DETERMINANTS OF KID MORTALITY IN STRAINS OF LOCAL GOATS IN A RESEARCH HERD IN MOROGORO, TANZANIA.

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SUMMARY

Determinants of kid mortality were investigated amongst local strains of the Small East African goat breed, namely Kigoma, Mtwara and Dodoma, in retrospective and prospective studies. The strength of association and the role of chance were evaluated using mortality relative risk (RR) measures, 95% confidence intervals for the RRs and χ^2 test based p-values.

Retrospective results showed that birth weight modified the effect of strain on kid mortality. The Dodoma strain was superior to the other two strains (RR was 2.34 and 2.15) and the p - values were 0.0000 and 0.0003 for the Kigoma and Mtwara strains, respectively, in the group of kids with above average population birth weight(1.89 kg). However, no association was found between strain and kid mortality in the group whose birth weight was below the mean population birth weight. Kids with below average birth weight were 1.66 times more likely to die than heavier kids (p=0.0000). Similarly, birth type was found to be associated with kid mortalities RR=1.60 (CI: 1.35,1.88, p=0.0000). Individuals from multiple births had 1.60 times at risk than single born kids (p=0.0000). Amongst the three age cohorts; pre-weaned kids (0-3 months) and weaned (>3-6 months) were at 5.8 and 3.92 times, respectively, the risk of the >6-9 months age group; these results were unlikely to have arisen by chance (p=0.0000), and the risk ratios were quite high. Sex had no significant effect on kid mortality (RR=1.14, p=0.1971). The prospective study revealed that respiratory conditions were responsible for 22.7% of the deaths and the pneumonia-helminthoses complex accounted for 19.7% of kid mortalities. It is concluded from this study that kid mortality is associated with strain, birth type, birth weight and age, but sex had no effect on kid mortality.

INTRODUCTION

According to FAO (1993) Animal Health Yearbook, it is estimated that Tanzania has about 9.4 and 3.8 millions goats and sheep, respectively. The numbers of

small ruminants have been increasing for the past five decades due to high demand of meat, milk and other livestock products and by products (Mtenga *et al.*, 1992).

The qualities of small ruminants compared with large ruminant animals such as cattle and/or buffaloes place them in an important position particularly in tropical agriculture. While they provide precious products like milk, meat, fat, fibers, skins and manure, goats require relatively small initial capital for investment and low running costs when compared to cattle.

There are a number of factors that contribute to the level of output achieved in any livestock production systems. These include: reproductive performance, growth rate, slaughter/mature weights, environmental influence, feeding regime, diseases control strategies and mortality rate. The economic output of a goat herd depends on the number of weaned kids in the herd. This in turn is determined by the kidding percentage and the mortality rate (Mittal, 1976). Husain *et al.*, (1995) reported that a high level of kid mortality represents a significant barrier to increased goats' productivity.

A number of factors influence the incidence of kid mortality. According to Traore and Wilson (1988), these factors can be categorized into environmental and pathological factors. Environmental factors include the effects of the system of production, year and season of birth, age, experience of the dam or parity, litter size (single or multiple) and sex of an animal. Pathological factors include those that are normally considered to be associated with disease conditions. Kambarage and Kusiluka (1996) reported that the main constraints hindering the productivity of this sector in most sub-Saharan countries are diseases, poor breeding policies and poor management. Other production constraints are social, economic, climatic and political factors (Mtenga *et al.*, 1992).

The Department of Animal Science and Production (DASP) at Sokoine University of Agriculture (SUA) has a goat herd made up of three local strains of the Small East African goat breed. The herd is used for research purposes. Mortality of kids from the three strains has been recorded in the post-mortem reports at the Department of Veterinary Pathology at Sokoine University of Agriculture (SUA).

The main objective of this study was to determine the risk factors associated with kid mortalities at the Enhancement of Research Capacity (ENRECA) goat project

at Magadu Research farm. The specific objectives of the study were (i) to study the association between strain and kid mortalities and (ii) identification of etiological agents or conditions associated with kid mortalities.

MATERIAL AND METHODS

Study area and animals

This study was conducted at Magadu ENRECA Goat project under the DASP at SUA.

A total of 243 local goats were brought in 1996 from Kigoma (81), Dodoma (90) and Mtwara (72). At the time of the present study (2001), the animals were at their fifth cropping season and a total 772 kids were involved in this study. Animals were bred once a year. Breeding was strain –specific that is between bucks and does of the same strain so as to maintain their genetic (strain) identity. During the off-season periods bucks were separated from the does in the house and during grazing. All goat strains were managed similarly, that is they were grazed on natural pastures and provided with concentrate feed (a mixture of maize bran and cotton seed cake) plus mineral supplements. Housing provided for good ventilation, drained concrete floors and sawdust beddings which were used and changed after every three days. Weaning was done at three months of age. Deworming was done at 3 months intervals, and ticks were controlled by spraying the animals with acaricides. No other disease control programs were undertaken and disease cases were reported and attended as they occurred.

Study design and data collection

A cohort study design (Martin *et al.*, 1987) was used to determine association between variables and deaths. The risk factors considered in this study were strain (Kigoma, Mtwara or Dodoma), birth weight (below or above population birth weight mean), sex (female or male), birth type (singlet or multiple) and age (0- 3, >3-6 or >6-9 months old).

Retrospective data

Herd breeding records for each cropping season from 1998 to 2000 were reviewed. For each kid born the following variables were retrieved; strain of the doe, sex, birth date, birth weight, birth type, does' identification number, kid's identification number, and if death was recorded the kid's date of death and cause of death were also recorded.

Prospective data

Sample Selection

A census of all kids that were born during the fifth cropping season (March 2001 to May 2001) was done. For each kid, variables were recorded as for retrospective

data and the kids were observed for 9 months.

Handling of dead kids

During prospective studies, postmortem examination of all dead kids was done at the Department of Veterinary Pathology. Relevant samples for bacteriological and histopathological examinations were taken. For each examined carcass the gross pathological features and bacteriological results were recorded.

Data analysis

Variables involved in analysis included strain, birth weight, sex, birth type and age. Causal association studies (effect of the risk factors on mortality) were based on kid mortality relative risk (RR) measures, 95% confidence intervals and the role of chance evaluated by the χ^2 tests' p-values in 2 x 2 contingency tables (Snedecor and Cochran, 1989; Martin *et al.*, 1987). All the calculations were computed with the aid of Epi Info version 6.0 statistical calculator (Statcalc) (Dean, et al 1994).

Since the primary objective was to find whether there is an association between local goat strains and kid mortality, putative confounding or effect modifying factors were identified and controlled by stratification (Martin *et al.*, 1987).

RESULTS

Factors affecting kid mortality

Strain

There were more kid deaths among Kigoma and Mtwara strains than among Dodoma strains. In Table 1, taking the Dodoma strain as the referent group, the risk of death in the Kigoma and Mtwara strains was 1.89 and 1.67 times the risk in the Dodoma strain, respectively. The 95% risk ratio confidence interval (1.48, 2.41) did not include the null value (RR=1). The probability of such results or more extreme results occurring if the null hypothesis is true was 0.0000. Such results are in conformity with the alternative hypothesis i.e. there is difference in the risk of death between the Kigoma (p=0.0000) and Mtwara (p=0.0004) strains when compared with Dodoma strain.

Table 1: Association between local goat strains and kid mortality at Magadu Research farm, Sokoine University of Agriculture, Tanzania.

Strain	Outcome		cRR	95% CI for RR	p-value
	Dead	Survived			
Kigoma	145	156	1.89	1.48,2.41	0.0000
Mtwara	74	100	1.67	1.27,2.19	0.0004
Dodoma	63	184	1	-	-

Legend: - cRR = crude relative risk, 95% CI for RR = 95% confidence limits for relative risk, and p-value = the χ^2 test's probability value.

Birth weight

More deaths occurred among kids that were born with birth weight below population mean as compared to those born with above population mean birth weight (mean=1.89kg). The relative risk (RR) was 1.66, indicating that kids born with low birth weight were 1.66 times more likely to die than those born with higher birth weight. The difference is unlikely to have arisen by chance (p= 0.0000) as shown in Table 2.

Table 2: Effect of birth weight on kid mortality at Magadu Research farm, Sokoine University of Agriculture, Tanzania.

Birth Weight	Outcome		RR	95% CI for RR	p-value
	Dead	Survived			
Below pop. mean	133	119	1.66	1.40,1.99	0.0000
Above pop. mean	149	321	1	-	-

Legend: - RR = relative risk, 95% CI for RR = 95% confidence limits for relative risk, and p-value = the χ^2 test's probability value. Population mean birth weight = 1.89kg.

Birth type and sex

Birth type was found to be associated with kid mortality, (RR=1.60; CI: 1.35,1.88; p=0.0000). Multiple birth type was shown to be 1.60 times risk

compared to single birth types. Sex was not associated with kid mortality (RR=1.14: p=0.1971).

Control for potential confounding effect of birth weight

Since birth weight was a risk indicator it was important in this study to examine the effect of birth weight on the association between strain and kid mortality through stratification, (Table3).

Table 3: Effect of stratification on birth weight on the association between strain and kid mortality at Magadu Research farm, Sokoine University of Agriculture, Tanzania.

Birth weight	Strain	Outcome		RR	95% CI for RR	p-value
		Dead	Survived			
Below pop.mean	Kigoma	99	90	1.14	0.86,1.5	0.42
	Mtwara	32	28	1.16	0.82,1.6	0.49
	Dodoma	33	39	1	-	-
Above pop. mean	Kigoma	45	67	2.34	1.58,3.5	0.00
	Mtwara	42	72	2.15	1.43,3.2	0.001
	Dodoma	30	145	1	-	-

Legend: - RR = crude relative risk, 95% CI for RR = 95% confidence limits for relative risk, and p-value = the χ^2 test's probability value. Pop. Mean=Population mean birth weight = 1.89kg.

It is apparent in Table 3 that with kids born with below population mean birth weight (1.89 kg), there is no association between strain and mortality. The risk ratios are close to one, the confidence intervals bracket the null risk ratio and the p-values are high indicating that such results could easily be due to chance. On the other hand the stratum of kids with birth weights above the mean population weight (1.89 kg) reveals strain differences. The Kigoma and Mtwara strains had higher risks of mortality as compared to the Dodoma strain, (RR 2.34 and 2.15 more times, respectively). Such results are unlikely to be explained by chance (p=0.0000 and 0.0003, respectively). Birth weight, therefore, modified the strength of the association between strain and mortality.

Age specific risk of kid mortality

The birth cohorts were categorized into three age cohorts; 0-3 months (pre -weaned), >3-6 months (weaned) and >6-9 months. Table 4 below

show that the risk of death in the 0 -3 months and >3 - 6 months age cohorts were 5.8 and 3.92, respectively, times the risk in the >6-9 months age group. This difference was unlikely to have arisen by chance (p=0000) and the risk ratios were quite high.

Table 4: Association between age cohorts and kid mortality at Magadu Research farm, Sokoine University of Agriculture, Tanzania.

Age (months)	Outcome		RR	95% CI for RR	p-value
	Dead	Survived			
0-3	173	549	5.8	3.67,9.18	0.000
>3-6	89	460	3.92	2.43,6.34	0.000
>6-9	19	441	1	-	-

Legend: - RR = crude relative risk, 95% CI for RR = 95% confidence limits for relative risk, and p-value = the χ^2 test's probability value

Descriptive studies

Pathological effects on kid mortality

Respiratory conditions were the major cause of mortality. This was evident in 15 cases (27%), which on postmortem examination were identified as having the following features of pneumonia: Changes in the color of the lung tissue that included dark red, grayish, brown gray; at times these changes involved all lobes, cranial lobes, ventral part of cranial lobes; consolidated lung tissue that was firm on palpation and digital pressure (this involved mainly individual lobes in the particular animal); frothy fluid that was colored differently (blood-tinged, brownish, or bluish black) oozed out on pressing cut-surfaces of the lungs and such fluids were also found in trachea, bronchi or bronchioles. There was a yellowish fibrinous material on the pleural membranes that led to adhesion between lung lobes or lung tissue adhered to thoracic wall and pericardium. The cut pieces of affected parts of the lung tissue sunk or submerged in water. Another pathological finding involved a combination of pneumonia and helminthoses which was encountered in 13 cases (19.7%). Features of the pneumonia as elucidated above plus actual presence of helminths, in the gastrointestinal tract, which were responsible for anemic carcasses. The helminths

involved were nematodes, especially *H. contortus* in the abomasum and tape worms, particularly *Moniezia species*, in the small intestines. This tapeworm sometimes filled the whole of the intestinal lumen in some of the animals examined. Helminths on their own were also noted to cause deaths to four kids. Helminths found were *Haemonchus species* and *Monienzia* species.

Starvation was encountered in four kids. In one case, starvation accompanied pneumonia and there was gelatinous subcutaneous and omental fat reserves, and plastic material in the rumen. Another kid had a large plastic material in the rumen. In a third kid there was prominent emaciation and loss of coronary fat. The fourth animal had poor body condition; extensive wounds at intermandibular region that contained pus and the rumen had no ingesta. In all four cases, possible infections due to opportunistic microorganisms or pyogenic bactteria that may be associated with pneumonia, and impaired feed intake due to physical lumen obstruction, digestion and absorption could have exacerbated the deaths of the kids.

Two kids had internal bleeding as the cause of death. One of them had a large blood clot about three centimeters in diameter near the liver. The other kid had three fractured ribs on the right side which probably led to traumatization of internal organs causing accumulation of about 300 milliliters of blood in the thoracic cavity. Four kids that were born weak died either shortly after birth or on the same day. These, however, were not presented for postmortem examination, but one case was observed to have deformity of hind limbs (congenital malformation). A group of 24 (36.3%) kids involved in this study were not subject to postmortem examinations either due to advanced putrefaction (two cases) or were not presented for examination at all (22 cases). The observed pathologic causes of kid mortality in the prospective study are summarized in Table 5.

Table 5: Causes of mortality at Magadu Research farm, Sokoine University of Agriculture, Tanzania.

Causes of mortality	Number of cases	Percentage of total deaths (%)
Pneumonia	15	22.7
Pneumonia and Helminthoses complex	13	19.7
Helminthoses	4	6.1
Born weak	4	6.1
Internal bleeding	2	3.0
Starvation	4	6.1

DISCUSSION

In the present study the crude measures of the strength of association showed that there was strain difference in mortality with risk of death of the Kigoma and Mtwara kid strains being higher than that of Dodoma strain. Vihan *et al.* (1992) and Obudu *et al.* (1995) compared different breeds and crosses observed similar results. However, contrary to the present observation, Mrutu (2001) found that strain had no effect on kid mortality; this might have been due to a small sample size used in that study. The observed differences in the mortality among strains might be attributed to inherent resistance against diseases between strains, susceptibility to harsh environmental and weather changes, nursing ability, adequate quantity of good quality and quantity of colostrum and milk produced by the does.

Birth weight appears to be an effect modifier i.e. the risk of death between the strains amongst kids do varies with the level of birth weight, (Rothman and Greenland, 1998). Birth weight in this study was inversely related to risk of kid mortality. The findings were similar to those of Lal and Swarup (1985) and Gupta and Sengar (1985). Birth weight is an important factor in determining the ability of the kid to maintain body temperature during harsh conditions, like cold weather (Vihan and Singh, 1992). Vihan (1988) observed that when kids were born with low body birth weight or small size as is the case with multiple births, they were unable to stand and suckle

colostrum, which is a crucial factor for the kids' survival. Amongst many functions provided by the colostrum is provision of vitamin A, which is important in the process of epithilialization of mucosal linings, and the secretory immunoglobulin, IgA, which enhance immunity of the kid to the very early chalienges by pathogenic microorganisms.

Birth type had significant effect on kid mortality rate and, multiple born kids had higher mortality rate than singles. Similar results were obtained by Sarmah *et al.* (1981), Abunie (1992) and Mrutu (2001). Weak multiple kids might have suffered competition of nutrients during their prenatal stages of development especially if the amount and nutritive nutritive values of feeds given to the does were inadequate. During post – natal life, the kids are more likely to consume less colostrum and milk due to competition as compared to single birth kids. It is, therefore, suggested that when multiple births occur, kids should be provided with extra colostrum and milk, especially to twins or triplets kids born from doe(s) known to have low quantity and quality of colostrum and milk. However, Mwatawala (1997) found no significant difference in mortality rate between singleton born kids and twins.

There was no association between sex with kid mortality. The observed findings were similar to those reported by Abunie (1992) and Mrutu (2001) who found no significant difference in mortality rate between male and female kids. Similarly, Mittal (1976) also found that sex had no effect on kid mortality of Barbari and Jamunapari kids in India. However these findings are contrary to those of Misra *et al.*, (1984) and Traore and Wilson (1988) who observed high mortality amongst male kids and studies by Ngowo (1988), Khalaf *et al.*, (1979) and Husain *et al.*, (1995) that showed female kids to have higher mortality rates. Absence of sex difference in the study could have been attributed by the fact that as experimental animals, all were treated equally.

Kids at the age group 0-3 months had higher mortality as compared to the other age cohorts. These findings are similar to those of Ranatunga (1971), Mchau (1979), Lal and Swarup (1985), Abunie (1992), and Thevaranjitham (1996). In contrast, Gupta and Sengar (1985) observed that kid mortality rate was highest in the 3-6 months age group kids due to weaning at the age of 3 months, and the sudden withdrawal of milk from kids with an under-developed rumen caused deaths from malnutrition. The higher mortality in early age groups might be associated with a deficiency of immunoglobulin in the newborn kids. In this case therefore, it is important to provide extra care during pre-

weaning period such as provision of adequate shelter, nutrition (colostrum and milk), and prophylaxis to the newly born kids to guard against prevalent diseases and harsh conditions such as environmental and weather stress that may predispose kids to losses.

The main pathologic causes of kid mortality observed and recorded in this study were pneumonia, helminthosis, starvation and weak kids at birth. These results are in accordance with other studies under tropical conditions. Srivastara (1996) observed that weak kids were at risk of dying, as they were unable to suckle sufficient colostrum and milk. As a result they lose their body food reserves, become hypothermic and die. Mittal (1976) reported that deaths among kids under 6 months of age were due to pneumonia and enteritis. Pneumonia, parasitism, enteritis, coccidiosis and paralysis were reported to be major causes of kid mortality within 6 months of age in farm conditions in Sri Lanka (Ranatunga, 1971).

CONCLUSION

Based on the results from this study it is concluded that the mortality rate was different in the three strains of kids and that Dodoma strain performed better than the other strains (Kigoma and Mtwara). Multiple birth kid had lower survival rate than single born kids and the highest mortality rate was observed in the 0-3 months age group. The sex of the kid did not have significant effect on mortality rate, and finally, most deaths were due to pneumonia, weakness of kids at birth and helminthoses.

It is, therefore, recommended that factors determining kid mortality in the 0-3 months old should be investigated in detail. Provision of pregnant does with high nutrition plane diet two to three weeks prior to kidding may improve birth weights. Finally, although multiple births are desired traits, it is important to supplement multiple born kids with extra colostrum from foster mother (or artificial colostrum) to build up their immunity against local pathogens.

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