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Risk Factors Associated with Preweaning Mortality of Barbari, Jamunapari and Jakhrana Goat Kids

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ABSTRACT

Background: High mortality of goat kids due to infectious and non-infectious diseases negatively impacts goat husbandry.

Methods: To study the influence of genetic and nongenetic factors on preweaning mortality of goat kids, three years' data (July, 2015 to June, 2018) of breeds maintained at Indian Council of Agricultural Research-Central Institute for Research on Goats (ICAR-CIRG) *viz*. Barbari, Jamunapari and Jakhrana was analyzed to find effect of breed, parity, birth weight, litter size, season of birth, sex and kid's age on mortality. Postmortem findings as entered in the record have been considered to arrive at the cause of mortality.

Result: A preweaning mortality rate of 2.59% was recorded in kids of all the three breeds studied. Mortality rate of Barbari, Jamunapari and Jakhrana kids was found to be 2.15%, 3.39% and 2.13% respectively. Kids birth weight, sex or age had no effect on mortality. Highest mortality was observed in kids born as triplet/quadruplet (4.49%) followed by that in twins (2.88%) and singlets (2.01%). Highest mortality was observed in kids born to primiparous dams (3.95%) followed by kids born to dams having =/> 5th parity (3.01%) and least in 2nd to 4th parity (1.82%). Most of the kids died due to enteritis (38.3%) followed by pneumonia (28.3%), debility and anemia (11.7%) septicemia (10%) and others in remaining 11.7% cases.

Key words: Barbari, Goat, Jakhrana, Jamunapari, Kid, Mortality, Pre-weaning.

INTRODUCTION

Economy of India is growing at a rapid pace and so is the demand of animal protein. Of all the sources of animal protein, demand of goat meat is increasing at highest rate. In a policy paper, Indian Council of Agricultural Research estimated that demand of goat meat will increase at a rate of 19.95% between 2000 and 2020 (ICAR, 2004). Ironically, goat population in India decreased by 3.82% to 135.17 million in 2012 than that was in 2007 (DAHD, 2012). Increased slaughter rate due to high demand might be one of the reasons for this trend. Other important reasons negatively impacting goat husbandry are feed scarcity due to limited grazing land and high neonatal mortality due to infectious diseases. In India, goats are reared mostly under extensive system of management by rural poor and nomads. In such a situation, mortality rate of goat kids is unacceptably high. Kumar *et al.*, (2003) have estimated the kid mortality rates for small (<5 goats), medium (5-10 goats) and large (>10 goats) categories of goat enterprises as 32.8, 32.1 and 15.8% respectively. To increase the production and profitability, it is important to shift goat rearing towards intensive or semi-intensive system of management. Studies on risk factors associated with mortality of goat kids in India, particularly those conducted in organized farm setting are lacking. In view of these facts, this study was designed to evaluate the risk factors associated with preweaning mortality of Barbari, Jamunapari and Jakhrana goat kids.

MATERIALS AND METHODS

The study was conducted at Indian Council of Agricultural Research - Central Institute for Research on Goats (ICAR - CIRG), Mathura. The institute is located at an altitude of 163.4 meters above mean sea level at latitude of 27.10°N and a longitude of 77.9°E. The area has semi-arid climate and receives rain mostly in monsoon season of July to September. Three years data (July, 2015 to June, 2018) of breeds maintained at CIRG *viz.* Barbari, Jamunapari and Jakhrana was analyzed to find effect of breed, parity, birth weight, litter size, season of birth, sex and kid's age on pre-weaning (<03 months) mortality of goat kids (Snedecor and Cochran, 1994).

Every death is recorded and post-mortem (PM) examination is conducted by a veterinarian as standard

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practice at the institute. PM findings as entered in the record have been considered to arrive at the cause of mortality. Mortality due to trauma or predation was not considered. Two seasons of kidding is observed in all the three breeds maintained at the institute. The first and major one lasts from early October to late December while second lasts from early February to late March with very few stray births outside these reasonably well defined seasons.

Animals of all the three breeds are managed in a semi-intensive system with common feed source and grazing area. All the animals were housed in well-ventilated sheds having facility for individual feeding and watering. Male and female animals were housed and grazed separately. Clean drinking water was provided ad libitum twice a day.

Health status of all the animals is monitored daily by a veterinarian and all animals are vaccinated as per the Health Calendar developed by ICAR-Central Institute for Research on Goats, Makhdoom, Mathura, India (Table 1). Also, all animals over 03 months of age are dewormed twice a year (before and after monsoon) with fenbendazole @ 10 mg/kg body weight.

RESULTS AND DISCUSSION

The present study intended to assess the overall mortality of pre-weaned goat kids in a well-organized goat farm. Total 2318 goat kids were born during the period of study (July, 2015 to June, 2018) out of which 60 kids died leading to overall mortality of 2.59%. The purpose of conducting the study in organized farm was to investigate the residual mortality that exist even after application of all available prophylactic and therapeutic measures along with adoption of effective management practices. Effects of breed, sex, litter size, dam's parity, kid's birth weight, kid age and disease on pre-weaning mortality were also assessed.

Effect of breed and season on goat kid mortality

The study was conducted on three goat breeds maintained at ICAR-CIRG *viz*. Barbari, Jamunapari and Jakhrana with mortality rates of 2.15%, 3.39% and 2.13% respectively during the study period. Mortality in goat kids born during first half of year (January to June) was 3.87% whereas it was only 1.73% in kids born during second half of year (July to December) (Table 2) with overall mortality of 2.59% which was far below previously estimated mortality rate of 15.8% in unorganised herds at the same location (Kumar *et al.,* 2003) and an average of 19.7% (Thiruvenkadan and Karunanithi, 2007). During the study period mortality rates of 2.15%, 3.39% and 2.13% were reported from Barbari, Jamunapari and Jakhrana flocks respectively. Comparatively, a higher mortality rate of 29% was reported in 0 to 3 month old Black Bengal kids (Ershaduzzaman *et al.,* 2007).

Effect of sex on goat kid mortality

No appreciable difference was recorded between mortality rates of male and female kids which were 2.66% and 2.52% respectively (Table 3). In the present study, no effect of sex was found on mortality rate of pre-weaned kids with mortality rate of male and female kids being 2.66 and 2.52 per cent respectively. Similar observations were made by

Table 1: Vaccination schedule as per the health calender developed by ICAR-Central Institute for Research on Goats, Makhdoom, Farah, Mathura, Uttar Pradesh, India.

Disease	Primary vaccination		Repeat vaccination
	First dose	Booster	
Peste-des-petits ruminants (PPR)	3 Months	Not required	3 Years
Foot and mouth disease (FMD)	3-4 Months	3-4 Weeks	6/12 Months*
Goat pox (GP)	3-4 Months	3-4 Weeks	12 Months
Enterotoxemia (ET)	3-4 Months	3-4 Weeks	6 Months
Haemorrhagic Septicemia (HS)	3-4 Months	3-4 Weeks	6/12 Months*

*As per manufacturer's instruction.

Table 2: Effect of breed and season on goat kid mortality.

Season	Barbari			Jamunapari			Jakhrana			Total		
	Born	Died	(%) Mortality	Born	Died	(%) Mortality	Born	Died	(%) Mortality	Born	Died	(%) Mortality
Jan-June	483	13	2.69	343	21	6.12	104	2	1.92	930	36	3.87
July-Dec	680	12	1.76	484	7	1.45	224	5	2.23	1388	24	1.73
Total	1163	25	2.15	827	28	3.39	328	7	2.13	2318	60	2.59

Table 3: Effect of sex on goat kid mortality.

Sex	Barbari			Jamunapari			Jakhrana			Total		
	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality
Male	599	13	2.17	402	15	3.73	164	3	1.83	1165	31	2.66
Female	564	12	2.13	425	13	3.06	164	4	2.44	1153	29	2.52

Kumar *et al.* (2009) and Thiruvenkadan and Karunanithi (2007) while, Saha (2005) reported significantly higher mortality in male kids.

Effect of birth weight on goat kid mortality

Mean birth weight of Barbari and Jamunapari goat kids that died (1.76±0.06 and 3.11±0.1 kg) was lower than and that of Jakhrana goat kids (2.59±0.18 kg) was higher than that of population mean birth weights of respective breeds (1.86±0.01 kg, 3.24±0.04 kg and 2.50±0.32 kg) (Table 4). Birth weights of kids that died were found to be only lower than that of population mean in our study. Dwyer *et al.,* (2015) have reviewed factors important for survival of neonatal lambs and opined that both significantly low and high birth weight tends to decrease the probability of survival and achieving an optimal intermediate birth weight is associated with more favourable outcomes.

Effect of goat kid's age on mortality

Pre-weaned goat kids were further divided into three age groups for calculating mortality to further narrow down the period of higher risk:

a) 1st month (0-30 days of age).
b) 2nd month (31-60 days of age).
c) 3rd month (61-90 days of age).

Overall mortality of kids of all the three breeds was found to be similar *i.e.* 33.33% but breed differences were appreciable. In Barbari kids, mortality was found to be higher during 1st and 3rd month of life (36%) than that in 2nd month (28%) of life whereas in Jamunapari kids, highest mortality was observed during 2nd month of life (42.86%) followed by that in 3rd month (35.71%) and 1st month (21.43%) (Table 5). Age of kids appears to have no major effect on pre-weaning mortality in the present study. However, breed differences were clearly visible with highest percentage of Jamunapari kids dying in 2nd month whereas Barbari and Jakhrana kids were more vulnerable during 1st month of life. Subramaniyan *et al*. (2016) have reported that kids above one month of age have higher chances of survival than kids below one month of age.

Effect of litter size on goat kid mortality

Similar trend of kid mortality was observed in all the three goat breeds studied. Highest mortality was observed in kids born as triplet/quadruplet (4.49%) followed by that in twins (2.88%) and singlets (2.01%) (Table 6). Birth type/ litter size appears to have significant effect on survival of goat kids. In this study, mortality rate of triplet-quadruplet kids was recorded to be higher than that of the kids born as twins and single. This is in concurrence with findings of Singh *et al.* (2022). Higher survival of single born kid is probably due to higher availability of milk from the dam compared to twin and triplet born kids.

Effect of dam's parity on goat kid mortality

Goats were divided into three parity-groups to study the effect of dam's parity on pre-weaning mortality of goat kids:

a) 1st parity.
b) 2nd - 4th parity.
c) 5th and higher parity.

When overall pre-weaning mortality of all the three breeds is considered, highest mortality was observed in kids born to primiparous dams (3.95%) followed by kids born to dams having ≥ 5th parity (3.01%) and 2nd to 4th parity (1.82%). However, the pattern was not similar in all the breeds studied; in Barbari and Jakhrana breeds, highest mortality was

Table 4: Effect of birth weight on goat kid mortality.

Group	Barbari		Jamunapari		Jakhrana	
	Mean birth wt	N	Mean birth wt	N	Mean birth wt	N
Population	1.86±0.01	1228	3.24±0.036	1612	2.50±0.32	627
Dead	1.76±0.0559	25	3.11±0.1	28	2.59±0.1818	7

Table 5: Effect of age on goat kid mortality.

Age at death	Barbari	Jamunapari	Jakhrana	Total
	% Mortality	% Mortality	% Mortality	% Mortality
0-30 Days	36 (9/25)	21.43 (6/28)	71.43 (5/7)	33.33 (20/60)
31-60 Days	28 (7/25)	42.86 (12/28)	14.29 (1/7)	33.33 (20/60)
61-90 Days	36 (9/25)	35.71 (10/28)	14.29 (1/7)	33.33 (20/60)

Table 6: Effect of litter size on goat kid mortality.

Litter size	Barbari			Jamunapari			Jakhrana			Total		
	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality
Singlet	417	6	1.44	387	11	2.84	141	2	1.42	945	19	2.01
Twin	685	17	2.48	422	17	4.03	177	3	1.69	1284	37	2.88
Trip/Quad	61	2	3.28	18	0	0.00	10	2	20.00	89	4	4.49

observed in kids born to dams having ≥ 5th parity followed by those born to primiparous dams and then least in those born to 2nd to 4th parity dams. Opposite trend was observed in Jamunapari breed where the said order was found to be 1st parity followed by 2nd to 4th parity and then ≥ 5th parity (Table 7). Pre-weaning mortality of goat kids also varied with the parity of the dam. When overall mortality of all the three breeds studied is considered, highest mortality was observed in kids born to primiparous dam followed by those born to dams of 5th and higher parity and least in those born to dams of 2nd to 4th parity. Increase in weight, milk production, immunological experience and social rank of the dam with age might be responsible for this.

Cause of mortality (post-mortem findings) in goat kids

When overall pre-weaning mortality of all the three breeds is considered, most of the kids died due to enteritis (38.3%) followed by pneumonia (28.3%), debility and anemia (11.7%) and septicemia (10%) and other causes in the remaining 11.7% cases. Here also, different mortality pattern was observed in kids of Jamunapari breed where most common cause of mortality was pneumonia (39.3%) and not enteric diseases (28.6%) (Table 8). During the study duration, enteritis was ascertained to be the foremost cause of kid mortality followed by pneumonia. Collectively, these two causes were responsible for 66.6% kid loss. Thiruvenkadan and Karunanithi (2007) also reported enteritis and pneumonia to be the primary cause of goat kid mortality. But, in their study more kids died due to pneumonia than enteritis. They also identified weakness/debility as an important cause of mortality and suggested low birth weight, malnutrition and mismothering as probable reasons.

In the present study, effect of breed, season of birth, sex, age, birth weight of kids and dam's parity and litter size on pre-weaning mortality was considered. In the present study, overall pre-weaning mortality of kids was found to be 2.59% which was far below the previously estimated mortality rate of 15.8% at field level in unorganized herds at the same location (Kumar *et al.,* 2003) and an average of 19.7% mortality reported from an organized farm in Tamilnadu (Thiruvenkadan and Karunanithi, 2007). Study of different reports on epidemiological pattern of pre-weaning mortality in goat kids throws up very divergent data which is not readily comparable. Significant variation exists between farms, geographies and breeds. Although it is reasonable to expect a lower rate of mortality in organized farms compared to unorganized ones but findings of above studies do not suggest so. Infectious diseases are considered to be the most significant cause of mortality in goat kids reared in a housed system (Dwyer *et al.,* 2015). Colibacillosis, an infectious disease, is the principal cause of neonatal diarrhoea in goat kids leading to heavy mortality (Smith and Sherman, 2009; Sharma *et al.,* 2022) similar to other livestock species like calves (Srivastava *et al.,* 2016). In the present study, no effect of sex was found on mortality rate of pre-weaned kids. Similarly birth weights of kids that died were found to be only lower than that of population mean. Higher survival of single born kid is probably due to higher availability of milk from the dam compared to twin and triplet born kids. Age of kids appears to have no major effect on pre-weaning mortality in the present study. Enteritis was ascertained to be the foremost cause of kid mortality followed by pneumonia in our study.

Causes of goat kid mortality have not been studied extensively. Most of the studies that have been conducted were at the level of smallholder rural farms where goats are reared in extensive system of management. In contrast to this, better datasets are available for lamb mortality particularly at farm levels - under intensive or semi-intensive system of management. Relative prevalence of causes of mortality also varies with the type of management system. Higher prevalence of obstetrical trauma, neonatal hypoxia, malnutrition and predation *etc*. is observed in small scale farm operations whereas

Table 7: Effect of dam's parity on goat kid mortality.

Parity	Barbari			Jamunapari			Jakhrana			Total		
	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality	Born	Died	% Mortality
1st	325	13	4	214	10	4.7	94	2	2.1	633	25	3.95
2nd - 4th	746	7	0.9	395	14	3.5	178	3	1.7	1319	24	1.82
≥5th	92	5	5.4	218	4	1.8	56	2	3.6	366	11	3.01

Table 8: Cause of mortality (post-mortem findings) in goat kids.

Cause of death	Barbari	Jamunapari	Jakhrana	Total
	% Mortality	% Mortality	% Mortality	% Mortality
Enteritis	48 (12/25)	28.6 (8/28)	42.9 (3/7)	38.3 (23/60)
Pneumonia	20 (5/25)	39.3 (11/28)	14.3 (1/7)	28.3 (17/60)
Septicemia	12 (3/25)	10.7 (3/28)	00 (0/7)	10 (6/60)
Anemia	12 (3/25)	10.7 (3/28)	14.3 (1/7)	11.7 (7/60)
Others	08 (2/25)	10.7 (3/28)	28.6 (2/7)	11.7 (7/60)

infectious diseases tend to prevail in animals managed under intensive system (Dwyer *et al.,* 2015).

Low rate of kid mortality observed in the present study might be due to strict adherence to the health calendar and round the clock availability of veterinary care. Other factors that played a role in reducing kid mortality in present and other well managed farms include -

1) Provision of assisted parturition thereby reducing chances of stillbirth due to neonatal hypoxia and/ other parturient injuries.
2) Ensuring immediate and adequate ingestion of colostrum.
3) Provision of hand feeding in cases of maternal rejection/ disease/death.

CONCLUSION

Low rate of goat kid mortality can be achieved by strict adherence to the vaccination schedule of Goat Health Calender developed by ICAR-CIRG and availability of veterinary care.

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Conflict of interest

All authors declare that they have no conflict of interest.

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