Ambient temperature, air pollution and childhood bronchiolitis

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Acute bronchiolitis is one of the main causes of lower respiratory infection-related hospitalisations among young children and is often attributed to infection with respiratory syncytial virus (RSV). Seasonality of RSV infection has been reported in different climatic regions, with a higher incidence in winter in temperate regions and in the rainy season in areas closer to the equator.[1] Ambient exposures, such as meteorological factors and air pollutants, that affect host susceptibility, survival of pathogen and transmission may partly drive the seasonality of acute bronchiolitis, but these have been less widely investigated when compared with other common childhood respiratory conditions such as asthma. In subtropical regions, seasonality in acute childhood bronchiolitis has been reported by a number of studies, but few investigated this in relation to environmental exposures.

The report in this issue by Leung *et al* makes a start in filling in some of these knowledge gaps.[2] In a well-conducted time series regression study, they investigated the association of meteorological factors and air pollutants on daily childhood (≤2 years old) acute bronchiolitis hospitalisations over a 10-year period in the subtropical metropolitan setting of Hong Kong. The study analysed data from 12 public hospitals and carefully considered delayed effects of each exposure, although possible synergistic effects were not presented.

Whereas studies from other regions show singular peaks in annual bronchiolitis and RSV incidence in either the winter or rainy season,[1 3] this study suggests two peaks in bronchiolitis incidence in Hong Kong—a major one in spring and a minor one in late summer.[2] After seasonal adjustment, there was a higher risk of admission associated with both high temperature (lagged by up to 5 days) and low temperatures (lags 5–15 days), although associations were weak. A previous study conducted in multiple settings also suggested a link with temperature, with higher RSV infection rates during days of 2°C–6°C in temperate regions and at 24°C–30°C in warm and humid regions.[3] Hong Kong residents seem vulnerable at both ends of the temperature distribution, and indeed a bimodal seasonal distribution has also been observed for influenza in the city as well as in other regions between the tropics and subtropics.[4] Whether the distinctions in bronchiolitis seasonality and temperature effects in temperate regions compared with other parts of the globe share similar characteristics to those for influenza warrants further studies focussing on bronchiolitis from tropical and subtropical settings.

The current study also observed consistent adverse effects of all pollutants considered except with ozone.[2] Despite the substantial evidence for harmful effects of ozone on respiratory health outcomes, Leung and colleagues suggest that the non-positive association found may be related to the virucidal activity of ozone and its effect on the host defence. Although ozone has been reported to be an effective agent for inactivation of airborne virus in a study conducted in a laboratory test chamber,[5] it is not likely to be the case in Hong Kong as the dose required to inactivate virus is much higher than ambient ozone levels present in the city. Studies in mice suggest exposure to ozone promotes immune responses against viral infections through inducing interleukin-33 and increasing protective antiviral CD8+ T-cell responses.[6] The mechanisms and net effects of the potential harmful and potential beneficial effects of ozone on human respiratory health are still unclear and warrant further investigation. This may be particularly timely and critical in the current COVID-19 global pandemic. Furthermore, ambient ozone is positively correlated with ultraviolet level, and ultraviolet B (UVB) is negatively associated with the epidemic activity of RSV.[3] Unfortunately, UVB was not included in the Hong Kong study; therefore, we cannot rule out the confounding effect of UVB on the acute negative association observed with ozone.

For other pollutants, Leung *et al*'s study suggests that air pollution has greater acute impacts compared with weather factors on bronchiolitis admissions among young children.[2] Daily mean nitrogen dioxide (NO_2) levels exhibited a threshold at around the median level of 50 µg/m^3. This figure is difficult to compare with the limits set in the WHO air-quality guideline for NO_2, as the guideline is based on different measurements—not exceeding a 1-hour mean of 200 µg/m^3 and an annual mean of 40 µg/m^3. Particulate matter (PM_{10}), however, demonstrated adverse impacts at least from the 25th percentile of 24 µg/m^3 on lags of 0–2 days. As the WHO guideline for 24 hours mean PM_{10} is 50 µg/m^3, this may not be sufficiently stringent to protect children's respiratory health. The Hong Kong government introduced an Air Quality Health Index (AQHI) alert warning system in 2013 to protect public health against the harmful effects of air pollution. The AQHI is based on the 3-hour moving average of priority air pollutants in the city and is accompanied by health advice to vulnerable groups. The effectiveness of the AQHI in reducing hospital admissions from respiratory infections has previously been demonstrated, in particular among children (<18 years old).[7] Further targeted strategies can help to reduce the burden of bronchiolitis among very young children. In Hong Kong, diesel vehicle exhausts are one of the main sources of particulate matter; therefore, ambitious strategies to further reduce particulate matter such as completely switching to zero emission vehicles, as targeted by the UK government by 2050, will likely provide great benefits to overall respiratory health. Although laudable, such aims do not address the dominance of cars in urban settings. A shift away from cars to more walkable cities—a model which is already in Hong Kong's favour[8]—would help to provide even greater health and environmental benefits.

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REFERENCES

1 Obando-Pacheco P, Justicia-Grande AJ, Rivero-Calle I, *et al*. Respiratory syncytial virus seasonality: a global overview. *J Infect Dis* 2018;217:1356–64.
2 Leung S, Lau S, Li K, *et al*. Short-term association among meteorological variation, outdoor air pollution and acute bronchiolitis in children in a subtropical setting. *Thorax* 2020:1–8.
3 Yusuf S, Piedimonte G, Auais A, *et al*. The relationship of meteorological conditions to the epidemic activity of respiratory syncytial virus. *Epidemiol Infect* 2007;135:1077–90.
4 Chong KC, Lee TC, Bialasiewicz S, *et al*. Association between Meteorological variations and activities of influenza A and B across different climate zones: a multi-region modelling analysis across the globe. *J Infect* 2020;80:84–98.
5 Tseng C-C, Li C-S. Ozone for inactivation of aerosolized bacteriophages. *Aerosol Sci Technol* 2006;40:683–9.
6 Bonilla WV, Fröhlich A, Senn K, *et al*. The alarmin interleukin-33 drives protective antiviral CD8$^+$ T cell responses. *Science* 2012;335:984–9.
7 Mason TG, Schooling CM, Chan KP, *et al*. An evaluation of the air quality health index program on respiratory diseases in Hong Kong: an interrupted time series analysis. *Atmos Environ* 2019;211:151–8.
8 Carrington D. Study reveals world's most walkable cities. Guard, 2020. Available: https://www.theguardian.com/cities/2020/oct/15/study-reveals-worlds-most-walkable-cities [Accessed 20 Oct 2020].