidity and mortality risk for calves with adequate transfer of passive immunity are extremely small when compared to calves with FPT (Table. 3).

3.3. Association Between Passive Immunity and Calve Morbidity and Mortality

The mortality and morbidity of calves were directly related with FPT. Among those calves having Total serum protein <5.5mg/dL are highly morbid 27 to 5 and subject to death 10 to 1; compared to those having total protein >5.5mg/dL.

3.4. Questioner Survey Result

According to the response from questioner interview, unlike most other cows no special care and attention are given to the pregnant cows near to giving parturition. As well, the exact month and week of pregnant cows going to give birth is not known. Sometimes, pregnant cows are engaged in grazing and given birth out in the field or at

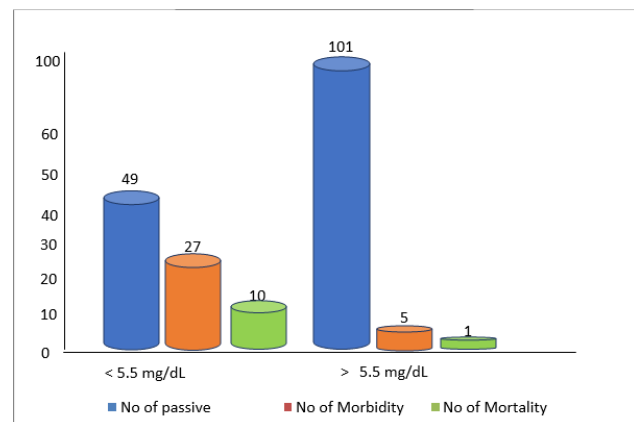


Figure 2: Association between passive immunity status and calve morbidity and mortality

grazing area. According to the pastoralist community, if calve was born out in the field and able to suckle little amount of colostrum at there, it is considered as a sufficient, and then calves come back to home by following the dam. Feeding of calve high amount of colostrum before six hours of age is not known by knowledge level.

4. Discussion

According to this finding, morbidity and mortality risk in calves decreased substantially as serum total protein concentrations increased. The highest mortality was observed among calves whose serum total protein concentration was less than 5.5 mg/dL. And calves having an adequate transfer > 5.5 mg/dL serum total protein are well protected from mortality than others.

Mean serum total protein concentration in the present report was 5.800 mg/dL and ranged from 2.76 to 8.34 mg/dL. The serum total protein concentration result showed 32.66% of newborn calves in the study area had less immunoglobulin and the remaining 67.34% had adequate passive immunity. The result was closer to the findings of Amoki (2001), who found 32% of total failure of FPT, Ibrahim and Lemma (2009), reported 30.2% of total FPT on market-oriented dairy farms. On the other hand, the result of the current study is quite low compared to the one done by Batiley (2018), who

found 35.11% on calves under pastoral production system. However, big difference was observed between the current study and the report of Yeshwas (2015), who reported (65.2%) of failure. The highest prevalence of passive failure in Yeshwas' study could be due to the small sample size. The report of Razzaque et al. (2009) also found, 50% of low level of IgG in calves' serum, which is different from the current study report. In fact, it is not hard to find out why this difference is coming; calve and colostrum management condition under different production system is not the same.

In the study, birth site, age at first colostrum ingestion, mothering instincts, birth condition and dam parity were key factors that were associated with the FPT of immunity.

The spectrophotometer serum total protein method classifies the degree of protection level in to two main categories (complete failure and adequate transfer of passive immunity), in complete failure of passive transfer the likelihood of infection is certainly higher either in neonatal or older life; complete failure of passive transfer of colostrum immunoglobulins is a primary cause of morbidity and mortality in neonatal calves McGuirk and Collins (2004). The current study result showed 32.66% calves had FPT (serum total protein concentration < 5.5 mg/dL) and 67.34% had adequate passive immunity transfer (serum total protein concentration was > 5.5 mg/dL); meaning the current study result classifies the FPT into complete failure and adequate transfer. However, Batiley (2018); Amoki (2001) and

Ferede (2015), stated their study result by grouping FPT condition into three categories (complete failure, partial failure and adequate transfer). Different management practice, including dam and calf factors are closely associated with development of low agammaglobulinemia. Among these, several factors such as sex (male), heifer as primiparous, birth at out in the field, the presence of birth difficulties, poor mothering instinct (heifers) and late colostrum consumption (after 6 hours) are the main factors for the occurrence of FPT in calves. Higher serum total protein concentration was observed in female calves than male calves. The result agrees with a previous study by Batiley (2018), Ibrahim et al. (2009), and Angulo et al. (2015), who indicated that cows with female calve produced higher amounts of colostrum and milk during lactation than cows with male calve. Due to possibility of management practice, which is the pastoral production system, male calves have less future replacement value, and they are also given less attention and care at the very beginning compared to female calves. Most of the smallholder community use one or two superior male bulls only for breeding purpose while other male calves in the herd are culled out from the herd by mostly selling or slaughtering.

In this study calves from primiparous cow have lower serum total protein (IgG) concentration than calves from multiparous. The influence of parity on total protein concentration in the present study agrees with the study of Batiley (2018), Godden et al. (2009) and Ibrahim et al. (2009). Similarly, Angulo et al. (2015), found that cows with one to two parity produced lower amounts of colostrum

than cows with more parity, this is due to the fact that primiparous animals have not had the time to accumulate and build up resistance to the various herd-specific pathogens. Older cows build up a larger number of antibodies because of a greater exposure time to pathogens. This exposure provides to calve attain higher amounts of antibodies from the maternal colostrum during ingestion. Immunoglobulin concentrations in primiparous cows significantly differed from older cows, with multiparous; cows secreting 1.3-1.6 times higher antibody concentration Liu et al. (2009).

High statistical association was observed between mothering instincts and failure of passive transfer of immunity. The study agrees with Batiley (2018) and Selk (2007), who reported on disease protection for newborn calves. He concludes that mothering instinct problem is observed more in heifers; cows have better maternal instincts than heifers. Mothered calves absorb 70 percent or more immunoglobulin than non-mothered calves. Poor mothering ability combined with reduced calve vigor could decrease the effectiveness of passive transfer in calves Sivula et al. (1996). It is possible to give some explanations for this study, calves that suckle colostrum from cow with poor mothering instinct are likely to ingest less colostrum than the recommended amount during the first feeding. Furthermore, the ability of calves to absorb IgG decreases with time, and some calves do not suckle quickly enough because of dam's poor mothering instinct. Based on the results of the study, it is advisable to milk the dam early after birth and feeding the colostrum to the newborn calve using another alternative like bottle feeding.

Statistically significant associations were observed between FPT and age at first colostrum ingestion. Higher serum total protein concentration is observed in calves feeding colostrum before six hours than calves with delayed colostrum ingestion. The current report agrees with previous reports of Batiley (2018), Ibrahim et al. (2009) and Bartier (2013), The timing of colostrum feeding is very crucial. In this study, higher association was observed between birth site and FPT condition in calves. Calves born outside in the field are more prone to develop lower immunoglobulin than calves born at home. When explaining this, calves born out in the field unable to suckle by themselves, due to lack of opportunity to get assistance. If, the cow has at the risk of birthing difficulty, may not have opportunity to get help. This situation will reduce the calves' vigor. This suggests that routine monitoring of pregnant cows will reduce the chance of giving birth out in the field or in grazing area. So that the cow can get assistance right away, if the cow has difficulties in giving birth. Also, the newborn calves won't develop FPT arising from low colostrum ingestion.

Highly significant association was observed between morbidity rate and presence of failure of passive transfer in calves. The report of the present study agrees with previous reports by Batiley (2018); Amoki (2001); Ibrahim et al. (2009). Particularly, calves with inadequate colostrum intake, leading to low immunoglobulin concentration within the first week of life exhibit a greater risk of neonatal

morbidity and mortality. Wittum and Perino (1995). Ibrahim et al. (2009), explain that presence of failure transfer of passive immunity in calves was directly associated with early calve morbidity. In this study, calves with complete failure exhibited 55.1% morbidity condition; and have possibility to be exposed to disease. In this study, the greatest relative risk of morbidity is observed in calves whose serum total protein concentration is lower than 5.5 mg/dL. This means that calves having adequate passive immunity are well protected from morbidity as supported by previous studies in Ethiopia Batiley (2018); Amoki (2001); Ibrahim et al. (2009); Ferede (2015). In this study, high significance association was observed between FPT and mortality. This report agrees with Batiley (2018) and Ibrahim et al. (2009). According to Ferede (2015), calves with history of less colostrum feeding were at higher risk of mortality than those calves with complete colostrum feeding. The present study showed 22.4% and 1.99% mortality were due to complete failure and adequate transfer of passive immunity respectively. Mortality rate in calves decreased substantially as serum total protein concentrations increased. A young stock mortality survey by Fentie et al. (2016), indicate that 26–29.2% mean annual young stock mortality was observed in the pastoral production system.

According to answer from key informants' interview, there is no special care and attention given to pregnant cows that are near to give birth. Likewise, the exact month and week of birth for pregnant cows are not known. Kerr (2013) described those pregnant animals needs a better management that are different from those of other livestock. Without good record keeping system or management calendar, livestock producers can easily overlook crucial management task and disaster can happen. Sometimes, pregnant cows engaged in grazing and given birth out in the field or at grazing area. For calves born in such situation it cannot be sure that calve have ingested adequate amount of maternal colostrum. When calves are born out in the field, they are less likely to develop adequate immunity. The pastoralists believed that if calve are born out in the field and are able to suckle little amount of colostrum, it is considered as sufficient. But M (2017), indicated that calves which do not ingest and absorb adequate IgG antibodies have lower weight gain, increased risk for disease and death, and decreased milk production during their first lactation. In addition, within a few hours after birth the newborn calves go back to home by following their dam. When newborn calves obligated to travel a long distance following their dam, they might be exposed to high physiological stress.

This stress condition may be able to cause other health problems lasts until death. Hulbert and Moisé (2016) mentioned that, psychological stress is known to suppress immune function and increase susceptibility to infections and if stress condition is severe, it may impede immunocompetence. The community is not well familiar in the feeding of calves with ample amount of colostrum before six hours of age. If once the cows deliver in the morning and removed fetal membrane, then the cow will be engaged in grazing

with other cows, therefore, calves do not have the chance to ingest colostrum until the dam returns from grazing. This would mean, the calve will no longer have enough milk before six hours and thus results in agammaglobulinemia in calves. Merricks (2005) stated that calves should consume a minimum of 2 liters of colostrum within the first hour after birth, preferably within the first 30 minutes. Similarly, Chigerwe et al. (2009) recommend that calves have to ingest 3 liters of colostrum in first feeding before six hours and again will need to ingest 1 liter of colostrum within 12 hours to have an optimum colostrum intake. Feeding high-quality colostrum to calves as soon as possible after birth will provide them not only with immunoglobulins to help fight disease but also with other nutritive values such as energy and high levels of vitamins and minerals and non-nutritive growth factors. On the other hand, key informants stated that male and female calves are not treated equally, because male calves are not used as future stock replacement unlike females, so female calves get more care than male.

5. Conclusion and Recommendations

The present study conducted in pastoral production system has revealed presence of high failure of passive transfer of immunity than most previous reports. This will, in the long run, influence the survival of newborn calves and contribute significant role to an increase in young stock mortality. Among factors that were studied for their effect on the failure transfer of passive transfer, calf sex, dam parity, birth site, birth condition, mothering instinct and age at first colostrum ingestion were found statistically significant associated with failure of passive transfer of immunity, morbidity and mortality. The incidence of morbidity and mortality was apparently higher in calves having lower serum total protein concentration. The highest percentage of failure of passive transfer of immunity in the study area could be associated with; improper colostrum feeding practice, improper handling of newborn calves and absence of regular care for pregnant cows. However, the existing management difficulty in the pastoral production system can be controlled and improved with a coalition of governmental and pastoralist communities almost at minimum cost (through pastoral community basic management training on calves' health). Based on the above conclusion the following recommendations are forwarded:

- Capacity building of pastoralists concerning colostrum, immunity and management practices, will help to ensure the newborn calve to ingested sufficient amount of colostrum just after birth for achieving adequate passive transfer of immunity.
- Caring for pregnant cows, newborn calves and adoption of regular observation will have great significance in reducing the FPT prevalence and incidence of morbidity and mortality of calves.
- Further studies of more emphasis on passive immune transfer in neonates are highly required.

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Conflict of Interest

The Authors declare that there is no conflict of interest

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