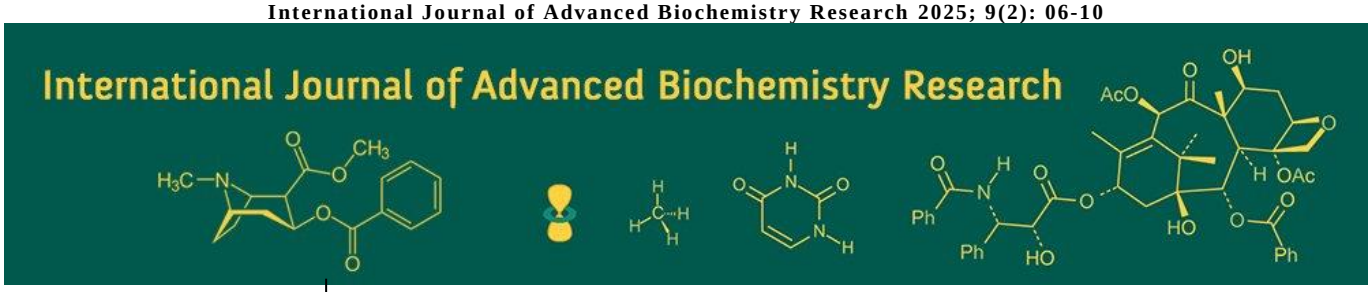

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Epidemiological pattern of canine parvovirus gastroenteritis in Kumaon region of Uttarakhand

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Abstract
The present study was carried out recording hospital based data of Canine Parvovirus gastroenteritis and its related risk factors impacting dogs within the Kumaon region of Uttarakhand. The study involved assessing the occurrence of Canine Parvovirus gastroenteritis through hospital records, focusing on factors such as gender, age, month, breed, vaccination status and seasonal variations. Data collection spans from November 2021 to December 2022. The overall prevalence of canine parvovirus gastroenteritis was 35.06% during the period from November 2021 to December 2022. Among different breeds, prevalence of CPV gastroenteritis in mixed/ non-descript breed of dogs was 30.04% and least prevalence was recorded in Great Dane (2.51%). A 61.73% of male and 38.27% of female dogs were affected. The prevalence in immunized dogs was recorded 19.63%, however, in non-immunized puppies, prevalence of CPV gastroenteritis was reported 80.36%. Age wise prevalence recorded as highest prevalence of 49.9% was accounted in dogs aged 3-6 months followed by 27.94% in less than 3 month old puppies and least prevalence of 22.36% was indicated in 6 months and above aged dogs. The highest percentage was also noted during winter season (26.68%), while the lowest prevalence of 11.80% was recorded during spring.

Keywords: Parvovirus, gastroenteritis, prevalence, immunization

Introduction
The dog stands as the first animal domesticated by humans. Their connection with humans has steadily strengthened. The urbanization trend suggests the potential for a higher dog population in urban areas (Philips *et al*., 2021) [1]. Over the past decade, scientific exploration and comprehension of animal welfare has significantly advanced. For dog owners, the primary concern remains the health of their dogs (Freiald *et al.,* 2014) [2]. Dogs, from a young age, are susceptible to various infectious diseases and other illnesses. Among infectious diseases, Canine parvovirus-2 (CPV-2) stands out as one of the most contagious DNA viruses, causing severe illnesses in young and unvaccinated dogs. The virus has evolved into a serious threat to canine health, exhibiting high morbidity (100%) and frequent mortality (91%) in untreated cases (Nandi and Kumar, 2010; Sykes, 2014) [3, 4]. As documented by Haque and Arfa (2012) [5], instances of parvovirus gastroenteritis were recorded in Mumbai and Madras, India, back in 1981. The prevalence peaks among puppies below 3 months old (48.7%), followed by those aged 4-6 months (17.2%) and over 6 months (8.3%) as noted by Hasan *et al.* (2016) [6]. Puppies become increasingly susceptible to parvovirus gastroenteritis as maternal antibody levels decrease. Inadequate vaccination and a higher population of non-specific dog breeds significantly increase vulnerability (26.7%) to CPV infection (Khare *et al.*, 2019) [7]. In puppies, CPV-2 infection primarily manifests as enteritis and myocarditis (Moon *et al.,* 2008) [8].

Materials and Methods
The current prevalence study of CPV gastroenteritis was conducted at Veterinary Clinical Complex, College of Veterinary and Animal Sciences, Pantnagar, Uttarakhand and was also carried out by recording hospital based data from various hospital/ veterinary clinics of Kumaon region of Uttarakhand. The aim of this research revolved around investigating the prevalence of Canine Parvovirus gastroenteritis and its related risk factors impacting dogs

within the Kumaon region of Uttarakhand. The study involved assessing the occurrence of Canine Parvovirus gastroenteritis through hospital records, focusing on factors such as gender, age, month, breed, vaccination status and seasonal variations. Data collection spans from November 2021 to December 2022.

Results and Discussion

Overall Prevalence

In the present study a total of 23127, clinically sick dogs irrespective of sex and below one year of age were taken, out of which 8110; canines were found suspected for canine parvovirus haemorrhagic gastroenteritis based hospital recorded data. The overall prevalence observed during this study period in the Kumaon region of Uttarakhand stood at 35.06%, as detailed in (Table 1).

The current research work was in agreement with previous research studies performed by Sen *et al.*, (2016) [9]; Navarro *et al.*, (2017) [10]; Shima *et al.*, (2021) [11]; Kalita *et al.*, (2022) [12] and Urvashi (2023) [13] who reported canine gastroenteritis prevalence as 30%, 24%, 41.2% 41.15% and 34.15% respectively. In contrast with present study, Yeison *et al.*, (2017) [14] documented majority of acute gastroenteritis cases (70.42%) related to CPV-2a/2b infections and Khare *et al.*, (2019) [7]; Kataria *et al.*, (2020) [16] and Bhattacharjee *et al.*, (2021) [15] recorded over all prevalence of Canine Parvovirus infection in dogs as 7.24%, (71/980), 12.24% (593/4847) and 15.28% respectively, which was not aligned with the present study.

Table 1: Overall prevalence of canine parvovirus gastroenteritis in Kumaon region of Uttarakhand based on hospital data (November 2021 to December 2022)

Overall clinically sick dog reported	Total hemorrhagic gastroenteritic dogs	Prevalence (%)
23127	8110	35.06

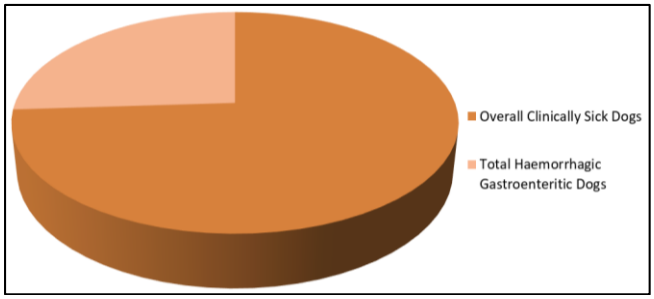

Fig 1: Pie chart depicting overall prevalence in Kumaon region of Uttarakhand

Sex wise prevalence

The sex wise outcome of prevalence showed the percentage of male dog out of total haemorrhagic gastroenteritis dogs were 61.73% (5006/8110). Similarly, in case of female dogs, this accounted for 38.27% (3104/8110) (Table 2). The findings of present research work was indistinguishable with Haque and Arfa (2012) [5]; Singh *et al.*, (2021) [17]; Kalita *et al.*, (2022) [12] and Urvashi (2023) [13] recorded 54.33%, 60.24%, 63.57% and 65.38% in male 45.66%, 39.76%, 34.43% and 34.61% in females. In contrast of the present work, Khare *et al.*, (2019) [7] recorded higher prevalence (7.91%) in male out of total canine parvovirus infected dog and in female lower prevalence (6.36%) was recorded. Yeison *et al.*, (2017) [14], reported no significant difference in gender distribution among population containing male prevalence with 48% while in female 52%.

Table 2: Dispersal of sex wise prevalence in Kumaon region (n=8110)

Sex	Total no of cases	Prevalence (%)
Male	5006	61.73
Female	3104	38.27

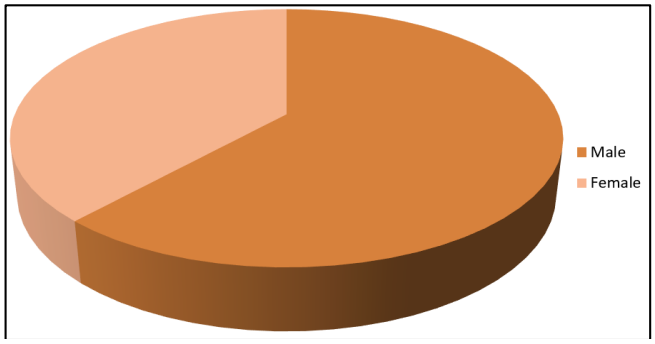

Fig 2: Pie chart depicting sex wise prevalence in Kumaon region of Uttarakhand

Immune status wise

The present study demonstrated the prevalence of parvovirus gastroenteritis in both immunized and non-immunized dogs and it was noticed that the prevalence was 19.63% (1592/8110) in immunized dogs. However, in non-immunized puppies, prevalence of CPV gastroenteritis was recorded 80.36% (6518/8110) (Table 3). The present study was in accordance with the observation of Singh *et al.*, (2021) [17] who reported that prevalence of CPV was 24.10% and 70.9% in vaccinated and non-vaccinated dogs, respectively.

Table 3: Dispersal of immune status wise prevalence in Kumaon region (n=8110)

Immunization	Total no of cases	Prevalence (%)
Vaccinated	1592	19.63
Non-vaccinated	6518	80.36

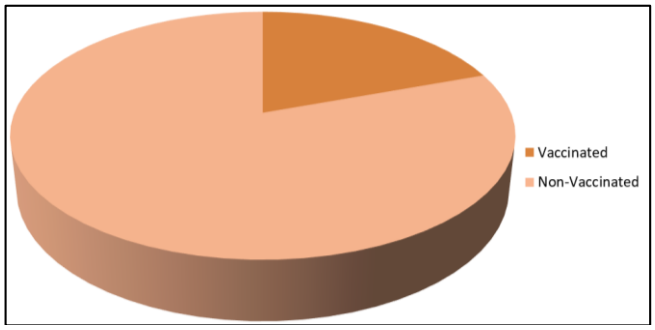

Fig 3: Pie chart depicting immunization status wise prevalence in Kumaon region

Age wise prevalence

During the period from November 2021 to December 2022, the age wise prevalence in canines was higher in 3-6 months aged dogs, i.e. 49.9% (4030/ 8110) followed by 27.94% (2266/8110) in less than 3 month puppies and at age of more than 6 months, it was recorded as 22.36% (1814/8110) respectively (Table 4). The findings of current study were accorded with Behera *et al.*, (2015) [18] and Urvashi (2023) [13]. While the present research work did not align with

Khare *et al.*, (2019) [7] who reported the prevalence of Canine Parvovirus infection in the puppies at the age of less than 3 months as 11.9%, between 3-6 month 7.09% and more than 6 months 5.31% respectively. Haque and Arfa (2012) [5] recorded that the prevalence of CPV infection puppies at the age of less than 6 month was 70.8% , while at the age of more than 6 month it was observed as 29.2% respectively. Singh *et al.*, (2021) [17] recorded age-wise prevalence of 73.49% in pups below 3 month of age.

Table 4: Dispersal of age wise prevalence in Kumaon region (n=8110)

Age	Total no of cases	Prevalence (%)
Less than 3 months	2266	27.94
3-6 months	4030	49.69
Greater than 6 months	1814	22.36

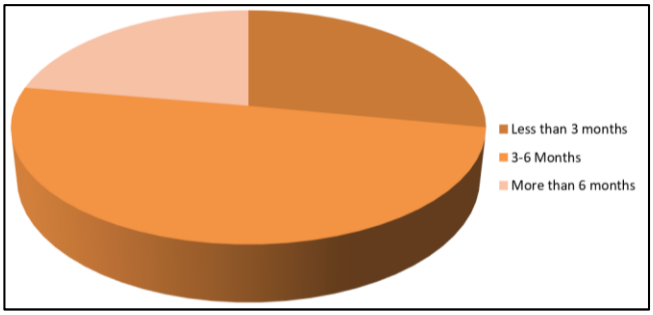

Fig 4: Pie chart depicting age wise prevalence in Kumaon region

Breed wise prevalence:

The breed wise prevalence of present study demonstrated that the highest prevalence, out of total clinically affected dogs was 30.04% (2436/8110) in mixed/ non-descript breed of dogs, followed by Germen Shepherd 22.17% (1798/8110) and Labrador 16.97% (1376/8110). However, least prevalence was recorded in Pitbull 5.46% (443/8110) and Great Dane 2.51% (204/8110) respectively (Table 5). This study was in accordance with Behera *et al.*, (2015) [18]; Sayed –Ahmed *et al.*, (2020) [19]; Kalita *et al.*, (2022) [12] and Urvashi (2023) [13] who observed maximum prevalence in non-descript breed, i.e. 34.48%, 48.5%, 51.16% and 52.23% respectively.

The results were dissonant with Khare *et al.*, (2019) [7] who observed that the percent prevalence in different breeds of dogs including non-descript, Germen Shepherd, Labrador, Spitz, Doberman and Great Dane were 12.37%, 6.12%, 3.82%, 3.61%, 3.57% and 10.00% respectively. Bhattacharjee *et al.*, (2021) [15] recorded highest prevalence in exotic breed like German Shepherd viz. 22.22% with no reports of CPV infection were recorded in local breed of dogs.

Table 5: Dispersal of breed wise prevalence in Kumaon region (n=8110)

Breeds	Total no of cases	Prevalence (%)
Non-descript/ Mixed	2436	30.04
Germen Shepherd	1798	22.17
Labrador	1376	16.97
Rottweiler	739	9.11
Pug	562	6.93
Spitz	552	6.81
Pitbull	443	5.46
Great Dane	204	2.51

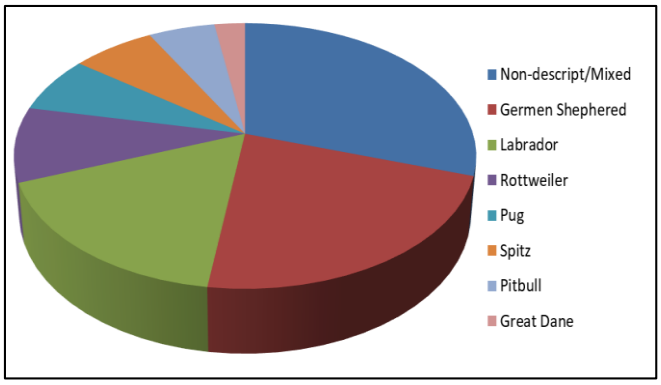

Fig 5: Pie chart depicting breed wise prevalence in Kumaon region

Month wise prevalence

The incidence of CPV gastroenteritis was noted to vary with months, with highest percentage of affected dogs in various hospital records was recorded as 14.99% (1216/8110) and 14.93% (1211/8110) in the month of December, 2021 and December, 2022 respectively, followed by 10.68% (866/8110) and 10.00% (811/8110) in the month of November, 21 and November, 2022. The least prevalence was noted as 2.53% (205/8110) in the month of June 2022 (Table 6). The present study was in accordance with the results of Mehta *et al.*, (2017) [20] who reported that the highest prevalence of CPV infected dogs were during the month of January and February, 62.22% and 65.00% respectively.

Table 6: Dispersal of Month wise prevalence in Kumaon region (n=8110)

Months	Total no of cases	Prevalence (%)
November -21	866	10.68
December-21	1216	14.99
January -22	950	11.71
February -22	453	5.58
March -22	504	6.21
April -22	482	5.94
May -22	296	3.65
June-22	205	2.53
July -22	212	2.61
August -22	228	2.81
September -22	278	3.42
October -22	398	4.91
November -22	811	10.00
December-22	1211	14.93

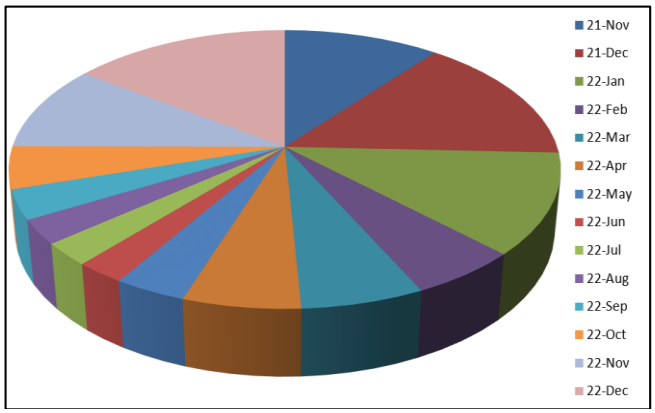

Fig 6: Pie chart depicting Month wise prevalence in Kumaon region

Season wise prevalence

The prevalence of CPV gastroenteritis extended seasonally with the highest percentages during winter season 26.68% (2164/8110) and autumn 18.67% (1515/8110) respectively. However, lowest cases were recorded during spring season 11.80% (957/8110) and summer 12.12% (983/8110) respectively (Table 7). The present study was supported by Mehta *et al.,* (2017) [20] who recorded highest prevalence of CPV gastroenteritis during winter season. In contrast with present research work, Kalita *et al.,* (2022) [12] accounted highest incidence, 33% of canine hemorrhagic gastroenteritis during spring season. While Sayed –Ahmed *et al*., (2020) [19] recorded highest prevalence of CPV infection in dogs during summer season, 77.10% followed by spring, 55.5%.

Table 7: Dispersal of season wise prevalence in Kumaon region (n=8110)

Season	Total no of cases	Prevalence (%)
Summer (April-June)	983	12.12
Autumn(September-November)	1515	18.67
Winter (December-January)	2164	26.68
Spring (February – March)	957	11.80

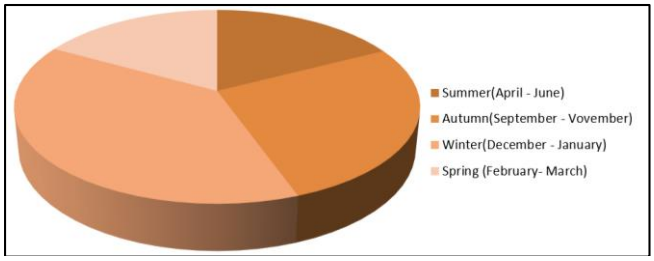

Fig 7: Pie chart depicting season wise prevalence in Kumaon region

Conclusion

The present study revealed that the overall prevalence of canine parvovirus gastroenteritis was 35.06% during the period from November 2021 to December 2022, in Kumaon region of Uttarakhand. Among different breeds, prevalence of CPV gastroenteritis in mixed/ non-descript breed of dogs was 30.04% followed by German shepherd (22.17%) and Labrador (16.97%). However, least prevalence was recorded in Pitbull (5.46%) and Great Dane (2.51%) respectively. Out of total cases, 61.73% of male and 38.27% of female dogs were affected. The prevalence in immunized dogs was recorded 19.63%, however, in non-immunized puppies, prevalence of CPV gastroenteritis was reported 80.36%. During the mentioned period the highest prevalence of 49.9% was accounted in dogs aged 3-6 months followed by 27.94% in less than 3 month old puppies and least prevalence of 22.36% was indicated in 6 months and above aged dogs. The highest percentage of haemorrhagic gastroenteritis cases were observed during winter season (26.68%) followed by 18.67% in autumn, while the lowest prevalence of 11.80% was recorded during spring and 12.12% in summer season.

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