# UNIVERSITI TEKNOLOGI MARA

# THE INTERACTION OF DENGUE CASES BETWEEN CLIMATIC FACTORS AND AIR POLLUTANTS IN PENINSULAR MALAYSIA

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# ABSTRACT

*Aedes aegypti* and *Aedes albopictus* had caused dengue in tropical and subtropical regions. Vector control is used for minimizing dengue cases, unfortunately, it relies on climatic and environmental variables which introduce the complex relationship in analysing dengue cases. Thus, this study aims in assessing the interaction of dengue cases between climatic factors and air pollutants in Peninsular Malaysia by using Principal Component Analysis (PCA). Secondary data on dengue cases, climatic factors from the year 2016 until 2020 are obtained from Ministry of Health (MOH) and Department of Environment (DOE), Malaysia, respectively. Results show among 91 districts in Peninsular Malaysia, 47.1% are denoted as hot spot (high prevalence of dengue cases) and 53.9% are classified as cold spot (low number of dengue cases). At the hotspot, meteorological factors such as wind speed ($r$=0.58), Nitrogen dioxide ($r$=0.424), Carbon monoxide ($r$=0.415), temperature ($r$=0.176), Sulphur dioxide ($r$=0.094), and Particulate matter ($PM_{10}$) ($r$=0.087) had correlated with dengue cases. At the cold spot, meteorological factors such as Nitrogen dioxide ($r$=0.244), Particulate matter ($PM_{10}$) ($r$=0.208), Carbon monoxide ($r$=0.149) temperature ($r$=0.151), humidity ($r$=0.124), Ozone ($r$=0.108), wind speed ($r$=0.054) and Sulphur dioxide ($r$=0.070) had correlated with dengue cases. KMO and Bartlett's Test showed that the significant values are smaller than 0.05 ($p$<0.05) at both spots. Overall, at the hotspot, factors for dengue cases showed the dominant contribution caused by PC 1 (Nitrogen dioxide and Carbon monoxide) followed by PC 2 (Temperature, humidity, and Ozone) and PC 3 (Rainfall and Sulphur dioxide) with contribution variance of 28.85%, 18.65% and 10.80%, respectively. At the cold spot, factors for dengue cases showed by PC 1 (Temperature, Nitrogen dioxide, Carbon monoxide and $PM_{10}$) followed by PC 2 (Humidity and windspeed), PC 3 (Ozone and Carbon monoxide) and PC 4 (Rainfall) with contribution variance of 26.60%, 19.20%, 14.33% and 10.23%, respectively. The result of this study shows that the dynamic number of dengue cases could have interaction between climatic factors and air pollutants at the study area.

Keywords: *Dengue, Climatic factors, Air pollutants, Principal Component Analysis*

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# INTRODUCTION

## 1.1 Research Background

In the 21st century, dengue has become a major global health issue (Xavier et al., 2021). Dengue is endemic in tropical and subtropical regions worldwide and it is classified as a vector-borne disease in which the virus is transmitted through two different types of mosquito vectors: the *Aedes aegypti* and *Aedes albopictus* (Murray et al., 2013; Thiruchelvam et al., 2021). A person can be infected by dengue caused by a ribonucleic acid (RNA) virus and so far, there are four identified virus serotypes: DEN-1, DEN-2, DEN-3, and DEN-4 (Carneiro et al., 2017). Once infected, the patient will manifest a variable febrile period or clinically known as dengue fever (DF), and can lead to dengue haemorrhagic fever (DHF) or dengue shock syndrome (DSS) which can cause fatal. Over the past 50 years, originating from Africa, this disease has crossed over the continents until Asia countries (Ebi & Nealon, 2016). The phenomenon of global warming has impacted the ecosystems in various ways such as the alterations in climate: rising temperature, amount of rainfall, and relative humidity of an area. These climate changes can lead to the fast-spreading and dissemination of the virus dengue serotypes and devote the number of dengue cases. Climatic factors such as temperature, relative humidity and precipitation are among the contributors of the dengue prevalence. Variation in weather and climate can affect the Aedes mosquitoes and DENV through multiple mechanisms such as the development, survival, and reproduction of mosquitoes. Temperature is one of the climatic factors an important determinant of biting rate, egg and immature mosquitos' development, development time of virus in the mosquito (extrinsic incubation period), and survival at all stages of the mosquito life cycle. The increase in temperature facilitates the development of Aedes mosquito life cycles and shortens the extrinsic incubation period which can lead to an increase in dengue cases (Ebi & Nealon, 2016).