Association between PM10, smoke haze, and under-5 mortality in Klang Valley, Malaysia

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Introduction

Particulate matter (PM) and health effects

- PM is one of the major global environmental health risk factor, which is attributable to 4.2 million premature deaths annually.
- PM is inhalable deep into the lungs, and lead to oxidative stress and systemic inflammatory responses.

Vegetation fires and climate change

- Vegetation fires around the world due to extreme weather conditions related to climate change has been occurring with increased frequency and intensity.
- Smoke plume from vegetation fires contains various chemical constituents, whereby PM is one of the predominant pollutant.
- The smoke plume could spread over long distance, affecting the health of populations both locally and regionally.

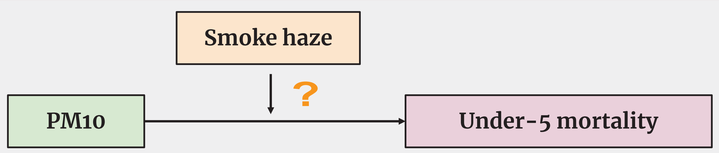
Smoke haze definition

- Smoke haze definition varies due to different air quality issues over regions.
- In this context, smoke haze was defined considering "intensity" and "duration" concurrently (Phung et al. 2021) (see method).
- It is unclear whether smoke haze defined by different intensity and duration would modify the association between ambient PM and under-5 mortality.

Under-5 mortality

- Large proportion of global children (age <14 yrs) mortality were the under-5 children.
- Children is the vulnerable population to environmental health risks. The under-5 children might be highly vulnerable, due to their physiological and immunological conditions.
- There is lacking of studies which focused on the under-5 children.

? What is the association between PM10, smoke haze, and under-5 mortality?



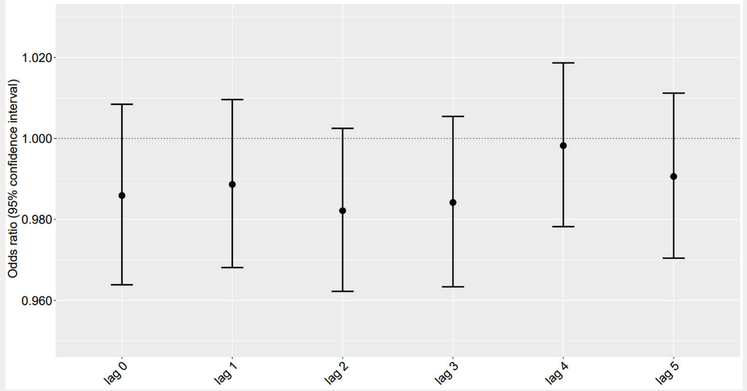
Objectives

To examine the association between ambient PM10, smoke haze, and under-5 mortality.

- To examine the association between PM10 and under-5 mortality.
- To examine effect modification of smoke haze on the association between PM10 and under-5 mortality.

Main Findings

Figure 1. Odds ratio of under-5 mortality for each 10μg/m³ increment in PM10



- Figure 1 shows the odds ratio of under-5 mortality for each 10μg/m³ increment in PM10.
- There was no significant association observed for PM10 and under-5 mortality.
- The association remained null for lagged days up to 5 days.

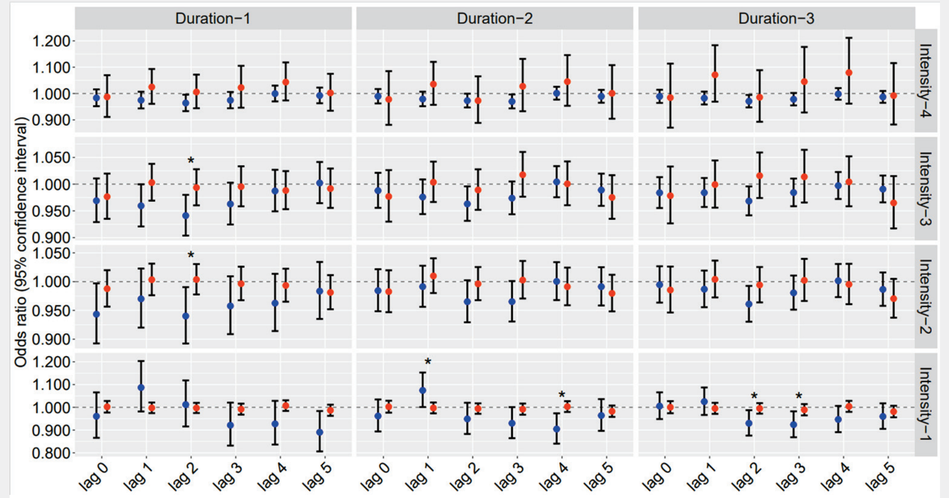
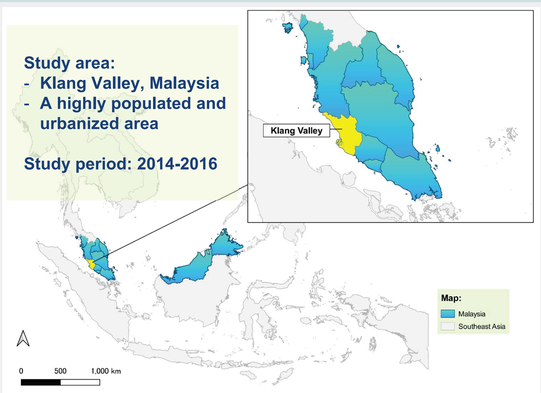


Figure 2. Odds ratio of under-5 mortality for each 10μg/m³ increment in PM10 on non-smoke haze (blue) and smoke haze (red) days, at different intensity and duration.

Symbol * indicates significant difference in odds ratio based on p<0.05.

- Figure 2 shows the odds ratio of under-5 mortality for each 10μg/m³ increment in PM10, on non-smoke haze (blue) and smoke haze (red) days.
- Different patterns of the association were observed when a smoke haze day was defined by different intensities.
- When a smoke haze day was defined at lower intensities, the odds ratio of mortality appeared to be higher at shorter lags of non-smoke haze days.
- When a smoke haze day was defined at higher intensities, the odds ratio of mortality were higher on smoke haze days.
- PM10 exposure appeared to be protective on non-smoke haze days.

Methods



Data sources

- The under-5 mortality data were provided by the Ministry of Health, Malaysia.
- The air pollutant and weather data were provided by the Department of Environment, Malaysia. The weather data were considered as the confounding factors in the model.

Smoke haze definition

- In this context, smoke haze was defined considering "intensity" and "duration" concurrently (Phung et al. 2021).
- 4 intensity levels by PM10 concentration: Intensity-1 (PM10 >50μg/m³), Intensity-2 (PM10 >75μg/m³), Intensity-3 (PM10 >100μg/m³), and Intensity-4 (PM10 >150μg/m³).
- 3 durations by consecutive days with each "intensity": Duration-1 (≥1 day), Duration-2 (≥2 days), and Duration-3 (≥3 days).

Statistical analysis

- A time-stratified case-crossover design was applied using a generalized linear model.
- The model was adjusted for temperature, relative humidity, and strata of day-of-week in the same month and year.
- Odds ratio of under-5 mortality for each 10μg/m³ increment in PM10 were examined.
- The effect modification by smoke haze was examined with p-value <0.05.
- The association was examined up to 5 lags.

Ethical consideration

The ethical consideration for this study has been approved by the Medical Research and Ethics Committee in the National Medical Research Register, National Institutes of Health, Ministry of Health, Malaysia [NMRR-18-2945-42784 (IIR)] and the Ethics Committee of the Graduate School of Engineering, Kyoto University, Japan [201902].

Conclusion

- This study observed null association between PM10 and under-5 mortality.
- The association showed different patterns on smoke haze day compared to a non-smoke haze day, and the pattern differed by level of intensities.

References

Phung, VLH., Ueda, K., Sahani, M., *et al.* (2021) *International Journal of Epidemiology*. https://doi.org/10.1093/ije/dyab100

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