

UNIVERSITI TEKNOLOGI MARA

**DAILY TEMPERATURE WITH NON-
ACCIDENTAL MORTALITY IN
KEDAH AND PENANG FROM 2011-
2019: A TIME SERIES REGRESSION
STUDY**

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ABSTRACT

Extreme temperature is one of the major public health concerns due to significant health impacts to humans. Hence, understanding the distinct patterns of temperature-related mortality for each geographical area becomes essential as global temperatures rise. This study examined the association between daily ambient temperature and non-accidental mortality in Kedah and Penang. Daily data on meteorology, air pollutants, non-accidental, cardiovascular and respiratory mortality during 2011-2019 were obtained. A quasi-Poisson generalized linear regression with a distributed lag non-linear model (DLNM) was applied to estimate the temperature and mortality association. A non-linear U-shaped and J-shaped relationship between mean temperature and non-accidental mortality was observed for cumulative effects of 21 days for Kedah and Penang respectively. The minimum mortality temperature (MMT) at 27.4°C and 28.2°C were observed for Kedah and Penang respectively. Heat effects were significant for non-accidental and respiratory mortality. No significant relationship was found between all categories of mortality with lower temperature in both states. In Kedah, the relative risk associated with extremely high temperature compared to MMT was highest at lag 0-3 (RR: 1.16 (95% CI: 1.08, 1.26) for non-accidental mortality and lag 0-7 (RR: 1.23 (95% CI: 1.03, 1.49) for respiratory mortality. Meanwhile, Penang demonstrated the highest relative risk associated with extremely high temperature compared to MMT at lag 0-7 (RR: 1.21 (95% CI: 1.11, 1.33) for non-accidental mortality and lag 0-14 (RR: 1.57 (95% CI: 1.24, 1.99) for respiratory mortality. No significant risk for cardiovascular mortality was seen during extreme temperature exposure. Spatio-temporal mapping revealed a slight increase in mean temperature was observed during 2016-2019, as compared to 2011-2015, with more districts experienced hotter temperature. People with respiratory disease, the elderly, both genders, and those living in urban and rural pose a significant risk of mortality following exposure to extremely high temperatures. Air pollutants did not modify the temperature mortality relationship as no significant change in the temperature-mortality risk estimates was observed during sensitivity analysis. Our results urge the implementation of climate-resilient health policies, including urban planning, the development of Heat-Health Warning Systems (HHWSs), strengthening healthcare systems and preparedness, enhancing infrastructure resilience, and prioritizing vulnerable groups with community-specific strategies, particularly in high-risk areas. These insights guide policymakers and practitioners in addressing the complex interplay between climate and public health in Kedah and Penang.

Keyword: temperature, non-accidental mortality, cardiorespiratory mortality, distributed lag non-linear model, minimum mortality temperature

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

This introduction chapter serves as the opening segment of this thesis, providing a detailed overview of the research topic. It begins with exploring the research background, where problem statements are clearly identified, emphasising the need for further investigation. Subsequently, the research questions are presented, outlining the specific questions the study aimed to answer. The justifications for conducting the research are articulated, highlighting the potential contributions and implications of the study. The objectives of the research are clearly stated, outlining the specific goals that the study aimed to achieve. Additionally, the scope of the research is established, specifying the boundaries and limitations of the study. Finally, the research hypotheses are presented, providing a framework for testing and analysing the data to derive research findings.

1.2 Research Background

Climate change is not only a future problem but also a current problem. Urgent identification of the population, assessment of health risks, and planning appropriate adaptation and mitigation policies are a must to protect human health. Climate change has been recognized as one of the most significant challenges of the 21st century and as a driver for climate-sensitive health hazards. Four types of hazards related to climate-sensitive are hydrological (e.g., flood, rainfall-induced landslide, ice caps melting, increasing sea level), climatological (e.g., drought and wildfire), biological (e.g., vector-borne diseases; and food and water-borne diseases) as well as meteorological hazards (e.g., temperature extremes, severe storms) (Banwell, Rutherford, Mackey, Street, et al., 2018). The World Health Organization (WHO) acknowledges that the perils of climate change pose a severe threat to human well-being, especially during extreme