



Original Article

A Comprehensive Study Analyzing the Prevalence, Distribution, and Factors Influencing the Occurrence of Newcastle Disease in Backyard Poultry Populations in Pakistan

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ABSTRACT

Background: Newcastle disease (ND) is a significant concern for backyard poultry populations in Pakistan. **Objectives:** This comprehensive study analyzed the prevalence, distribution, and factors influencing the occurrence of ND in these populations. **Methods:** A cross-sectional design was employed, covering four regions of Pakistan and assessing 384 backyard poultry flocks. **Results:** Overall prevalence rate of ND was found to be 11.97%. Among the regions, Layyah had a prevalence rate of 12.0%, Muzafargarh had 14.0%, Multan had 11.2%, and Khushab had 11.9%. Factors such as flock size, poultry breeds, biosecurity measures, and vaccination coverage were identified as significant influences on ND occurrence. Notably, small flocks (less than 50 birds) had a prevalence rate of 13.33%, medium-sized flocks (50-100 birds) had 11.11%, and large flocks (more than 100 birds) had 11.90%. Local breed flocks had a prevalence rate of 5.00%, hybrid breeds had 11.11%, and exotic breeds had 20.19%. **Conclusion:** The study provided valuable insights into ND prevalence and associated factors, facilitating the development of targeted control and prevention strategies for backyard poultry populations in Pakistan.

INTRODUCTION

Backyard poultry refers to small-scale poultry production systems commonly found in residential areas, rural households, and small farms ¹. It involves raising a variety of poultry species, including chickens, ducks, geese, turkeys, and quails, for various purposes such as egg production, meat consumption, and hobby farming. Backyard poultry farming plays a crucial role in the global agricultural sector, providing a sustainable source of protein, income generation, and food security, particularly in low-income and rural communities ².

The practice of backyard poultry farming has gained significant popularity in recent years due to several factors ³. First, it offers an opportunity for individuals and families to produce their own food and reduce dependence on commercially produced poultry products ⁴. This self-sufficiency is particularly relevant in regions with limited access to affordable and quality poultry products ⁵. Furthermore, backyard poultry farming provides an avenue for income generation and livelihood improvement. It allows individuals to generate supplemental income through the sale of eggs, meat, or live birds. Additionally, it offers opportunities for entrepreneurship and small-scale business development, empowering individuals to become self-employed and contribute to the local economy ⁶.

In many developing countries, including Pakistan, backyard poultry farming serves as a vital source of nutrition and food security, especially for low-income households ⁷. Poultry products, such as eggs and meat, are rich in essential nutrients and serve as affordable sources of high-quality protein. Backyard poultry farming enables households to have regular access to these nutritious products, improving dietary diversity and addressing malnutrition concerns ⁸.

However, backyard poultry farming is not without challenges. One significant concern is the occurrence and spread of infectious diseases, such as Newcastle disease, avian influenza, and coccidiosis. These diseases can cause significant losses in poultry productivity, negatively impacting the livelihoods of backyard poultry farmers and posing risks to public health ⁹⁻¹⁰.

Newcastle disease (ND), also known as Avian Paramyxovirus type 1, is a highly contagious viral disease that affects a wide range of bird species, including poultry ¹¹. It poses a significant threat to the poultry industry worldwide, leading to substantial economic losses. In Pakistan, where backyard

poultry farming is a common practice and a vital source of income and nutrition for rural communities, ND has emerged as a major concern ¹².

The prevalence, distribution, and factors influencing the occurrence of Newcastle disease in backyard poultry populations in Pakistan have become subjects of great interest and concern for researchers, veterinarians, and policymakers. Understanding the dynamics of this disease is crucial for developing effective control and prevention strategies ¹⁴.

This comprehensive study aimed to analyze the prevalence, distribution, and factors influencing the occurrence of Newcastle disease in backyard poultry populations in Pakistan. By examining the disease's scope and impact, the study intends to shed light on the underlying factors that contribute to its spread and identify potential interventions for its control. The study utilized a combination of epidemiological surveys, laboratory diagnostics, and statistical analysis to gather data on the occurrence of ND in different regions of Pakistan. The prevalence and distribution of the disease was determined through the systematic sampling of backyard poultry flocks in selected areas, considering factors such as geographic location, flock size, and management practices.

MATERIAL AND METHODS

Study Design

This comprehensive study on Newcastle disease in backyard poultry populations in Pakistan utilized a cross-sectional design, combining epidemiological surveys, laboratory diagnostics, and statistical analysis. The study was conducted over a period of 12 months, from January to December, 2022, covering various geographical regions of Pakistan including Layyah, Muzafargarh, Multan and Khushab.

Sample Selection

A multistage sampling technique was employed to select study sites and backyard poultry flocks. A sum of 384 backyard poultry flocks within the selected villages was identified using a systematic sampling approach and a sum of 384 flocks was assessed for investigation of ND ¹⁵.

Epidemiological Surveys

Structured questionnaires were administered to the poultry owners to collect data on flock characteristics, management practices, biosecurity measures, and vaccination history. Information on factors such as flock size, poultry breed, housing

conditions, source of birds, and contact with other bird species was also recorded.

Laboratory Diagnostics

Cloacal or oropharyngeal swabs were collected from selected birds in each flock and transported in viral transport media to the laboratory. Samples were tested for the presence of Newcastle disease virus (NDV) using reverse transcription-polymerase chain reaction (RT-PCR) or viral isolation techniques. Serological testing was performed using enzyme-linked immunosorbent assay (ELISA) to determine the seroprevalence of NDV antibodies.

Data Analysis:

Data collected from the questionnaires were entered into a database and analyzed using appropriate statistical software. Descriptive statistics, such as frequencies, proportions, means, and standard deviations, were calculated to summarize the characteristics of the backyard poultry flocks and their management practices. The prevalence and distribution of ND in different regions were estimated based on laboratory diagnostic results.

Statistical analysis

Multivariable logistic regression analysis was performed to identify factors influencing the occurrence of ND in backyard poultry populations. Variables with a significant association ($p\text{-value} < 0.05$) were included in the final regression model. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to measure the strength of association between the identified factors and ND occurrence.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board before the commencement of the study. Informed consent was obtained from poultry owners participating in the study, ensuring their voluntary participation, confidentiality, and the right to withdraw at any time.

Limitations

The study's limitations included the reliance on self-reported data from poultry owners, potential recall bias, and the cross-sectional design, which limited the ability to establish causal relationships between factors and ND occurrence. Despite these limitations, this comprehensive study provided valuable insights into the prevalence, distribution, and factors influencing the occurrence of Newcastle disease in backyard poultry populations in Pakistan, facilitating the development of targeted control and

prevention strategies.

RESULTS

The prevalence of Newcastle disease in backyard poultry flocks was studied in different regions of Pakistan. A total of 384 flocks were examined across the four regions: Layyah, Muzafargarh, Multan, and Khushab. In Layyah, 75 flocks were examined, out of which 9 flocks tested positive for Newcastle disease, resulting in a prevalence rate of 12.0%. In Muzafargarh, 50 flocks were examined, with 7 flocks testing positive, yielding a prevalence rate of 14.0%. Similarly, in Multan, 125 flocks were examined, and 14 flocks were positive for Newcastle disease, giving a prevalence rate of 11.2%. In Khushab, 134 flocks were examined, out of which 16 were positive, resulting in a prevalence rate of 11.9%. Overall, across all the regions, a total of 46 flocks tested positive out of the 384 flocks examined, resulting in an average prevalence rate of 11.97%. These findings indicated that Newcastle disease is present in backyard poultry flocks in these regions of Pakistan, although the prevalence rates vary slightly between the regions (Table 1).

Factors associated with the occurrence of Newcastle disease in backyard poultry populations were categorically studied. The study analyzed several variables, including flock size, poultry breeds, biosecurity measures, and vaccination coverage. Regarding flock size, a total of 120 small flocks (with fewer than 50 birds) were examined, out of which 16 flocks tested positive for Newcastle disease, resulting in a prevalence rate of 13.33%. In the medium-sized category (50-100 birds), 180 flocks were examined, with 20 flocks testing positive, yielding a prevalence rate of 11.11%. For large flocks (more than 100 birds), 84 flocks were examined, and 10 flocks were positive for Newcastle disease, resulting in a prevalence rate of 11.90%. The odds ratios and their corresponding 95% confidence intervals (CI) were calculated for each category. Regarding poultry breeds, 100 local breed flocks were examined, with 5 flocks testing positive for Newcastle disease, resulting in a prevalence rate of 5.00%. For hybrid breeds, 180 flocks were examined, and 20 flocks tested positive, yielding a prevalence rate of 11.11%. In the case of exotic breeds, 104 flocks were examined, with 21 flocks testing positive for Newcastle disease, resulting in a prevalence rate of 20.19%. The analysis of biosecurity measures revealed three categories: good, moderate, and poor. Among 250 flocks with good biosecurity measures, 14 flocks tested positive for Newcastle disease, resulting in a

prevalence rate of 5.6%. For flocks with moderate biosecurity measures, 80 flocks were examined, and 15 flocks tested positive, yielding a prevalence rate of 18.75%. In the case of flocks with poor biosecurity measures, 50 flocks were examined, and 17 flocks were positive for Newcastle disease, resulting in a prevalence rate of 34.0%. Regarding vaccination coverage, three categories were considered: adequate, partial, and inadequate. Among 240 flocks with adequate vaccination coverage, 5 flocks tested positive for Newcastle disease, resulting in a prevalence rate of 2.08%. For flocks with partial vaccination coverage, 90 flocks were examined, and 19 flocks tested positive, yielding a prevalence rate of 21.11%. In the case of flocks with inadequate vaccination coverage, 50 flocks were examined, and 22 flocks were positive for Newcastle disease, resulting in a prevalence rate of 44.0%. These findings suggested that flock size, poultry breeds, biosecurity measures, and vaccination coverage are the factors that may influence the occurrence of Newcastle disease in backyard poultry populations (Table 2).

The frequency of various clinical

signs or symptoms observed in cases of Newcastle disease indicated that respiratory distress was the most common clinical sign, reported in 65% of the cases. This indicated that a significant majority of the affected birds experienced difficulties in breathing or exhibited other respiratory problems. Nervous signs were observed in 30% of the cases, suggesting the presence of neurological symptoms such as tremors, paralysis, or abnormal behaviors. Diarrhea was reported in 35% of the cases, indicating a substantial proportion of birds showed loose or watery feces. Swollen joints were observed in 15% of the cases, implying that a smaller percentage of birds exhibited joint inflammation or swelling. Sudden mortality, with birds dying unexpectedly, was reported in 45% of the cases, indicating a relatively high proportion of birds succumbing to Newcastle disease without apparent clinical signs. Additionally, torticollis, characterized by a twisted neck or head tilt, was observed in 35% of the cases. These findings provide valuable insights into the clinical presentation and manifestations of Newcastle disease in affected poultry populations (Figure 1).

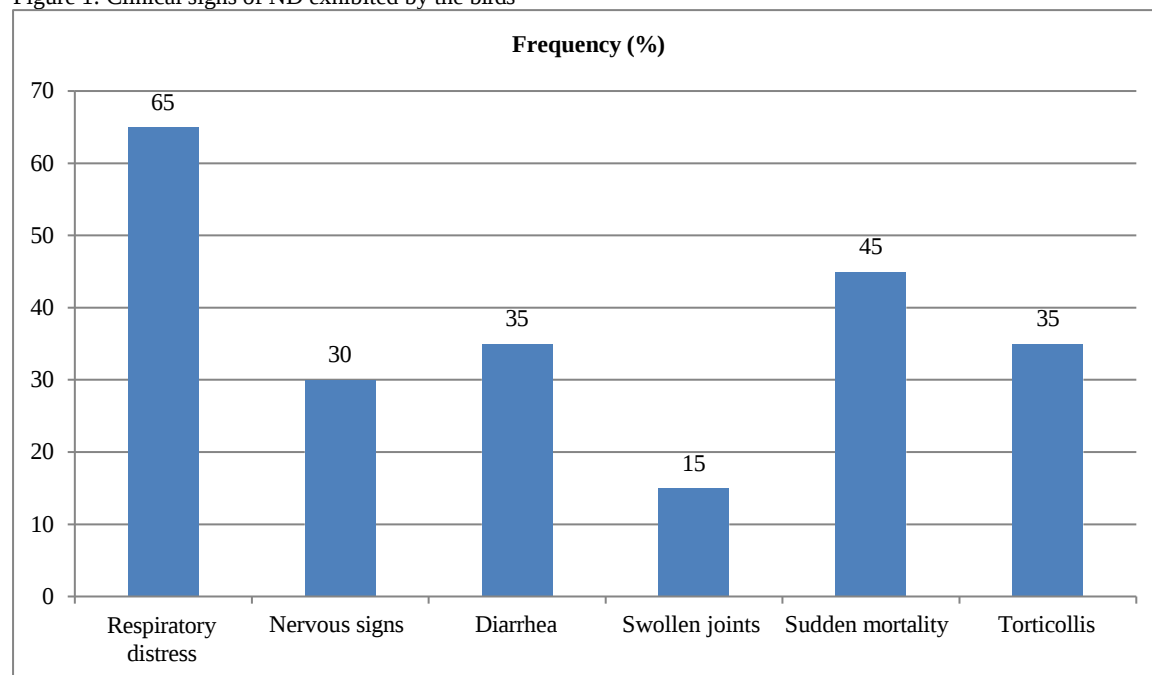
Table 1; Prevalence of Newcastle disease in backyard poultry flocks in different regions of Pakistan

Region	No. of flocks examined	No. of positive flocks	Prevalence (%)	p-value
Layyah	75	09	12.0	0.0005 (Significant at p<0.05)
Muzafargarh	50	07	14.0	
Multan	125	14	11.2	
Khushab	134	16	11.9	
Total	384	46	11.97	

Table 2: Factors associated with the occurrence of Newcastle disease in backyard poultry populations

Variables	Category	Number of Flocks (n)	Number of Positive Flocks (ND cases)	Prevalence (%)	Odds Ratio (95% CI)
Flock Size	Small (<50 birds)	120	16	13.33	1.00 (0.22-1.50)
	Medium (50-100 birds)	180	20	11.11	1.45 (0.78-2.70)
	Large (>100 birds)	84	10	11.90	1.42 (0.70-2.87)
Poultry Breeds	Local	100	05	5.00	1.00 (0.22-1.50)
	Hybrid	180	20	11.11	0.87 (0.50-1.51)
	Exotic	104	21	20.19	0.38 (0.15-0.98)
Biosecurity measures	Good	250	14	5.6	1.00 (0.22-1.50)
	Moderate	80	15	18.75	3.18 (1.73-5.82)
	Poor	50	17	34.0	4.42 (2.24-8.72)
Vaccination Coverage	Adequate	240	05	2.08	1.00 (0.22-1.50)
	Partial	90	19	21.11	4.29 (2.40-7.67)
	Inadequate	50	22	44.0	4.45 (2.22-8.93)

Figure 1: Clinical signs of ND exhibited by the birds



DISCUSSION

Newcastle disease (ND) is a significant viral infection affecting backyard poultry populations in Pakistan. This comprehensive study aimed to analyze the prevalence, distribution, and factors influencing the occurrence of ND in backyard poultry populations. The study spanned over a 12-month period, from January to December 2022, covering various regions of Pakistan, including Layyah, Muzafargarh, Multan, and Khushab. A multistage sampling technique was used to select study sites and backyard poultry flocks, with a total of 384 flocks being examined. Structured questionnaires were administered to collect data on flock characteristics, management practices, biosecurity measures, and vaccination history. The laboratory diagnostics involved collecting cloacal or oropharyngeal swabs from selected birds in each flock and subjecting them to reverse transcription-polymerase chain reaction (RT-PCR) or viral isolation techniques to detect the presence of Newcastle disease virus (NDV). Serological testing using enzyme-linked immunosorbent assay (ELISA) was conducted to determine the seroprevalence of NDV antibodies.

The data collected from the questionnaires were analyzed using appropriate statistical software. Descriptive statistics, such as frequencies, proportions, means, and standard deviations, were calculated to summarize the characteristics of the backyard poultry flocks and their

management practices. The prevalence and distribution of ND in different regions were estimated based on the laboratory diagnostic results¹⁶.

The study found varying prevalence rates of ND in different regions of Pakistan. Layyah exhibited a prevalence rate of 12.0%, Muzafargarh had a prevalence rate of 14.0%, Multan showed a prevalence rate of 11.2%, and Khushab had a prevalence rate of 11.9%. Overall, the average prevalence rate across all regions was 11.97%. These findings indicate that ND is present in backyard poultry flocks in these regions, highlighting the need for effective control measures.

Factors influencing the occurrence of ND in backyard poultry populations were also investigated. Flock size, poultry breeds, biosecurity measures, and vaccination coverage were analyzed as variables. The study revealed that larger flock sizes (>100 birds) had a prevalence rate of 11.90%, while medium-sized flocks (50-100 birds) showed a prevalence rate of 11.11%, and small flocks (<50 birds) had a prevalence rate of 13.33%. Hybrid breeds had a prevalence rate of 11.11%, while local breeds showed a lower prevalence rate of 5.00%. Exotic breeds had the highest prevalence rate of 20.19%. Biosecurity measures played a significant role, with flocks having good biosecurity measures exhibiting a lower prevalence rate of 5.6%, moderate biosecurity measures resulting in a prevalence rate of 18.75%, and poor biosecurity measures associated with a higher

prevalence rate of 34.0%. Adequate vaccination coverage resulted in a prevalence rate of 2.08%, while partial coverage and inadequate coverage showed higher rates of 21.11% and 44.0%, respectively.

The study identified significant associations between these factors and ND occurrence using multivariable logistic regression analysis. The odds ratios (OR) and 95% confidence intervals (CI) were calculated to measure the strength of association. These findings provide evidence that flock size, poultry breeds, biosecurity measures, and vaccination coverage are important factors influencing the occurrence of ND in backyard poultry populations¹⁷.

The frequency analysis of clinical signs or symptoms observed in cases of ND highlighted respiratory distress as the most common clinical sign, reported in 65% of cases. Nervous signs were observed in 30% of cases, while diarrhea was reported in 35% of cases. Swollen joints were observed in 15% of cases, sudden mortality in 45% of cases, and torticollis in 35% of cases. These findings provide valuable insights into the clinical presentation and manifestations of ND in affected poultry populations.

It is important to acknowledge the limitations of this study, including reliance on self-reported data from poultry owners, potential recall bias, and the cross-sectional design, which limits the establishment of causal relationships between factors and ND occurrence¹⁸.

Thus it shed light on the prevalence, distribution, and factors influencing the occurrence of ND in backyard poultry populations in Pakistan. The findings underscored the need for targeted control and prevention strategies, focusing on factors such as flock size, poultry breeds, biosecurity measures, and vaccination coverage. By addressing these factors, efforts can be made to reduce the burden of ND and safeguard the health and productivity of backyard poultry populations in Pakistan.

CONCLUSION

This comprehensive study analyzing the prevalence, distribution, and factors influencing the occurrence of Newcastle disease (ND) in backyard poultry populations in Pakistan provides valuable insights into the dynamics of the disease. The study highlighted the presence of ND in different regions of Pakistan, with varying prevalence rates. Factors such as flock size, poultry breeds, biosecurity measures, and vaccination coverage were identified as significant influences on ND occurrence. The findings

emphasize the importance of implementing effective biosecurity measures and ensuring adequate vaccination coverage to mitigate the risk of ND. Furthermore, the study highlights the common clinical signs associated with ND, aiding in early detection and management. Despite certain limitations, this study contributes to the understanding of ND in backyard poultry populations and informs the development of targeted control and prevention strategies to safeguard the health and productivity of these populations in Pakistan.

CONFLICT OF INTEREST

None.

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