Reschedule Your Travel Plans: Human Health and Air Pollution

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Abstract

Air pollution is one of the biggest challenges for human health, and this is especially true for $PM_{2.5}$ pollution in developing countries like China. Much of the $PM_{2.5}$ research has been conducted in urban areas, but most tourist attractions are outdoors and outside cities and have been left out of related studies, leaving tourists unaware of the deadly air. To fill this gap, we investigated monthly $PM_{2.5}$ concentrations in all of China's outdoor tourist attractions. Our results indicated that summer is the healthiest time to travel in the Northeast, South, Southwest, and Northwest of China. Without air pollution management, our results also indicated that more than one third of the outdoor attractions would become unhealthy throughout the year. Thus, our work provides medical information to suggest that all tourists schedule China travel during periods of healthy air quality and also calls for instant air pollution management in China and beyond.

Keywords

air pollution, $PM_{2.5}$, China, outdoor attraction, human health

Air pollution causes noncommunicable diseases, and this is particularly true for $PM_{2.5}$ (fine particulate matter with an aerodynamic diameter of 2.5 μm or less), which accounts for more than 90% of world mortality from outdoor air pollution (Forouzanfar et al. 2015; Lim et al. 2013).

Although recreational travel in natural environments is physically and psychologically benign for human health (Chen and Petrick 2013; Bowler et al. 2010), without protection, it becomes unhealthy or even fatal under $PM_{2.5}$ pollution (Grover et al. 2017). For example, daily mortality and unscheduled hospitalizations due to heart arrhythmias and stroke are significantly correlated to short-term exposure to serious $PM_{2.5}$ pollution (Kowalska and Kocot 2016; Kloog et al. 2013).

Because of atmospheric transport, $PM_{2.5}$ pollution is severe in cities and their downwind regions (Zhang et al. 2017). Nevertheless, air quality monitoring equipment is installed in cities, leaving the downwind regions unmonitored. It is hard for tourists to discern $PM_{2.5}$ values without equipment, as visibility is still moderate when $PM_{2.5}$ reaches low unhealthy levels (Zhang, Shao, and Cheng 2006; National Weather Service 1995; World Health Organization 2005). Since most outdoor tourist attractions are located outside cities and the downwind regions, tourists are unaware and are likely to be poisoned by $PM_{2.5}$. To provide timely medical suggestions and schedule healthy travel plans, we provide a spatiotemporal report on $PM_{2.5}$ pollution for tourists traveling in China.

China is among the top tourist destinations, but it is also notorious for its air pollution, dominated by $PM_{2.5}$ (Figure 1). For example, $PM_{2.5}$ reached to 900 μg/m^3 in Beijing on January 12, 2013 (Stanway 2013), compared to the World Health Organization (WHO) recommended 24-hour guideline value of 25 μg/m^3 (World Health Organization 2005). We thoroughly searched all 5,796 outdoor tourist attractions registered in China's 2015 National Tourism Administration and recorded their longitude and latitude (Hong Kong SAR, Macau SAR, and Taiwan Province of China were excluded due to data availability). We then used $PM_{2.5}$ data (provided at 0.01 degree spatial resolution) newly developed by the Atmospheric Composition Analysis Group at Dalhousie University, to extract monthly $PM_{2.5}$ value of each tourist attraction from 2001 to 2016 (Van Donkelaar et al. 2015).

Although summer is China's cleanest time, this is not peak tourist season, so tourists are more susceptible to deadly $PM_{2.5}$ pollution in other times of the year (Figure 1). Specifically, most domestic tourists arrive in the first quarter, while tourists from Hong Kong SAR, Macau SAR, and

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