

## **A GENERALIZED MODELLING APPROACH TO ASSESS CLIMATE INFLUENCES ON HAND, FOOT, AND MOUTH DISEASE IN EAST COAST MALAYSIA**

*(Pendekatan Pemodelan Teritlak untuk Mengkaji Pengaruh Iklim Terhadap Penyakit Tangan, Kaki dan Mulut di Pantai Timur Malaysia)*

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### *ABSTRACT*

Hand, foot, and mouth disease (HFMD) outbreaks in Asia have increased since the late 1990s, causing severe and often fatal consequences. Several statistical approaches, such as Generalized Linear Models (GLM) and Generalized Additive Models (GAM), have been used in numerous studies to examine the association between climate factors and HFMD cases. However, the results vary by country. In Malaysia, these issues require further research, as there are only a few studies employing GLM and GAM approaches that focus on HFMD cases and climate factors, particularly in the East Coast region. Therefore, this study explores the association between HFMD and climate factors on Malaysia's East Coast using GLM and GAM with Negative Binomial to identify the best model for interpreting HFMD cases. The findings show that climate factors affect HFMD differently across states in East Coast Malaysia. The results show that the GAM Negative Binomial model best represents these issues. The temperatures between 26°C and 28°C will decrease the risk of HFMD cases in Pahang over the next two weeks. Besides, temperatures ranging from 25 to 27°C and 28.5 to 30°C significantly increased HFMD risk in Terengganu over the next two weeks. Nevertheless, Kelantan found no correlation between climate and HFMD. These findings can help local health authorities in developing a climate-based early warning system to minimize HFMD outbreaks in Malaysia's East Coast Region.

*Keywords:* generalized linear model; generalized additive model; climate change; disease

### *ABSTRAK*

Penyakit tangan, kaki, dan mulut (HFMD) telah meningkat di negara Asia sejak akhir 1990-an, membawa kepada kesan negatif dan sering kali membawa maut. Beberapa pendekatan statistik, seperti Model Linear Teritlak (GLM) dan Model Tambahan Teritlak (GAM), telah digunakan dalam banyak kajian untuk mengkaji hubungan antara faktor iklim dan kes HFMD. Namun, hasil setiap kajian berbeza mengikut negara. Di Malaysia, isu ini memerlukan penyelidikan lanjut kerana hanya ada beberapa kajian yang menggunakan pendekatan GLM dan GAM untuk kes HFMD dan faktor iklim, terutama di Pantai Timur. Pendekatan GLM dan GAM Binomial Negatif digunakan untuk menentukan model terbaik bagi mewakili kes HFMD dan faktor iklim di Pantai Timur. Hasil kajian ini menunjukkan bahawa faktor iklim mempengaruhi kes penyakit HFMD secara berbeza mengikut negeri di Pantai Timur Malaysia. Kajian ini menunjukkan bahawa model GAM Binomial Negatif adalah yang terbaik untuk mentafsir isu ini. Suhu antara 26°C dan 28°C akan mengurangkan risiko kes HFMD di Pahang dalam tempoh dua minggu akan datang. Selain itu, suhu antara 25 hingga 27°C dan 28.5 hingga 30°C secara signifikan meningkatkan risiko kes HFMD di Terengganu dalam tempoh dua minggu akan datang. Manakala, tiada korelasi ditemui antara iklim dan kes penyakit HFMD di Kelantan. Hasil ini dapat membantu pihak berkuasa kesihatan tempatan membangunkan sistem amaran awal penyakit berasaskan perubahan iklim untuk mengurangkan wabak HFMD di Pantai Timur Malaysia.

**Kata kunci:** model linear teritlak; model tambahan teritlak; perubahan iklim; penyakit

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