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## Epidemiological risk factor analysis in goats and sheep naturally infected with *Peste des petits ruminants virus*

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**Abstract**

Present investigation was aimed to study detail epidemiological risk factors associated with *Peste des petits ruminants* (PPR) in Odisha. There were fourteen outbreaks consistent to that of PPR disease among 361 small ruminants across eight districts of the state of different agro-climatic zones was attended. Presumptive diagnosis of PPR was mostly based on typical clinical signs and pathomorphological changes as well as histological alterations in affected animals. Data recorded analyzed statistically by SAS software through Chi-Square analysis to see their significance in occurrence of the PPR. Over all morbidity, mortality and case fatality was 89.47%, 46.81% and 5.32% respectively. Higher occurrence of PPR encountered in females (80.49%), among 6-12 months age group (46.13%), Ganjam breed (45.51%), animals with poor body conditions (54.48%) and in summer season (50%). Grazing pattern, farmer's literacy and vaccination status showed non-significant association in incidences of PPR disease. Endoparasitic infestations (67.49%) considered as one of the major stress factor predisposing the disease. Assessment of epidemiological measures may be helpful in formulating appropriate steps to minimize various determinants causing the disease.

**Keywords:** Epidemiology, PPR, risk factors, small ruminants

**Introduction**

*Peste des petits ruminants* (PPR) is one of the acute, febrile and fast spreading economically important viral disease affecting small ruminants across the globe caused by *Morbili virus* belonged to family *Paramyxoviridae*. PPR was first reported in 1942 in Ivory Coast of West Africa<sup>[1]</sup> and subsequently spread to more than 70 countries affecting thirty millions of sheep and goats yearly. PPR disease is endemic in India occurring sporadic outbreaks throughout the year posing a serious threat to the cloven-hoofed small ruminant population<sup>[2]</sup>. Sheep and goat population comprising nearly 13.8% and 27.8% of the total livestock population belonging to majority of landless to marginal farmers in rural areas providing sustainable income as well as food security. This epizootic contagious disease is characterized by high morbidity and mortality with typical clinical signs like profound depression, high fever, serous to mucopurulent ocular-nasal discharge, diarrhea and respiratory difficulty. Perusal of available literature on various epidemiological risk factors on occurrence of PPR disease may play a putative role in mitigating the spread of this economically important disease as per OIE mandate for eradication of PPR from the globe by 2030.

**Materials and Methods**

Outbreaks of disease showing heavy mortality among small ruminants showing typical clinical signs suggestive of PPR were attended promptly by getting information from the local veterinarians. Necropsy of carcasses were conducted at the outbreak site to record the major pathoanatomical changes in consistent with PPR disease. Affected small ruminants in the flock were categorized into three groups i.e. < 6 months, 6-12 months and > 12 months as per age. Data recorded as per the proforma of the questionnaire pertaining information regarding age, breed, sex, deworming and vaccination status, grazing pattern, season, farmer's literacy, body conditions etc in an excel data sheet for statistically analysis by using SAS software through Chi-square test to find their level of significance in occurrence of disease. Representative tissue samples were collected during necropsy and processed in the Department of Veterinary Pathology for observing microscopic changes.

## Results

### Morbidity, Mortality & Case fatality

Total fourteen natural outbreaks of PPR disease were attended during the study period comprising nearly 361 cloven hoofed small ruminants in the flock with 286 goat and 75 sheep across eight districts of Odisha. There was over all morbidity of 89.47% (n=323) with mortality of 46.81% (n=169) among the affected flocks. Case fatality in the present study was observed nearly 52%. Typical clinical signs observed during the outbreaks among affected sheep and goats were marked depression, fever, serous to mucopurulent nasal discharge (Fig.1), encrusted nose causing respiratory illness, matting of eye lids, diarrhea with soiling of perineum and tail (Fig.2) along with fibrinous exudates on tongue (Fig.3) with yellowish necrotic crusts on oral commissures.

### Epidemiological Risk Factors

Various epidemiological determinants influencing in occurrence of the disease with their significance and Chi-square value are presented in Table-1.

### Age, Sex & Breed

Chi-square analysis showed significant association between different age groups for susceptibility towards PPR infection. There was overall highest prevalence of PPR among the age groups 6 month-12 months (46.13%) followed by < 6 month (24.14%) and > 12 months (29.72%). Total affected small ruminants in the age group of < 6 months were 78 (91.76%) with 149 (94.40%) in age group of 6-12 months and 96 (80.67%) belonging to > 12 months. There was highest prevalence of PPR in 6-12 months (95.77%) of goats followed by < 6 months (94.52%) and 87.10% in > 12 months of goats. Similarly highest prevalence of PPR was observed among 6-12 months (86.67%) of sheep followed by < 6 months (75%) and 57.69% in > 12 months of sheep. There was over all highest prevalence of PPR infection in females (80.49%) followed by males (19.50%) irrespective of species including both sheep and goats. There was 81 numbers of male and 280 numbers of females included in the present study with males (77.78%) and females (92.86%) showing affections with typical clinical signs of PPR. Chi-square analysis showed significant association between sexes with occurrence of PPR disease. The goats included in the present study were categorized into three different breeds such as Black Bengal, Ganjam and non-descript breed. Sheep included in the study were also belonging to two different breeds such as Ganjam and non-descript breeds. There were 154 numbers of small ruminants (both Sheep and goats) were of Ganjam breed followed by 116 numbers of only goats belonged to Black Bengal breed and 81 numbers of non-descript breeds of both sheep and goats. Overall prevalence of Ganjam breed was highest with 45.51% followed by 33.12% of Black Bengal and only 21.36% of non-descript among both sheep and goats. Present study showed a significant association of PPR prevalence with the breeds of small ruminants resulting highest prevalence in Ganjam breed of goats (98.70%) and sheep (79.49%). Least incidences of PPR were recorded in non-descript goats and sheep with 81.82% and 42.86% respectively. Affections with Black Bengal goats were observed in 95.45%.

### Body Conditions, Farmer type & Grazing Pattern

All the Sheep and Goats included in the present study were categorized into three types accordingly to their body

conditions such as poor, moderate and good which showed a significant association with prevalence of PPR through Chi-square analysis. Overall prevalence of PPR was highest in animals with poor body conditions (54.48%) followed by moderate (37.15%) and 8.35% in animals with good body conditions. Species wise incidence of PPR also recorded highest in poor body conditions both in sheep and goats. Only one farmer having some knowledge and education was the owner of 20 small ruminants while all 13 farmers were of illiterate with no basic awareness regarding PPR disease. There was non-significant association between the literacy of farmers in prevalence of PPR in small ruminants as recorded in the present study. Among 323 small ruminants affected with some sorts of clinical signs related to PPR, majority were following nomadic grazing pattern with prevalence rate of 64.39%. There was relatively lesser prevalence (35.60%) of PPR in small ruminants with a history of permanent housing or grazing pattern. There was non-significant association between grazing pattern in incidences of PPR observed in our study as per Chi-square analysis.

### Status of vaccination & Deworming

Only 59 animals got vaccination against PPR with 302 animals not vaccinated against PPR as reported by the animal owner during counseling. Chi-square analysis recorded a non-significant association between prevalence of PPR and their vaccination status. There was 83.90% (n=271) PPR affections in non-vaccinated animals as comparison to 16.09% in vaccinated populations. Species wise prevalence of PPR was showing a non-significant association between vaccination status and PPR incidences in small ruminants. As per the information collected from the animal owners during counseling at the outbreak site, only two flocks (n= 43) were with history of previous deworming within 2 months. Fecal sample examinations of all morbid animals revealed some kinds of endoparasite infestations in 67.49% (n=218) of small ruminants.

### Flock pattern & History of recent animal purchase

Flock pattern comprising either goats or sheep housed separately or co-housing pattern i.e. both sheep and goats housed together adopted by farmers in Odisha. There was only 28.57% (n=4) of flocks belonging to co-housing pattern comprising both goats and sheep lived together while 71.43% (n=10) of flocks consists of only goats. There was a history of recent animal purchase from the nearby livestock markets or adjoining districts or states in seven outbreak areas out of total fourteen reported in the study.

### Season

Out of fourteen outbreaks occurred during the study period, seven numbers of outbreaks was encountered in summer season (50%) with four numbers of outbreaks in rainy season (28.57%) and least occurrence in winter season (21.42%).

### Discussion

Higher morbidity, mortality and case fatality as observed in the present study was in agreement with earlier reports [3, 4]. Higher mortality and case fatality rate in the present study might be due to lack of awareness among the animal owners, improper diagnosis, use of ethno-veterinary practices or improper treatment through village quacks and insufficient door step veterinary services and availability of veterinary care in the rural pockets [5]. Clinical signs as observed were in

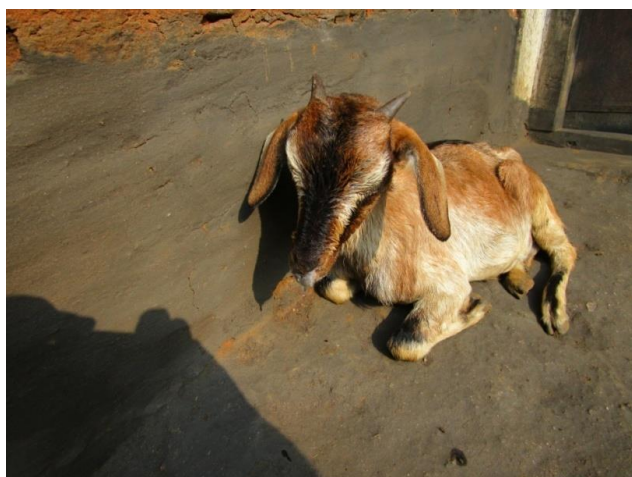
agreement with previous reports <sup>[1, 2, 4]</sup>. A few affected sheep and goats showed scabby lesions and yellowish crusts around the mouth, muzzles and oral commissures <sup>[2, 6]</sup>. Significantly higher occurrence of PPR among 6-12 months of small ruminants in the present study was in agreement with previous findings <sup>[7, 8]</sup> which might be attributed to lowering of maternal derived antibody after 4 months. Increased prevalence in females in this study might be due to relatively more number of females in the sample as compared to males. Animal owners generally in a practice for keeping less number of male animals i.e. only for breeding purpose in the flock as compared to a larger female flocks in proportion <sup>[9]</sup>. Higher prevalence in Ganjam breeds might be due to the more sample size in present study as well as these dual purpose breeds domesticated for relatively longer period by the animal owner thereby with an increased chance for contracting infection. Early slaughtering of Black Bengal breed may be attributed for relatively lesser affections in the present study <sup>[9, 10]</sup> while Least affections in non-descript breed might be due to their genetic makeup and increased disease resistance <sup>[10, 11]</sup>. Increased susceptibility of disease in small ruminants with poor body conditions attributed to nutritional imbalance and pre-existing parasitism as reported earlier <sup>[12]</sup>. Non-significant association between the literacy of farmers in prevalence of PPR in small ruminants as recorded in the present research was in accordance with other researchers <sup>[13, 14]</sup>. There was

non-significant association between grazing pattern in incidences of PPR observed in our study is in agreement with earlier findings <sup>[15]</sup>. Nomadic grazing pattern favors the possibility of getting infection from any infected animals during their movement <sup>[16]</sup>. Non-significant association between vaccination status and PPR incidences in small ruminants is in consistent with previous reports <sup>[17]</sup>. Higher prevalence of disease in non-vaccinated herds might be due to absence of protective antibody in their body <sup>[18]</sup>. Lack of quality vaccines, failure of cold chain maintenance in the field as well as improper dose of vaccination per animal as most often practiced by the field quacks might be a reason of vaccine failure in tropical countries like India <sup>[19]</sup>. Increased endoparasite infestation in affected animals as observed in the present research may be viewed as an augmenting factor in occurrence of PPR which corroborates with previous report <sup>[20]</sup>. Nutritional imbalance and co-infection with pre-existing worm infections may alter the course of disease severity <sup>[21]</sup>. Mixing of migratory populations of small ruminants with the native population may always be regarded as a contributing factor for contracting the PPR infection <sup>[2]</sup>. Increased outbreaks in summer season might be due to the scarcity of fodder and water thereby roaming for long distances and congregate at few places thereby contracting PPR infections from other infected animals <sup>[22]</sup>.

**Table 1:** Epidemiological risk factors in sheep & goats naturally affected with PPRV

Risk factors	Groups	Healthy	Affected	%prevalence	Chi square value	DF	P Value*
Age	≤6 months	7	78	91.76	15.17	2	0.0005
	7 -12 months	8	149	94.90			
	>12 months	23	96	80.67			
Sex	Male	18	63	77.78	15.16	1	0.0001
	Female	20	260	92.86			
Breed	Ganjam	7	147	96.70	24.79	2	0.0001
	Black Bengal	9	107	95.45			
	Indigenous	22	69	81.82			
Body condition	Poor	0	176	100	168.09	2	0.0001
	Moderate	03	120	97.55			
	Good	35	27	43.55			
Farmer type	Literate	0	20	100	2.49	1	0.1145
	Illiterate	38	03	88.86			
Vaccination status	Non-vaccinated	31	271	89.74	0.13	1	0.7142
	Vaccinated	7	52	88.14			
Grazing Pattern	Permanent	11	115	91.27	0.663	1	0.4155
	Nomadic	27	208	88.51			

\*  $p \leq 0.05$  means significant



**Fig 1:** Serous to mucopurulent nasal discharges



**Fig 2:** Diarrhea with soiling of perineum and tail



**Fig 3:** Fibrinous exudates on tongue

### Conclusion

There was high morbidity, mortality and case fatality recorded in PPR outbreaks. Significantly higher incidences of PPR were observed in Ganjam breeds, females, between 6-12 months and small ruminants with poor body conditions. Pre-existing parasitic infection as well as un-warranted mixing of animals after purchase from local markets may be viewed seriously for occurrence of PPR outbreaks. Non-significant association between vaccination statuses is being regarded as an alarm for the scientist and policy makers to go for the molecular characterization of circulating viral strain and vaccine strain for efficient immunization. Knowledge on various determinants of epidemiology may be helpful in mitigating the disease spread with awareness among the farming community as well as field vets.

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