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Seasonal patterns and distribution of neurological diseases in caprine populationin the tropical climate of tamilnadu, india: A study of 18 months

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ABSTRACT

A retrospective epidemiological study was undertaken to assess the seasonal distribution of neurological diseases in goats presented to the small ruminant clinic of Veterinary College and Research Institute, Orathanadu, Thanjavur district, Tamil Nadu, during the years 2024 and 2025. A total of 550 cases were diagnosed with neurological disease and classified into infectious (n=197), non-infectious (n=283), and idiopathic (n=70) neurological disorders. Among the infectious conditions, tetanus (n=119) was most prevalent, followed by listeriosis (n=24) and enterotoxemia (n=23). Polioencephalomalacia accounted for the majority of non-infectious cases (n=218). Seasonally, the highest incidence of neurological disorders was recorded during winter (37.64%), followed by summer (25.45%), pre-monsoon (20.36%), and monsoon (16.55%). Idiopathic cases predominantly occurred in winter (64.29%). These findings highlighted a the influence of seasonal variation on the occurrence of both infectious and non-infectious neurological diseases in goats. The present study helps for guiding seasonal disease preparedness and preventive veterinary interventions in this region.

Keywords: *Goats, Neurological diseases, Seasonality, Epidemiology, Tetanus, Polioencephalomalacia, Thanjavur.*

1. INTRODUCTION

Neurological disorders in goats pose a significant veterinary challenge due to their multifactorial origins, diagnostic complexity, and substantial impacts on animal health and rural economies. These conditions arise from infectious agents such as *Clostridium tetani*, *Listeria monocytogenes*, *Clostridium perfringens*, and rabies virus, as well as from non-infectious causes including polioencephalomalacia, hypovitaminosis A, pregnancy toxemia, and organophosphate poisoning (Divakaran Nair, 1999; Puvarajan *et al.*, 2020). Polioencephalomalacia (PEM), also known as cerebrocortical necrosis, is prominently reported in goats and often associated with thiamine deficiency and high sulfur intake. (Divakaran Nair, 1999; Chavda, 2015).

Climatic and seasonal factors critically influence the occurrence of these neurologic conditions in tropical regions. Studies have consistently shown that PEM cases were peak during the cooler,drier months, while warmer, wetter periods favor conditions like listeriosis and enterotoxemia due to spoilage of silage and feed (Chavda, 2015). In the Cauvery delta region, , tetanus was more prevalent remains a recurring concern in goats, particularly following practices such as ear tagging or wounding during the pre-monsoon to monsoon transition (Puvarajan., 2020).

Despite the recognized relevance of seasonality, there is a very meagre reports, on the temporal distribution of neurological diseases in goats from the Thanjavur region. Understanding these trends is critical for optimizing preventive measures like planning vaccination schedules and improve clinical preparedness fordisease control.

The present study aims to delineate the seasonal prevalence and distribution patterns of neurological diseases in goats of Thanjavur.. Further, this study helps to provide actionable insights for region-specific disease management strategiesfor goats.

2. MATERIALS AND METHODS

2.1. Study Area and Period

The present retrospective epidemiological study was conducted in and around the Thanjavur district, located 10º 09'00"N to 11º 14' 00"N Latitude, 78º 50' 00"E to 79º 33'30"E Longitude in the Cauvery delta zone of Tamil Nadu, India. The study area had tropical climate with distinct seasonsData were collected over spanning from January 2024 to December 2025.

2.2. Case Selection and Data Collection

Neurological cases of goats presented to the Small Ruminants Medicine Outpatient Unit, Veterinary Clinical Complex (VCC), Veterinary College and Research Institute (VCRI), Orathanadu,were included in thisstudy. A total of 11735 goats were presented to during the study period.

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A total of 550 confirmed neurological cases were retrospectively analyzed. Cases were classified into infectious, non-infectious, and idiopathic categories based on clinical signs, history, laboratory diagnosis, and postmortem findings where available. Clinical records were meticulously reviewed to extract relevant epidemiological information, including animal age, sex, breed, clinical presentation, season of occurrence, and diagnosis. Diagnoses were confirmed through standard laboratory tests such as bacterial culture, histopathology, biochemical assays, and, whenever applicable, sero diagnosis and molecular assays were performed. Cases with ambiguous diagnoses or incomplete data were excluded.

2.3. Seasonal Classification

In the present study, clinical cases were categorized based on the season of onset, determined by the date of clinical presentation. The seasons were defined as follows: Winter included the months of December to February, covering the periods from 2023–2024 and 2024–2025. Summer encompassed the months of March to May for the years 2024 and 2025. The Pre-monsoon season was defined as the period from June to August 2024, while the Monsoon season included the months of September to November 2024. This classification facilitated seasonal trend analysis of neurological disease occurrences in goats (Fig.1).

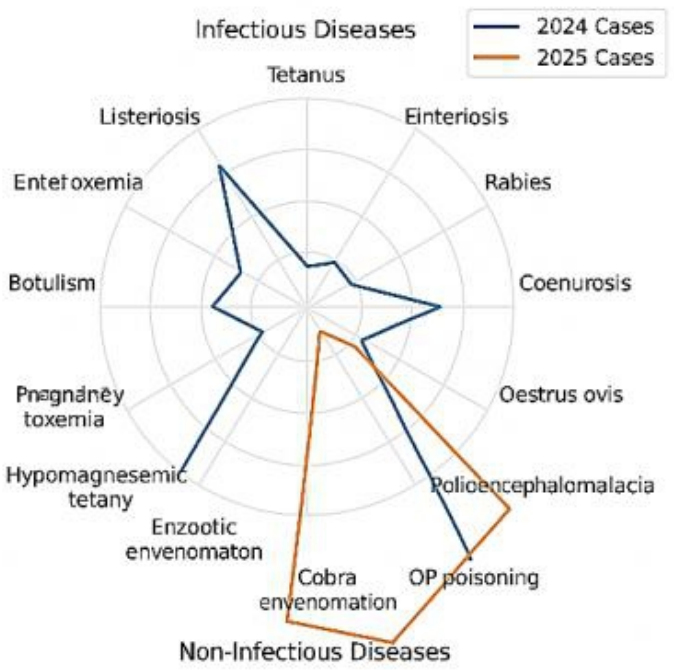

Fig.1. Visualizes distribution patterns across diseases in a circular layout of neurological diseases of goats

3. RESULTS

A total of 550 neurological disease cases in goats were recorded during the study period from 2024 to 2025 in and around the Thanjavur district. These cases were categorized into infectious (n=197; 35.82%), non-infectious (n=283; 51.45%), and idiopathic (n=70; 12.73%) neurological disorders. The overall incidence of neurological disorders was highest in winter (207 cases, 37.64%), followed by summer (140 cases, 25.45%), pre-monsoon (112 cases, 20.36%), and monsoon (91 cases, 16.55%) seasons (Fig.2).

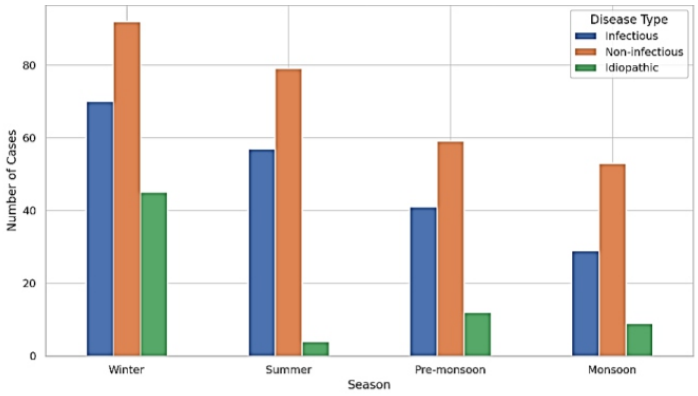

Fig.2. Absolute number of neurological cases by season

3.1. Infectious Neurological Diseases

Among infectious diseases, tetanus was the most frequently diagnosed in 119 cases (60.41% of infectious cases), followed by listeriosis (24 cases, 12.18%), enterotoxemia (23 cases, 11.68%), rabies (12 cases, 6.09%), botulism (7 cases, 3.55%), coenurosis (8 cases, 4.06%), and *oestrusovis* infestation (4 cases, 2.03%). Tetanus cases were higher during summer and winter seasons with 41 and 39 cases, respectively, whereas listeriosis and enterotoxemia were predominantly recorded during pre-monsoon and monsoon seasons. Rabies and botulism cases were distributed mainly in winter and pre-monsoon seasons.

3.2. Non-Infectious Neurological Diseases

Polioencephalomalacia (PEM) was the most commonly recorded non-infectious neurological disorder in goats with 218 cases (77.03% of non-infectious diseases), followed by enzootic ataxia (17 cases, 6.01%), pregnancy toxemia (18 cases, 6.36%), hypovitaminosis A (13 cases, 4.59%), organophosphate poisoning (8 cases, 2.83%), hypomagnesemic tetany (5 cases, 1.77%), and cobra envenomation (4 cases, 1.41%) (Fig.3). PEM cases were distributed slightly higher during summer and winter. Enzootic ataxia and hypovitaminosis A cases were more frequent during winter and monsoon seasons.

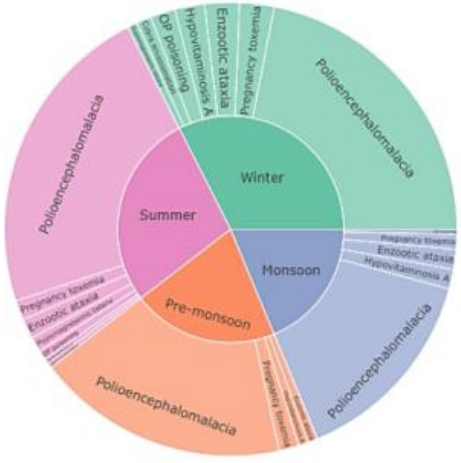

Fig.3. Season wise distribution of Non-infectious neurological cases of goats

3.3. Idiopathic Cases

A total of 70 idiopathic neurological cases were reported, most often cases occurred during with a majority occurring in winter (45 cases, 64.29%), followed by pre-monsoon (12 cases, 17.14%), monsoon (9 cases, 12.86%), and summer (4 cases, 5.71%).

4. DISCUSSION

The present study highlights the seasonal distribution and epidemiological patterns of neurological diseases in goats from the Thanjavur district, emphasizing the critical role of climatic and environmental factors in disease dynamics. The predominance of neurological cases during winter (37.64%) aligns with findings from Kandi and Vaish (2019), who reported that cold stress and reduced forage availability during cooler months increase vulnerability to metabolic and infectious diseases in small ruminants.

Among infectious neurological diseases, tetanus was the most frequently diagnosed condition, constituting over 60% of infectious cases. This corroborates the work of Puvarajan (2020), who described tetanus outbreaks in the Cauvery delta region associated with traumatic injuries and suboptimal immunization coverage. The seasonal peak of tetanus cases in summer and winter may relate to increased environmental contamination during dry and cold conditions and the consequent immunosuppression due to nutritional stress (Radostits *et al*., 2007).

Listeriosis and enterotoxemia cases were notably higher in pre-monsoon and monsoon seasons, consistent with the observations of Mozaffari et al. (2013), who linked listeriosis outbreaks to silage contamination in humid conditions. Enterotoxemia, caused by *Clostridium perfringens* type D, typically arises from sudden dietary changes leading to bacterial overgrowth (Smith, 2014). These findings underscore the importance of season-specific feed management and vaccination strategies to mitigate outbreaks during vulnerable periods.

During winter, cold stress, shortened daylight hours, and poor forage quality that predisposes the animals to metabolic and infectious diseases. The predominance of tetanus cases during this season could be due to environmental contamination by poor wound hygiene and reduced vaccination efficacy under stress-induced immunosuppression (Smith and Sherman, 2009; Chanter *et al*., 1998). This seasonal spike in tetanus aligns with studies emphasizing increased vulnerability to clostridial infections during periods of nutritional inadequacy and environmental rigor (Uzal *et al*., 2016).

Conversely, the summer season was characterized by high temperatures, dehydration stress, and dusty conditions, which could exacerbate open wounds, facilitate entry of *Clostridium tetani* organism.. Additionally, heat stress was known to alter gut permeability and immune function, further predisposing animals to tetanus and enterotoxemia (West, 2003; Callan and Garry, 2002). The dry environment, coupled with declining nutritional content in forage, is a compounding factor in disease development during this period (Lindsay *et al*., 2004).

In the present study, Pre-monsoon and monsoon seasons were particularly critical for diseases like listeriosis, enterotoxemia, and rabies. The high humidity and moderate temperatures create favorable conditions for the proliferation of *Listeria monocytogenes* in silage, leading to silage-borne encephalitic listeriosis outbreaks (Rocourt *et al*., 2000; Low *et al*., 2005). Similarly, *Clostridium perfringens* type D, the causative agent of enterotoxemia, thrives under conditions of sudden dietary changes and lush pasture ingestion typical of pre-monsoon grazing practices (Songer, 1996; Dabo et al., 1994). The seasonal flush in high-energy feed availability, when not balanced by gradual dietary adaptation, significantly elevates the risk of enterotoxemia (Uzal *et al*., 2010).

The monsoon season also poses a challenge due to poor housing conditions and water stagnation, which increase the transmission risks for vector-borne and waterborne infections (Patel *et al*., 2017). However, lower recorded neurological disease incidence in this study during the monsoon could reflect the seasonal migration of animals or restricted movement patterns due to flooding, which may lead to underreporting (Chand *et al*., 2014).

Polioencephalomalacia (PEM), the leading non-infectious neurological disorder in this study, demonstrated relatively even seasonal distribution but showed slight increases in winter and summer. This pattern parallels findings by Nair (1999) and Chavda (2015), who reported PEM incidence linked to thiamine deficiency and dietary sulfur content variations, which fluctuate with seasonal fodder quality. The occurrence of hypovitaminosis A and pregnancy toxemia during winter and monsoon also reflects the impact of nutritional stress and physiological demands under changing environmental conditions (Behrens and Scholz, 2012).

Idiopathic neurological cases, accounting for approximately 13% of total cases, clustered predominantly in winter, suggesting potential unrecognized etiologies including subclinical nutritional imbalances or environmental neurotoxins, as suggested by Kumar *et al*. (2018). The clustering of such cases during winter season, mandates the advanced diagnostics to uncover potential emerging or overlooked etiologies.

Overall, the findings confirm the influence of seasonal climatic factors on the epidemiology of neurological diseases in goats. Temperature fluctuations, humidity, and feed quality collectively affect pathogen survival, host immunity, and toxin exposure, as noted by Mahato *et al*. (2021). Targeted preventive measures such as timely vaccination, improved nutritional management, and farmer awareness campaigns timed to high-risk seasons are essential to reduce disease burden.

Taken together, this study emphasizes that season-specific trends in neurological disease prevalence were reflects of dynamic interrelations among feed availability, environmental exposure, immune competency, and pathogen survival (Taylor *et al*., 2016). Proactive and tailored interventions, including timely vaccination programs before high-risk seasons, nutritional supplementation, and farmer education on seasonal risk mitigation, are imperative (OIE, 2022).

CONCLUSION

The deployment of early disease warning systems and routine herd health monitoring based on climatic forecasting could reduce morbidity and improve livestock productivity in tropical agro-climatic zones like Thanjavur. This study provides valuable region-specific epidemiological data that could inform veterinary public health policies and improve neurological disease management in small ruminants within tropical agroecosystems.

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