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Pre-weaning kid mortality in Adamitulu Jedokombolcha District, Mid Rift Valley, Ethiopia

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A longitudinal study was conducted, from October 2008 to April 2009, on 188 kids born from flocks of 50 randomly selected households in Aneno and Edokontola villages in Adamitulu Jedokombolcha district, mid rift valley, Ethiopia. The aim of the study was to estimate pre-weaning mortality, identify associated factors and establish possible causes of death in goat kids. Data collected were used to evaluate the effect of sex, birth weight, parity, type of birth and some management practices on pre-weaning mortality. All the factors, except sex of the kid, significantly (at least *P*<0.05) influenced the mortality of kids. Generally mortality increased (*P*<0.05) with parity. There were more deaths in kids born in triplets than in twins and single litters. Management practices such as keeping new born kids with their doe near homestead, and separation of sick animals had significantly reduced (*P*<0.001) pre-weaning kid mortality. Mismothering was the most frequently suspected cause of mortality followed by pneumonia, enzootic ataxia, diarrhea, goat pox and predators. The study revealed the existence of very high kid mortality in the study area. Supplementation of multiple-bearing pregnant does and nursing does with multiple litters may be considered to reduce pre-weaning kid lose.

Key words: Adamitulu, Ethiopia, goat, kid, mortality, pre-weaning

INTRODUCTION

Goat production is affected both by genetic and environmental factors. One of the most important production factors that adversely affect goat production is high pre-weaning mortality of young kids (Devendra and Burns, 1970). Kid mortality, in addition to the immediate economic loss, has a direct effect on genetic progress by its effect on selection pressure. A high mortality may also represent a compromised animal welfare which poses ethical concern in animal production (Martin et al., 2004). Several factors had been reported in the literature to affect mortality rate in goat kids such as type of birth, sex of kid, birth weight of kid, parity order, season of kidding and age of the kid (Awemu et al., 1999; Mtenga et al., 1993; Turkson, 2003; Turkson et al., 2004; Hailu et al., 2006). Generally, higher kid mortality occurs at birth and from birth to weaning while mortality is relatively low from weaning to breeding age in many production systems (Mtenga et al., 1993; Donkin and Boyazoglu, 2004).

The death of kids before weaning is perhaps the single biggest cause of economic loss to goat farmers and may be reduced by improvements in the management and feeding of the kidding flock (Payne and Wilson, 1999; Snyman, 2010). Such efforts to improve survival of kids would increase productivity and economic return to the farm (Devendra and Burns, 1970). Very little work on mortality, morbidity and their causes in goat kids has been published from Ethiopia (Hailu et al., 2006; Debele et al., 2011). In general, there is shortage of information on diseases, mortality and morbidity rates and constraints in goat production in Ethiopia. Therefore the objective of this study was to estimate pre-weaning kid mortality, identify factors which influence mortality and to find out

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probable causes of mortality in traditionally managed goat flocks in the study area.

MATERIALS AND METHODS

Study area

The study was conducted between October 2008 and April 2009 in Anenno and Edokontola villages in Adiamitulu Jedokombolcha district, which is located in the mid rift valley of Ethiopia, approximately 170km south of Addis Ababa. The area is situated at an altitude of 1650 m above sea level at 7°9'N latitude and 38°7'E longitude and receives an average rainfall of 766 mm. Mean maximum and minimum temperatures of the area are 29.2 and 12.7°C respectively. The area is mainly dominated by Pennisetum, Cenchrius grass species and acacia trees (Hailu et al., 2006). The study period mainly falls in the dry season.

Study Animals

The study was conducted on 188 Arsi-Bale kids born during the study period in randomly selected 50 households. The kids were individually identified with ear tags and followed until the age of 90 days (3 months) or until the end of the study period. Goat flocks in the area were traditionally managed. The flocks browse oncommunal grazing area dominated by open grassland and there is virtually no habit of supplementation of any group of goats including nursing and pregnant does. The goats reproduce year round without control breeding (Kebede et al., 2012).

Study design

The study involved a longitudinal monitoring of kids born from flocks of 50 randomly selected households in Anneno and Edokontola villages in Adamitulu Jedokombolcha district. A structured questioner was used to collect information regarding animal management practices of the households (care for neonatal kids, disease prevention measures and feed supplementation) and doe history. Kids born during the study period were weighed within 12hr, using suspended scale with sensitivity of 100 g, and ear tagged. They were monitored by regular weekly visit for the rest of the study period. Date of birth, birth weight, sex, type of birth, death of kids, disease signs and possible causes of mortality were recorded by resident enumerators and by research team members though weekly visits. Probable cause of death was established based on signs of disease observed by the owners and research team members.

Data Analysis

Recorded data were entered in excel spread sheet as database and used to analyze different attributable factors. The response variables considered were kid birth weight and mortality of kids to a specific age (birth to 30, birth to 60 and birth to 90 days). The factors considered for birth weight were birth type, parity and sex, while the risk factors considered for mortality were sex of the kid, birth weight, parity of the doe, type of birth and management practices. Descriptive statistics was employed to summarize the data. Student t-test (two samples) and ANOVA were used to determine the effect of the independent variables on birth weight, while chi-square and fishers exact test were used to see the effect of the risk factors on mortality of kids. STATA version 7 (Stata corporation, 2001) and SPSS version 13(SPSS, 2004) were used to analyze the data.

Table 1. Birth weight of kids by sex, parity and type of birth.

Factors	Number of Obs.	Mean	SD
Overall mean	188	2.04	1.03
Sex		NS	
Male	101	2.13	1.07
Female	87	1.95	0.97
Dam Parity		***	
1	23	3.24^{a}	0.77
2	24	2.75^{b}	0.98
3	30	2.15^{c}	0.99
4	35	2.00^{c}	0.85
5	34	1.46^{d}	0.77
6	42	1.42^{d}	0.64
Type of birth		***	
Single	33	3.03^{a}	0.92
Twins	78	2.30^{b}	0.96
Triplets	77	1.37^{c}	0.60

NS, P>0.05, *** $P < 0.001$. ^{a,b,c,d} means within a column and within the same factor followed by different alphabets differ significantly $P< 0.05$.

RESULTS

Birth weight

The overall mean birth weight of kids was 2.04(±1.03 sd) Kg. There was no significant difference in birth weight between male and female kids (P>0.05). Birth weight was significantly (P<0.001) affected by parity of the dam and the type of birth. Generally birth weight decreased with increased parity and kids born single were heavier than kids from twins and triplets. The birth weight of triplets and those from 5^{th} and 6^{th} parities was less than 2 kg (Table 1).

Type of birth

Table 2 summarizes the number of kids obtained from single, twin and triplet births. As parity increased the number of kids obtained from multiple births generally increased. The highest proportion of single born kids were recorded from primiparous does, while the highest proportion of kids obtained from twins and triplet births were observed from does at parity 4 and 6 respectively.

Mortality of kids

One hundred and seventy eight kids were followed for up to 30 days of their age and 54 (30.3%) died before they were 30 days old, 162 kids were followed up to 60 days and 62 (38.3%) died before they were 60 days old and 65 out of 139 (46.8%) died before they were 90 days old.

Age of the kid in months had significant effect (P <0.05) on mortality of kids (Table 3). Out of 65 kid deaths

Table 2. Type of birth by parity.

Type of birth	Parity of does												
	1		2		3		4		5		6		
	N	%	N	%	N	%	N	%	N	%	N	%	
Single	14	60.9	8	33.3	6	20	2	5.7	2	5.9	1	2.4	33
Twin	9	39.1	11	45.8	14	46.7	19	54.3	12	35.3	13	31	78
Triplets	0	0	5	20.8	10	33.4	14	40	20	58.8	28	66.7	77
Total	23		24		30		35		34		42		188

Table 3. Number and proportion of kids died in their first, second and third months of life.

Age of kid in months	Number of Obs.	Number of deaths	% of total death
First month	178	54	83.1
Second month	162	8	12.3
Third month	139	3	4.6
Total		65	100

Table 4. Number and proportion of kids died in the first 4 weeks of their life.

Age in week	Number of deaths	% of total death
First week	19	35.2
Second week	13	24.1
Third week	10	18.5
Fourth week	12	22.2
Total	54	100

recorded during the study 54 (83.1%) occurred within the first month of their age. However, there was no significant difference (P>0.05) regarding number of deaths among the first 4 weeks of kid's life (Table 4).

Birth weight of kids affected (at least *P*<0.01) pre-weaning mortality to all specific ages considered in the analysis. A highest mortality (59.1%) was recorded for kids less than or equal to 2 kg while the lowest mortality (14.3%) was recorded for kids more than 3 kg at birth. There was no significant difference between kids born with less than or equal to 1kg and those born between 1.1 and 2 kg.

In this study parity of the dam significantly (P<0.05) affected pre-90 days and pre-60 days kid mortality. Generally mortality increased with parity. The influence of litter size on mortality of kids was significant source of variation (P<0.05). There were more deaths for kids which were born in triplets than in twins and single litters. Interestingly there was no statistically significant difference in the mortality of kids born as singles and twins (Table 5).

Management practices by the farmers, keeping the newborn kid and the doe near homestead for the first week postpartum and the habit of separation of sick animals from healthy ones had significantly affected pre-weaning kid mortality (*P*<0.05).

Keeping kids and does separated from the rest of the flock for at least 1 week significantly (*P*<0.05) decreased birth to 60 and 90 days mortality. However, birth to 30 days mortality was not influenced by this management practice (*P*<0.05). Kids born in households who have the habit of separating sick animal from the healthy ones had lower mortality (at least *P*<0.05) compared to kids from households without this practice.

Causes of kid mortality

Table 6 summarizes major causes of kid mortality identified during the study and their contribution to the total number of death. Mismothering was the most frequently suspected cause of mortality (26%); followed by pneumonia (20%), enzootic ataxia (18.5%), diarrhea (17%), unknown causes (7.7%), goat pox (6.2%) and predators (4.6%).

DISCUSSION

Factors affecting kid birth weight

The average kid birth weight (2.04 kg) recorded in this study is lower compared to reports from other parts of Africa (Aganga et al., 2005; Maphosa et al., 2009). This higher birth weight in other studies may be due to breed difference including difference in twining and tripleting. Multiple births were high in our study. Of the 188 live kids born during the period of the study 41.5 and 41.0% were twins and triplets respectively. Multiple litters had low

Table 5. Birth to 30, 60 and 90 days mortality of kids by risk factors.

Factor	Birth to 30 days			Birth to 60 days			Birth to 90 days		
	N	Death	%	N	Death	%	N	Death	%
Overall	178	54	30.3	162	62	38.3	139	65	46.8
Sex			NS			NS			NS
Male	96	32	33.3	88	37	42.0	76	37	48.7
Female	82	22	26.8	74	25	33.8	63	28	44.4
Birth weight (Kg)			**			***			***
≤1	63	28	44.4^{a}	58	33	57.0^{a}	54	35	64.8^{a}
1.1-2	69	19	38.8^{a}	47	19	40.0^{a}	39	20	51.3^{a}
2.1-3	34	5	14.7^{b}	29	7	24.0^{b}	25	7	28.0^{b}
3	32	2	6.3^{c}	28	3	11.0^{c}	21	3	14.3^{c}
Parity			NS			**			*
1	22	3	13.6	16	3	18.8^{a}	14	3	21.4^{a}
2	22	3	13.6	20	3	15.0^{a}	15	3	20.0^{a}
3	28	7	25.0	24	6	25.0^{a}	19	7	36.8^{a}
4	32	10	31.3	30	11	36.7^{ac}	29	13	44.8^{ad}
5	32	14	43.8	31	17	54.8^{bc}	28	17	60.7^{bd}
6	42	17	40.5	41	22	53.7^{bc}	34	22	64.7^{c}
Type of birth			*			*			*
Single	31	6	19.4^{a}	28	7	25.0^{a}	25	7	28.0^{a}
Twins	74	18	24.3^{a}	65	21	32.3^{a}	53	21	39.6^{a}
Triplets	73	30	41.1^{b}	69	34	49.3^{b}	61	37	60.7^{b}
Separation of newborn kids and does			NS			**			**
Yes	82	19	23.2	72	18	25.0	58	19	32.8
No	96	35	36.5	90	44	48.9	81	46	56.8
Separation of sick animals			*			**			**
Yes	88	19	21.6	80	22	27.5	66	22	33.3
No	90	35	38.9	82	40	48.8	73	43	58.9

NS, not significant (P>0.05); * P<0.05; ** P < 0.01; *** P < 0.001. ^{a,b,c,d} proportions with in a column and within the same factor followed by different alphabets differ significantly at *P*<0.05

Table 6. Relative importance of causes of pre-weaning kid mortality

Causes of mortality	Number of deaths	% contribution to the total death
Enzootic ataxia	12	18.5
Miss mothering	17	26
Pneumonia	13	20
Diarrhea	11	17
Goat pox	4	6.2
Predator	3	4.6
Unknown	5	7.7
Total	65	100

birth weight compared to single litter kids.

Contrary to several reports of higher birth weight of male kids compared with females (Aganga et al., 2005; Ukanwoko et al., 2012), there was no statistically significant difference in birth weight of male and female kids in this study.

We observed a steady decline in birth weight of kids as parity of dam increased. This may be explained by the observed increase in litter size as parity increased.

Factors affecting kid mortality

The overall pre-weaning kid mortality observed in this

study (46.8%) was very high compared to 25% mortality reported for an experimental flock of the same breed reared on station not far from our study area (Hailu et al., 2006) and 34.2% on farm (Debele et al., 2011). It was also high compared to reports from other African countries ranging from 10 to 40.6% (Mtenga et al., 1993; Awemu et al., 1999; Turkson, 2003; Turkson et al., 2004; Aganga et al., 2005; Snyman, 2010).

Sex

The effect of sex on pre-weaning mortality was not found important ($P>0.05$), consistent with the works of Mtenga et al. (1993) and Awemu et al. (1999). However it contradicts with the finding of Perez-Razo et al. (1998), Aganga et al. (2005) and Hailu et al. (2006) who recorded a higher mortality for male kids compared to females. Debele et al. (2011) on the other hand, reported higher death rates in females than males in Arsi-Bale kids kept in a similar environment.

Birth weight

Birth weight of kids significantly affected mortality to all age groups considered (birth to 30, 60 and 90 days). A high pre-weaning mortality was recorded for kids less than or equal to 2 kg at birth. Losses were relatively low in kids that weighed 3 kg or more at birth. The result found in this investigation is in agreement with many earlier works (Mtenga et al., 1993; Awemu et al., 1999; Aganga et al., 2005; Hailu et al., 2006; Snyman, 2010) who reported higher mortality in light kids at birth. This may be attributed to low energy reserve which renders the kid susceptible to harsh environmental conditions.

Type of birth

The influence of litter size on mortality rate of kids was a significant source of variation. There was more death for triplets than twins and single litters. The low birth weight of kids observed for multiple births in this study may be partly responsible for higher mortality in triplets. Insufficient milk to satisfy triplets can also largely contribute for this. Feed resources are in general in short supply in the dry season in Ethiopia. This result is in agreement with Hailu et al. (2006), who reported high mortality in triplets compared to singles and twins.

Mtenga et al. (1993) recorded higher mortality in twins than singles and Snyman (2010) reported highest survival rate in single born kids followed by twins and triplet-born kids.

Parity

Parity had a significant influence on pre-weaning kid mortality. Mortality rates were generally found increasing with increasing parities. This result is in agreement with reports of Butswat et al. (1995) who reported an increase in mortality rate with parity in lambs due to an increase rate of twinning as parity increased. The increase in mortality as parity increased may be due to increase in multiple births as parity increased as shown in Table 2. Increase in litter size was associated with low birth weight. Low birth weight is frequently associated with high kid mortality (Mtenga et al., 1993; Awemu et al., 1999; Hailu et al., 2006; Snyman, 2010). However, this result contradicts with Awemu et al. (1999) who reported reduction in mortality rate with increased parities and attributed this to physiological maturity of older does and their ability to provide enough milk for the kids. The difference between the two results may be due to high percentage of tripleting in our study and difference in feed availability. This study was conducted in the dry season when forage availability and quality is generally low.

Management

In the present study, keeping the new born and the doe near homestead separated from the rest of the flock for 1 week significantly affected pre-weaning kid mortality, more deaths were found in flocks in which new born kids and their does run with the rest of the flock. This may be associated with a high risk of miss-mothering, injury, exposure to predators and insufficient ingestion of colostrum. There might also be a high chance of getting contagious diseases by running with the flock when the new borne kids are not immunologically competent. This result is in agreement with Sharif et al. (2005) who reported that kids were at higher risk of dying if they were not separated from adult animals. Separation of sick animals from the flock contributes to kid survival as it minimizes the risk of transmission of contagious diseases.

Causes of kid mortality

In this study the most frequently suspected cause of mortality was miss-mothering. This may be due to extensive system of goat husbandry practiced in the study area and large flock sizes which contribute to poor mother-kid relationship. Another important possible cause for loss of kids due to miss-mothering may be allowing the new born kid to run with the rest of the flock. Death due to starvation-mismothering exposure was reported in lambs and kids in Jordan (Sharif et al., 2005) and in lambs in Ethiopia (Bekele et al., 1992; Mukasa-Mugerwa et al., 2000).

Other important causes of mortality included pneumonia and diarrhea. Death in kids due to pneumonia and diarrhea were reported by earlier works (Khan et al., 1991; Donkin and Boyazoglu, 2004; Sharif et al., 2005;

Ershaduzzaman et al., 2007).

Diseases were responsible for the highest proportion of kid mortality in this study. High proportion of kid mortality (44.6%) due to diseases and parasites was reported from Botswana (Aganga et al., 2005). Even higher (63%) contribution of diseases to kid mortality was reported in Black Bengal Kids in Bangladesh (Ershaduzzaman et al., 2007). Enzootic ataxia was found to be the cause of mortality since the soil in the rift valley is deficient in copper. Enzootic ataxia in lambs and kids with high morbidity and mortality, in the Ethiopian Rift Valley, was described by Roeder (1980). Unknown causes, goat's pox and predators like hyena also contributed to the mortality of kids.

This study revealed that there is very high pre-weaning kid mortality in the study area; associated mainly with low kid birth weight and multiple litters especially triplets.

Therefore it is recommended that does bearing multiple litters and those nursing twins and triplets should be supplemented appropriately to reduce kid loses.

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