Retrospective Study of Canine Pathologies Causing Mortalities in Ilorin Kwara State, Nigeria

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ABSTRACT

Canine pathologies refer to the various diseases, disorders, and abnormalities that can affect a dog's different body systems and cause mortality. The primary aim of this study was to investigate the common pathologies that are associated with the mortality of dogs in Ilorin, Kwara State. A retrospective review of post-mortem records from 7 years was undertaken at a necropsy unit of the Department of Veterinary Pathology, University of Ilorin. Data collected included age, sex, breed, disease pathogens, and year. A total of 150 dog carcasses were presented for necropsy during the period between January 2016 and December 2022. In this study, the cases used were confirmed based on PCR results in some cases, bacterial culture and isolation, parasite identification, gross lesions, and histopathological findings in other cases. Descriptive statistics were employed to evaluate the effect of disease pathogens on age, sex, and breed distribution patterns associated with the mortality of dogs. The prevalence of viral infection among other diseases was statistically significant (34.00%; OR = 0.53; P<0.01). The percentage prevalence of each disease showed that bacterial infections were evident, with Staphylococcosis being the most prevalent at 49.01%, followed by Salmonellosis at 7.84%, Leptospirosis at 23.53%, and Brucellosis at 19.6%. Parasitic infections were also notable, encompassing canine babesiosis (34.80%), acariosis (39.10%), and canine ehrlichiosis (26.08%). Toxicosis cases were largely dominated by diclovous poisoning, constituting 88.88% of instances, while medication toxicity was observed in 11.11% of cases. Neoplastic conditions were represented by hepatic lymphoma, with a prevalence of 1%, while nutritional deficiencies included hepatic lipidosis, noted in 1% of cases. Traumatic injuries were common, with bone fracture having the highest prevalence at 66.67% and muscle laceration observed in 33.33% of cases. Intestinal obstruction cases, specifically gastric impaction, were noted in 1% of cases. Viral infections comprised parvovirus infection with the highest prevalence at 81%, and canine distemper was observed in 18.92% of cases. In conclusion, this study has exposed the leading causes of mortalities among the dog population, which include parvovirus enteritis, staphylococcosis, and acariosis infections. The emphasis should be on preventive measures to curtail disease transmission and associated financial loss.

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Keywords: Canine; Bacterial; Mortality; Parasitic; Virus.

INTRODUCTION

Canine pathologies encompass a wide range of disease conditions affecting dogs, ranging from infectious diseases to genetic disorders. Understanding the underlying factors, clinical manifestations, and diagnostic approaches is crucial for effective therapy and management. Canine infectious diseases are caused by various pathogens, including viruses, bacteria, fungi, and parasites (**Greene, 2012).** Common viral pathogens, including canine parvovirus,

canine distemper virus, and canine adenovirus, are among the key viral pathogens affecting dogs (**Decaro and Buonavoglia, 2012).** Also, bacterial pathogens such as *Staphylococcus, Streptococcus*, and *Leptospira* are common bacterial pathogens causing skin infections, respiratory issues, and zoonotic diseases (**Sykes** *et al.,* **2014).** External parasites like ticks and fleas, as well as internal parasites such as heartworms, roundworms, and hookworms, pose significant health risks to dogs (**Bowman and Atkins, 2009).**

However, common genetic issues such as hereditary conditions like hip dysplasia, certain cancers, and heart defects are prevalent among specific dog breeds (**Bell, 2012).** Immune-mediated hemolytic anaemia (IMHA) and systemic lupus erythematosus (SLE) are autoimmune diseases affecting dogs (**Day, 996**). In addition, osteoarthritis and degenerative myelopathy are common degenerative conditions affecting the musculoskeletal and nervous systems (**Levine** *et al.,* **2006).** Finally, dogs can develop various types of cancer, with breed predispositions and environmental factors playing roles (**Dobson, 2013**). For more than 10,000 years, humans have shared their lives with dogs and cats (**Vitale** *et al.,* **2019).** They share our environment and have grown significantly in prestige as "pets" in our contemporary, highly urbanized culture (**Bruno, 2014; Tian** *et al., 2018).* Dogs are frequently kept for several reasons, including as pets or companionship, as protection or guard dogs, hunting, herding, pulling loads, and assisting police and the military with crime detection (**Villareal** *et al.,* **2018; Thorsrud and Huson, 2021).**

Feil *et al.,* **(2021)** showed that dogs' olfactory ability is used for search and rescue, highlighting their effectiveness in locating missing persons in urban environments. Also, **Beebe** *et al.,* **(2020)** in their review article focus on the use of scent-detection dogs in various fields, such as detecting drugs, explosives, and human diseases. Again, authors reported in their review article about the history, prevalence, and characteristics of guide dogs used by individuals with visual impairments (**Kassem** *et al.,* **2022).** In addition, **Mueller** *et al.,* **(2018)** also, explore the positive impact of therapy dogs on the well-being of elderly individuals. The greater recognition of dogs' practicality has made dog breeding a very lucrative industry; nonetheless, it must deal with the problem of managing health and disease. Bacterial, viruses, parasitic, nutritional, and neoplasms (**Bruno, 2014),** and non-infectious diseases are a few of the many diseases that hinder the expansion of dog breeding and keeping. Canine brucellosis can be transmitted through breeding or close contact with infected dogs, which causes reproductive disorders, including infertility and abortion, in both male and female dogs (**Lefkowitz and Ferroglio, 2020).** Viral diseases such as canine herpesvirus infection can cause respiratory and neurological symptoms with high mortality rates in puppies (**Roels** *et al., 2016).* Another disease transmissible from breeding during contact is the canine transmissible venereal tumour, as reported by **Murchison, (2018).**

In nature, bacteria are found everywhere. The majority of bacterial pathogens exist commensally and shield the host immune system from other diseases, but a small number of them have the potential to harm people (**Patel** *et al.,* **2022).** In general, dogs are exposed to a variety of infections from many sources, including the environment, pests, people, and other animals. Numerous variables, such as poor diet, ageing, allergies, inactivity, stress, and other illnesses, can make bacterial infections worse. The animal's immune system plays a critical role in defending it against infections. The host's immune system typically eliminates the bacterial pathogen without seriously harming the host. However, in young and immunosuppressed dogs, the immune system might also be unable to prevent the illness (**Ghasemzadeh and Namazi, 2015).** Canine viral infections are a major cause of dog mortality. Some viral infections are defined by lymphoid tissue, the neurological system, or both. Infected cells, such as lymphocytes, monocytes, and platelets, can spread the virus throughout the body or non-cell-associated viruses can do so, which can infect different organs. As reported by **Mazzaferro, (2020),** canine parvoviral infection causes the highest mortality in dogs. Because some infectious diseases that dogs are prone to can be fatal if not treated quickly, dog owners may worry about this. Different bodily parts can become infected with bacterial and fungal diseases.

Furthermore, many of them spread between humans and dogs through zoonotic illnesses. Any disease's symptoms often vary depending on whether the infection is local or systemic and where it originated. The local infection typically affects the skin's surface, where swellings might be hard or soft and include discharges (**Chermprapai** *et al., 2019).* This study aims to extract the disease that led to the death of canines in the past 7 years submitted for necropsy in the Department of Veterinary Pathology, University of Ilorin, Nigeria, from January 2016 to December 2022. Information regarding the age, breed, and sex of individual animals was derived from the post-mortem records. The dogs examined ranged in age from less than 1 year to 4 years and above. One hundred and fifty animals died from different diseases such as viruses, bacteria, parasites, neoplasms, toxicosis, trauma, and nutritional deficiency diseases. Viral diseases were the leading cause of death in the canines during this study.

MATERIALS AND METHODS

Study Area, Period, and Cases Selection

A retrospective review of January 2016 and December 2022 of post-mortem records from 7 years was undertaken at a necropsy unit of the Department of Veterinary Pathology, University of Ilorin. Veterinary Teaching Hospital. Data collected included age, sex, breed, disease pathogens, and year. Information regarding the age, breed, and sex of individual animals was derived from the post-mortem records. The dogs examined ranged in age from less than 1 year to 4 years and above. The gross diagnosis was obtained from the departmental post-mortem records. Most of the dogs used in this study were kept as pets, guard dogs, and for hunting. The clinical diagnosis was based on history and clinical signs presented before the death of animals. The recorded cases used in this study were confirmed cases based on polymerase chain reaction (PCR) in some cases while bacterial culture and isolation, parasite identification, gross lesions, and histopathological findings in some cases.

Statistical Analysis

Statistical analysis was conducted to describe how age, sex, breed, and year affect the likelihood of contracting the diseases mentioned, using Statistical Package for the Social Sciences (SPSS, Chicago, Ill., USA) for Windows version 20.0. Descriptive statistics were carried out to estimate the associated risk factors using percentages, confidence intervals (CI), and odds ratios (OR), presented in tables.

RESULTS

According to **Table 1**, in 2016, the highest percentage of deaths was recorded for the female sexes (38.9%), while the lowest percentage was recorded for the male sexes. Also, in 2017, the female had the highest percentage of deaths (59.1%), and the male had the lowest percentage (40.9%) of deaths. Again, in 2018, the female had a percentage death rate of 68.2%, while the male had a percentage death rate of 31.8%. The death rate of females was 60%, and the death rate of males was 40% in 2019. Our findings also showed in Table 1 that the female had a percentage death rate of 70% and the male had a 30% death rate in 2020. It was also observed that in 2021, the female had a 70.3% percentage death rate while the male had a 29.3% death rate. In 2022, the female also had a 72.7% death rate, and the male had a 27.3% death rate, as shown in **Table 1.** One hundred and fifty post-mortem cases were considered: 74 (44%) died of viral infection (canine parvovirus infection), 51 (31%) died of bacterial infection (staphylococcosis), 23 (14%) died of parasitic infection (canine babesiosis), 9 (5%) died of toxicosis, 3 (1.8%) died of neoplasm (lymphosarcoma), 1 (0.6%) died of nutritional deficiency, and 1 (0.6%) died of intestinal infections.

Table 1: Sex percentage mortality recorded per annum of dogs examined for post-mortem from 2016–2022 (n=150).

Year	Number recorded	Number in female	Percentage in females (%)	Number in male	Percentage in males (%)
2016	18	07	38.9	11	61.1
2017	22	13	59.1	09	40.9
2018	22	15	68.2	07	31.8
2019	30	18	60.0	12	40.0
2020	10	07	70.0	03	30.0
2021	37	26	70.3	11	29.7
2022	11	08	72.7	03	27.3

% = Percentage, n = Sample size

The summary is presented in **table 2**. The Alsatian dogs had the highest percentage death rate of (22.67%; 95% C.I= 16.70-30.00): German shepherds at 19.33%; 95% C.I=13.81-26.39): Mongrels at (14.67%; 95% C.I= 9.89-21.21): Boerboels at (13.33%; 95% C.I=8.80-19.70): Rottweilers at (12%; 95% C.I= 7.73-18.17): Caucasians at (11.33%; 95% C.I= 7.20-17.40): Amerika Eskimo at (2.67%; 95% C.I= 1.04-6.66) while the Briddle, Terrier, and Pitbull had the lowest percentage death rate of (0.66%; 95% C.I= 0.12-3.68).

Table 2: Breed percentage mortality recorded of dogs examined for post-mortem from 2016-2020 (n=150).

Breeds of dog	Number of dead carcasses	Percentage of dead carcasses (%)	95% C.I
Alsatian	34	22.67	16.70 – 30.00
American Eskimo	4	2.67	1.04 – 6.66
Boerboel	20	13.33	8.80 – 19.70
Caucasian	17	11.33	7.20 – 17.40
Duberman	2	1.33	0.37 – 4.73
German sphered	29	19.33	13.81 – 26.39
Lhasa Apso	1	0.66	0.12 – 3.68
Mongrel	22	14.67	9.89 – 21.21
Pitbull	1	0.66	0.12 – 3.68
Rottweiller	18	12	7.73 – 18.17
Terrier	1	0.66	0.12 – 3.68

C.I= Confidence interval, % = Percentage, n = Sample size.

As seen in **Table 3**, the mortality rate of dogs from bacterial diseases is twice as low as that from viral infections (34.00%; OR = 0.53; $P < 0.01$). Also, the mortality rate from parasite infection is eight times lower than that from viral infection (15.33%; OR = 0.19; $P<0.01$). Again, toxicosis exhibits a death rate nine times lower than viral infection (6.00%; OR = 0.07; $P<0.01$) compared to toxicosis. When compared to viral infection over the period, the mortality rates for neoplasm (3.33%; OR = 0.04; $P < 0.01$), trauma (2.00%; OR = 0.02; $P<0.01$), nutrition (0.67%; OR = 0.01; $P<0.01$), and intestinal obstruction (0.67%; OR = 0.01; $P<0.01$) are lower.

Table 3: Disease distribution and percentage prevalence of dogs examined for post-mortem from 2016 – 2022 (n=150).

Diseases	Number of occurrences	Percentage occurrence (%)	OR	P value
Bacterial	51	34.00	0.53 (0.33 - 0.84)	0.01
Parasitic	23	15.33	0.19 (0.11 - 0.32)	<0.01
Toxicosis	9	6.00	0.07 (0.03 - 0.14)	<0.01
Neoplasm	5	3.33	0.04 (0.01 - 0.09)	<0.01
Traumatic injuries	3	2.00	0.02 (0.01 - 0.06)	<0.01
Nutritional deficiency	1	0.67	0.01 (<0.01- 0.04)	<0.01
Intestinal obstructions	1	0.67	0.01 (<0.01- 0.04)	<0.01
Viruses [*]	74	44.33	1.00	

OR= Odds Ratio; C.I= Confidence Interval; *= Reference Category, n = Sample size, % = Percentage, < = Less than.

As shown in **Table 4**, the percentage prevalence of each disease showed that bacterial infections were evident, with Staphylococcosis being the most prevalent at 49.01%, followed by Salmonellosis at 7.84%, Leptospirosis at 23.53%, and Brucellosis at 19.6%. Parasitic infections were also notable, encompassing canine babesiosis (34.80%), acariosis (39.10%), and canine ehrlichiosis (26.08%). Toxicosis cases were largely dominated by diclovous poisoning, constituting 88.88% of instances, while medication toxicity was observed in 11.11% of cases. Neoplastic conditions were represented by hepatic lymphoma, with a prevalence of 1%, while nutritional deficiencies included hepatic lipidosis, noted in 1% of cases. Traumatic injuries were common, with bone fracture having the highest prevalence at 66.67%, and muscle laceration observed in 33.33% of cases. Intestinal obstruction cases, specifically gastric impaction, were noted in 1% of cases. Viral infections comprised parvovirus infection with the highest prevalence at 81%, and canine distemper was observed in 18.92% of cases.

Table 4: Percentage classification of each disease distribution of dogs examined for post-mortem from 2016 – 2022 (n=150).

Bacterial Infection	Parasitic infection	Toxicosis	Neoplasm	Nutritional deficiencies	Traumatic Injury	Intestinal obstruction	Viral infection
Staphylococcosis (49.01%)	Canine babesiosis (34.80%)	Diclovous poisoning (88.88%)	Hepatic lymphoma (1%)	Hepatic lipidosis (1%)	Bone fracture (66.67%)	Gastric impaction (1%)	Parvovirus infection (81%)
Salmonellosis (7.84%)	Acariosis (39.10%)	Medication toxicity (11.11%)			Msucle laceration (33.33%)		Canine distemper (18.92%)
Leptospirosis (23.53%)	Canine Ehrlichiosis (26.08%)						
Brucellosis (19.6%)							

According to **table 5**, when compared to dogs between the ages of 2 and above, dogs under the age of one to two years had the greatest mortality rate from 2016 to 2022.

Table 5: Percentage age distribution of dogs examined for post-mortem from 2016 – 2022.

Age (year)	2016	2017	2018	2019	2020	2021	2022
< 1	8 (44%)	12 (55%)	10 (45%)	17 (56%)	5 (50%)	18 (48%)	6 (55%)
1 – 2	7 (39%)	8 (36%)	10 (45%)	11 (37%)	4 (40%)	8 (22%)	4 (36%)
2 – 3	3 (17%)	0	1 (5%)	0	0	1 (3%)	0
3 - 4	0 (0.00)	2 (9%)	1 (5%)	2 (7%)	1 (10%)	10 (27%)	1 (9%)

< = Less than, % = Percentage

DISCUSSION

The current study showed that viral diseases caused the highest percentage of mortality among the dog population, followed by bacterial and parasitic infections in Ilorin Kwara State. The study shows that 74% of all the dogs presented were affected by viral diseases. Among the viral diseases were parvovirus enteritis (81%) and canine distemper (18.92%). The bacterial count was 51%, of which staphylococcosis (49.01%), leptospirosis (23.53%), brucellosis (19.6%), and salmonellosis (7.84%). In addition, parasitic diseases were 23%, among which were acariosis (39.10%), canine babesiosis (34.80%), and canine ehrlichiosis (26.08%). The impact of canine pathologies as causes of mortalities has been emphasized by the previous studies: **Decaro and Buonavoglia, (2012); Greene, (2012) and Sykes et al., (2014).** According to the analysis of the current study, viral infection is the main cause of canine mortality, especially parvovirus enteritis, which had the highest percentage recorded from the post-mortem submission at the necropsy unit of the Department of Veterinary Pathology, University of Ilorin, between 2016 and 2021. This study also revealed that, apart from viral infections, bacterial and parasitic infections were the next causes of mortality in dogs. This could

be due to exposure of the animals to infected animals, contaminated environments, poor hygiene in dog kennels, and compromised immune systems. Because of their decreased maternal immunity, these animals are more susceptible to infection, leading to higher mortality rates. This served to support other authors' reports, **Foud et al., (2018); Vermillion et al., (2018) and Chaya et al., (2019)** even more. In addition to the aforementioned factor, young animals suffer more due to stress brought on by early weaning or a lack of antibodies produced by the mother. This might be a result of the young canines' frequent closeness to the ground and the gradual development of immunity. Also, factors like overcrowding, inadequate vaccination, and a lack of preventive measures can increase the risk of infectious diseases in the canine population. The findings of **Mosallanejad et al., (2012) and Abdukareem et al., (2018)** are supported by this observation. According to this study's findings, the vast majority of these animals between the ages of 2 and 4 years do not frequently contract illnesses.

However, mortality patterns in adult dogs may have been associated with stress in dogs, as reported by **Cridge et al., (2022)**. Although female dogs in this study showed higher mortality rates than male dogs, this may be because the majority of dog owners utilize

them for breeding with little regard for the kind of diseases the other sex is carrying. The animals are exposed to infections as a result of this practice, particularly when mating with diseased dogs. Diseases such as Brucellosis are often transmitted through breeding and mating. This disease can lead to infertility, abortion, and other reproductive problems (**Domosławska and Zdunczyk, 2020**). Severalresearchers, **Danta-Torres *et al.,* (2010) and Abdukareem *et al.,* (2018**) have observed that this may be because of hormonal changes during reproduction and the sedentary behaviors that female dogs frequently participate in during nursing, which are avenue for disease transmission. This retrospective investigation further revealed that from January 2016 through December 2022 mortality due to viral, bacterial, and parasitic infection carried the highest percentage compared to toxicity, neoplasm, traumatic injury, nutritional deficiency, and intestinal obstruction. This may be due to increased humidity and poor sanitation, which can facilitate the spread of the diseases. This observation could also be a factor arising from the two major seasons in Nigeria: the rainy and dry seasons. This report further agreed with the reports of authors such as **Shima *et al.,* (2015); Karshima *et al.,* (2020); Pilau *et al.,* (2022).**

There is little information in the literature about the distribution of canine diseases in Ilorin, Kwara State, Nigeria. The study also revealed that the most common breeds of dogs that were necropsied at the Veterinary Teaching Hospital, University of Ilorin, were Alsatian (22.7%), German shepherd (19.3%), Mongrel (14.7%), and Boerboel (13.3%), Rottweiler (12%), and Caucasian (11.3%). This indicated that most of these breeds of dogs were domesticated to dog owners in Ilorin, Kwara State. This could be because these breeds are the most prevalent exotic breeds of dogs in the Ilorin area. Among the listed breeds of dogs that perished from canine diseases, are the Mongrel (a local breed), which had 14.7% of the total. This could be a result of the owner's free-range management policies and stress exposing the animals to diseases and infections. This confirms previous authors' reports **(Cridge *et al.,* 2022).**

CONCLUSION

In conclusion, this study has exposed the leading causes of mortalities among the dog population, which include viral (parvovirus enteritis), bacterial (staphylococcosis), and parasitic (acariosis) infections. The study also revealed that viral, bacterial, and parasitic infections were the major causes of canine mortalities, with huge health and economic implications. By implication, these diseases are still in the dog population with significant negative health impacts. Some of these infections could be life-threatening, affecting the overall well-being of individual animals. Also, with these findings, infectious diseases such as parvovirus enteritirs and canine distemper can spread rapidly within dog communities, especially in areas with close contact between animals. This can lead to outbreaks and increased transmission rates. Again, some of these infections can be transmitted from dogs to humans (zoonoses). Infected dogs may suffer from pain, discomfort, and a decreased quality of life. In addition, some infections can impact fertility and reproduction in dogs, affecting breeding programs and the overall genetic health of specific breeds. The emphasis should be on preventive measures to curtail disease transmission and associated financial loss.

Conflicts of interest

All authors declare that they have no conflict of interest.

Acknowledgments

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