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The Price of Service: Assessing the Health Risks from PM2.5 Exposure of Public Utility Jeepney Drivers in Metro Manila, Philippines

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INTRODUCTION

The price of the rapid economic growth and urbanization of Metro Manila has been steep as it has been accompanied by the deterioration of its air quality. In the Philippines, about as many people die annually from air pollution than from the pandemic during 2020-21. Thus, this study aims to evaluate the health status of jeepney drivers relative to their personal exposure to PM2.5 or particulate pollution composed of solid and liquid droplets with diameters less than or equal to 2.5 micrometers.

METHODS

This is a cross-sectional study of the association between personal exposure to PM2.5 and cardiovascular and pulmonary parameters. Real time PM2.5 personal exposure measurements were conducted using seven AS-LUNG portable PM2.5 devices for 10 to 12 hours every day inclusive of weekends. Health outcomes (i.e., heart rate (HR), blood pressure (BP), oxygen saturation (sPO2) and peak expiratory flow volume (PEFV)) were also measured three times a day, i.e. in the morning, noon, and afternoon. A generalized linear mixed model (GLMM) was used to determine the association.

RESULTS

The average value of the PM2.5 measurements was 36.4 µg m-3 taken over the 30-day field campaign (Figure 1).

Significant spatial variability of PM2.5 was observed along the route with higher concentrations at specific areas relative to the route mean due to the presence of traffic- promoting factors such as commercial establishments, stop lights, and public utility vehicle stops (Figure 2). A typical 14-hour shift showed that PM2.5 was highest when the jeepney drivers were inside the terminals (i.e., at the start and end of their shifts).

The time series plot of all the PM2.5 measurements shows the diurnal pattern of the particulate pollution in the route (Figure 3). Highest concentrations are observed in the morning with peak values at 7 AM, followed by a decrease in concentration during midday, and an increase in in the late afternoon.

HR peaked at this time, dropping only after the rush hours. This trend was also present in other outcomes (e.g., systolic, diastolic, and mean BP, and sPO2). Percent PEFV was lowest in the morning and highest during the end of their shift. An increase of PM2.5 was found to significantly increase the HR, percent PEFV, and sPO2, but not the BP of the drivers.

DISCUSSION

Our findings show that short-term exposures of jeepney drivers to ambient PM2.5 can lead to significant changes in their heart and lung parameters. The presence of hotspots at several transport microenvironments in the jeepney route, as well as the periods when extreme exposures are experienced by the jeepney drivers (i.e., during morning and afternoon rush hours) point to the challenges towards improving the traffic conditions and transport system in Metro Manila. The results show the significant contribution of traffic on observed PM2.5 levels, which appeal for the greater vigilance in monitoring vehicle compliance to emission standards and shifting to efficient mass transport as well as to cleaner technologies for vehicles in the city.

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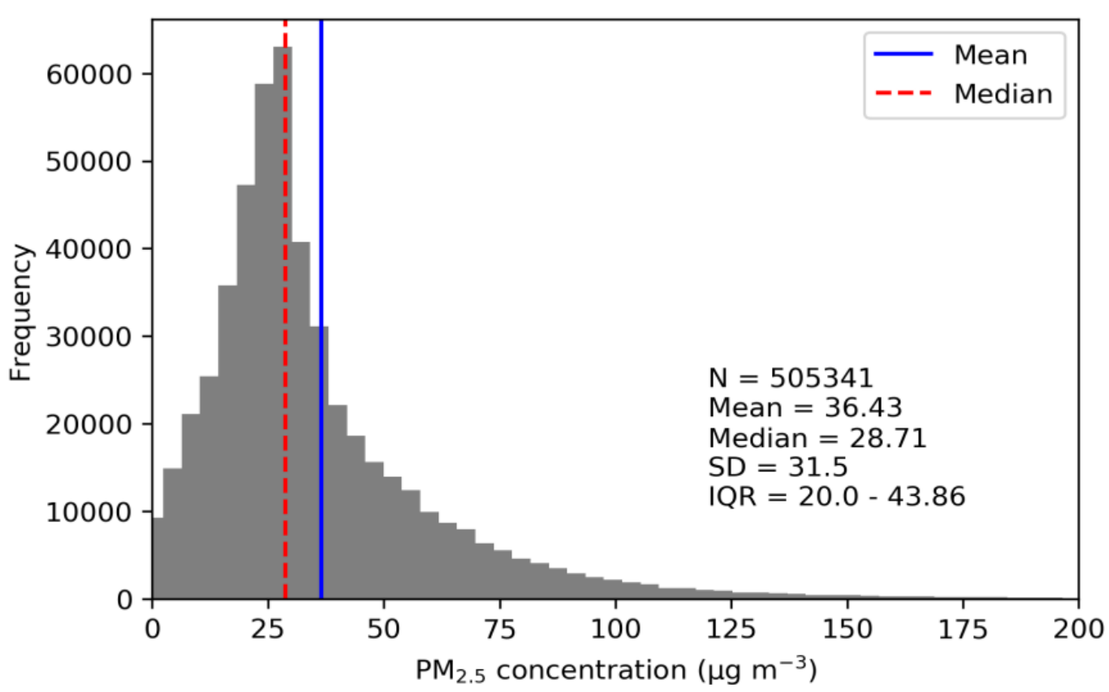


Figure 1. The mean PM2.5 concentration exceed both the WHO annual mean threshold of 5 ug/m3 and 24-hour threshold of 15 ug/m3.

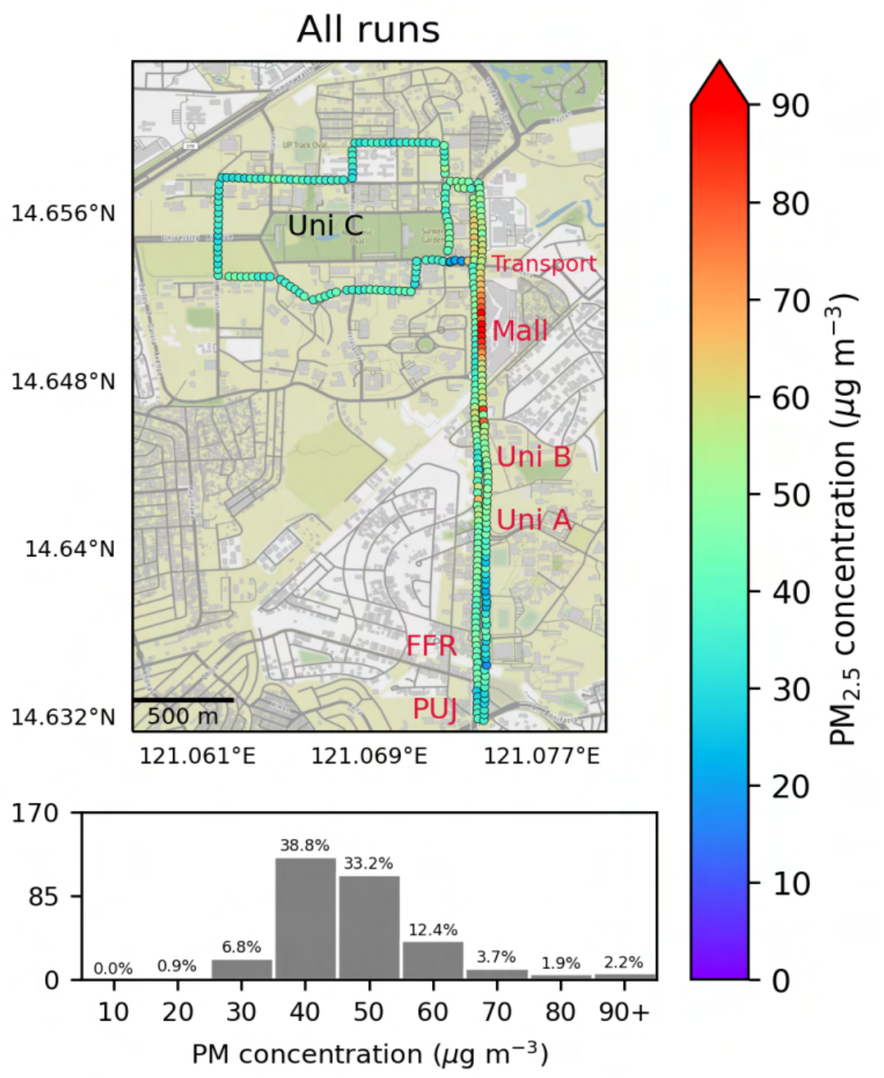
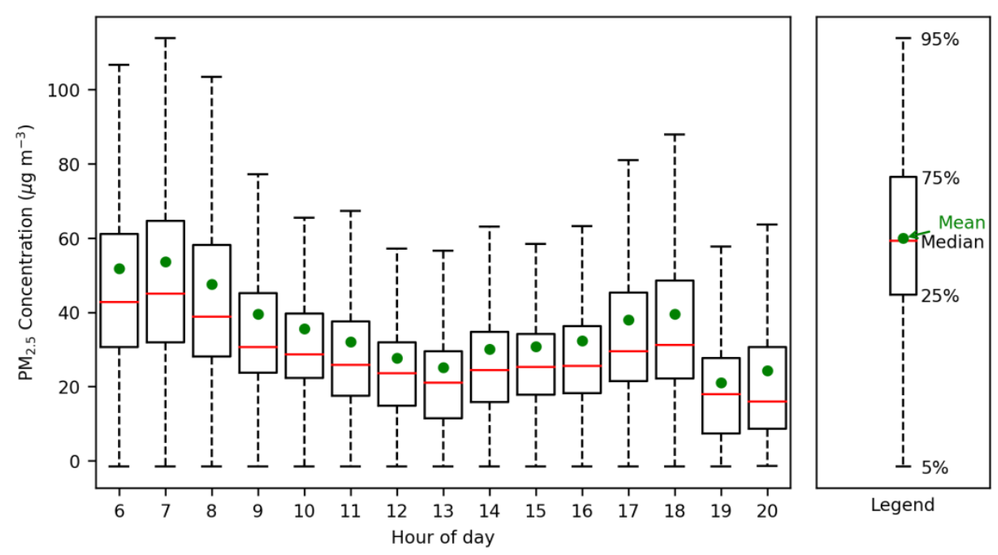


Figure 2. About 40% of the geospatial average PM2.5 measurements were at about 40 ug/m3 with the highest concentrations in front of a shopping mall (90 ug/m3) and a tricycle transport terminal (65 ug/m3) where the traffic was slowest.



The temporal distribution of the PM2.5 concentration had two peaks: one at 7 am and the other at 6 pm. Both are rush hours when traffic is at their heaviest.