## Letter to the Editor

# Physical, Psychological, and Social Health Impact of Temperature Rise Due to Urban Heat Island Phenomenon and Its Associated Factors[*]

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The Urban Heat Island Effect (UHI) has now become a commonly observed phenomenon worldwide. Indeed, it has become a significant environmental effect of urbanisation. In Malaysia, research results showed that UHI effects are very evident in several cities such as Kuala Lumpur and Putrajaya[1,2]. UHI effect has long been observed to cause temperature of cities. Temperature rise associated to UHI phenomenon may have a profound impact on the health and welfare of urban residents. Physical health impacts of temperature rise in urban cities have been the subject of numerous studies worldwide and have been reported more frequently in recent years in both Western and Asian regions[3]. Among the most important effects of temperature rise on physical health is the exacerbation of pre-existing chronic diseases, particularly cardiovascular, and respiratory disorders, respiratory illnesses as well as outright heat exhaustion and heat stroke[4]. Climate change and ongoing trend of increase temperature also has tremendous impact of manifestations of vector borne diseases such as malaria and dengue[5].

Temperature rise also impacts psychological health. Increased temperature is associated with depression and anxiety, emotional disturbance and aggression; there is evidence that it may exacerbate psychotic or depressive illnesses. High temperature has also been linked to increased mortality from mental and behavioural disorders and psychoactive substance use[6]. Rising temperatures in the cities also bear a profound effect on people's social health. Research indicates that higher temperatures affect social interactions, connectivity, social networks, influence occupational performance as well[6,7].

The health impact of temperature rise, particularly psychological, and social health, on the city community in Kuala Lumpur city has never been extensively studied. Physical illnesses related to air pollution and poor air quality in Kuala Lumpur have been reported[1], but not investigated in detail. We conducted a study that assessed the knowledge, attitudes, prevention practices, and health impact of temperature rise associated to UHI in Greater Kuala Lumpur, Malaysia. The detail findings on knowledge, attitudes, and prevention practices were reported comprehensively elsewhere. This paper is the first to report on the impact of temperature rise associated to UHI on psychological and social health in Malaysia. Most importantly, the paper first describes the extent to which temperature rise affects the physical, psychological, and social health of the residents of Greater Kuala Lumpur. Secondly, factors that associate with temperature rise on health will also be illustrated.

The sample was drawn from Greater Kuala Lumpur. In this study, three areas in Greater Kuala Lumpur were randomly selected. These were (1) Mont Kiara, (2) Jalan Raja Chulan, and (3) Setia Alam. Interviews were conducted using computer-assisted telephone interviewing between October 2016 and May 2017. Sampling was drawn by random digit-dialling of landline phone numbers from all the three study areas. The selection of respondents within contacted households was accomplished by randomly requesting to speak to adults (18 years of age or older) residing in the household.

The questionnaire was developed by the researcher based on a literature review, and adjusted to fit the study objectives. Subsequently, face and content validation testing of the

questionnaire was conducted panel of experts. The expert panel members were requested to evaluate the content relevance of the questionnaire. The content validity was determined by computing a content validity index (CVI) based on the experts' ratings of item relevance. The range of CVI was 0.8 to 1.0. The questionnaire was revised and the final draft version of the questionnaire was pilot tested.

The questionnaire consisted of three sections. In the first section, demographic data were collected. In the second section, respondents were asked about their living environment, which included questions on building types, how the building is cooled, and the number of people living in the household. The third section queried respondents about UHI and temperature rise (its causes, consequences, and health impacts). Knowledge of health impacts included physical, psychological, and social health impacts. The total number of knowledge item questions was 29 items. Response options were either 'yes', 'no', or 'don't know'. Knowledge questions were scored as follows: one point was given for each correct answer and a 0 was given for wrong answers or don't know responses. The total knowledge scores ranged from 0-29, with higher scores indicating a higher level of knowledge of UHI. The internal consistency, as measured by Cronbach's alpha coefficients was 0.955 (range 0.596 to 0.704).

In the fourth section, respondents were queried about any health impact they have experienced (physical, psychological and social) that are related to temperature rise associated to UHI. Physical health impact consisted of seven items; physiological health consisted of four items, and social health consisted of three items. Internal consistency was 0.941 (range 0.690 to 0.900). Response options were either 'yes' or 'no'. Health impact questions were scored by giving one point for 'yes' response and zero points for 'no'. The total health impact scores ranged from 0-14, with higher scores indicating a higher level of health impact from urban heat.

The fifth section addressed health belief questions (total of five questions). The study used the Health Belief Model (HBM)[8] as a framework to understand how the public's perceptions of benefits, threats, cues to action, and self-efficacy affect the likelihood of them becoming involved in practicing control measures to reduce UHI effect. The HBM constructs have been used to explain the adoption of preventative behaviours and healthy lifestyles, as well as illness prevention practices[9].

The sixth section consists of questions on practices to reduce temperature rise associated to UHI. The practices section consists of four subsections that queried respondents on practices to mitigate UHI impact on personal physical health, environmentally responsible practices, green infrastructure, and transportation-related practices. The total number of questions was 16. Response options were either 'yes' or 'no'. These questions were scored by giving one point for 'yes' responses and zero points for 'no'. The total practices scores ranged from 0-16, with higher scores indicating a higher level of control practices against the effect of UHI. Cronbach's alpha coefficient for practices items was 0.935 (range 0.344 to 0.861).

Informed consent was obtained verbally. The study was approved by the University of Malaya Medical Ethics Committee (MECID NO: 2016928-4295). Due to word limitation, this manuscript reports finding of health impact associated to UHI phenomenon. The detailed findings of knowledge, attitudes, and mitigation practices of this study have been submitted elsewhere.

Data were statistically analysed with SPSS statistics version 19.0 (SPSS Inc., Chicago, USA). All mean total scores were subjected to normality tests to explore their normality distributions. As all the mean total scores were not normally distributed, K-means clustering was performed to cluster the scores with similar patterns into two[10]. To evaluate the factors associated with mean total health impact score, the Chi-square test was used to examine the univariate associations between each of the factors (the independent variables) and the clusters for total scores for health impact. Multivariable logistic analysis was subsequently carried out if there were two or more significant associations ($P < 0.05$) in the univariate analysis. All significant variables in the univariate analysis were entered into the multivariable logistic regression analysis using a simultaneous forced entry model (enter method).

A total of 558 participants completed the survey (response rate was 40%). As shown in Table 1, a high proportion of participants reported experiencing the health impacts queried in this study. On average, the proportion of respondents that experienced physical and social health impacts associated with temperature rise was higher than the proportion that experienced psychological impacts. Heat exhaustion (89.4%) and respiratory problems (87.3%) were the most commonly