**Seasonal patterns and climatic determinants of human rabies cases in Bangladesh: insights from 2006 to 2024**

**Abstract**

**Background:**

Rabies continues to be a significant public health concern worldwide, especially in regions like Bangladesh where it is endemic. The country’s climate, marked by distinct seasonal transitions – pre-monsoon, rainy, and winter – may create favorable conditions for rabies transmission. Previous research has highlighted the role of environmental factors in the spread of vector-borne diseases, with rising temperatures and specific precipitation patterns influencing the growth of vectors and the spread of pathogens. However, despite the acknowledged impact of seasonality on disease patterns, there is a lack of comprehensive studies in Bangladesh that focus on these temporal dynamics in relation to rabies.

**Objective:**

The aim of this research is to examine the relationship between seasonal climatic variations and the incidence of human rabies cases in Bangladesh from 2006 to 2024. Utilizing long-term data, the study seeks to identify trends and seasonal patterns in rabies cases and explore how weather factors influence their occurrence.

Methods: The study uses descriptive analysis to examine the characteristics of rabies cases and deaths, employing mean and standard deviation. We also compared rabies cases, ARV, MDV, and weather parameters before and after large-scale rabies control programs (2006-2013 and 2014-2024) using paired sample t-tests. ANOVA tests were conducted to compare rabies cases, ARV, and MDV across the three major seasons in Bangladesh. Additionally, Mann-Kendall (M-K) trend analysis was applied to detect potential upward or downward trends, while Sen's slope test assessed variations in annual rabies cases. To investigate the association between climatic factors and rabies cases over time, a time-series Poisson regression model, part of the generalized linear model (GLM) approach, was used.

**Results:**

Between 2006 and 2024, there were 1,902 rabies cases, with a monthly mean of 7.5 (SD: 4.68). From 2006 to 2013, there were 1,135 cases (annual mean: 129.88, SD: 39.23), and from 2014 to 2024, 767 cases (annual mean: 58.00, SD: 24.59), with a significant difference between the two periods (P < 0.001). Rabies cases varied by season: 413 cases in the pre-monsoon season (monthly mean: 6.25, SD: 4.01), 724 in the monsoon season (mean: 6.70, SD: 3.88), and 765 in winter (mean: 9.34, SD: 5.51). The M-K trend analysis showed a significant negative trend (p < 0.001, tau = -0.84), and the Sen’s slope test indicated a downward trend (-7.5, 95% CI: −9.50 to -5.33). The count GLM model suggested that a 1°C increase in temperature and 1mm increase in rainfall would decrease rabies cases by 1%, while the rainy and winter seasons saw a 21% and 18% increase in cases compared to the pre-monsoon season.

**Conclusion:**

Rising temperature and rainfall have been associated with a decrease in rabies cases in Bangladesh. Rabies cases are higher in the rainy and winter seasons compared to the pre-monsoon season. These findings can help prevent future seasonal rabies spread and guide public health authorities in policy-making. Prioritizing community engagement, regular monitoring, and timely vaccination is crucial to controlling rabies cases and deaths in Bangladesh.