

Thunderstorm-related asthma: recognizing environmental and population susceptibility factors

Box Hill Hospital, Eastern Health Clinical School, Monash University, Melbourne Australia

Frank Thien

Background: On 21st November 2016, the world's largest and most catastrophic epidemic of thunderstorm asthma occurred in Melbourne, Australia, precipitating several thousand acute respiratory presentations to EDs and associated with ten deaths. Since first described just over 30 years ago, research suggests thunderstorm asthma events result from a complex interaction of environmental and individual susceptibility factors. Postulated environmental factors include: (i) high concentrations of an aeroallergen (ii) rain and moisture to rupture pollen grains, releasing fine allergen-bearing starch-granules respirable to the lower airways; and (iii) thunderstorm outflows which bring respirable allergen particles down to ground level. Individual susceptibility factors include: (i) prior sensitisation to seasonal aeroallergens; (ii) a history of seasonal allergic rhinitis (iii) low rates of inhaled corticosteroid use in patients with diagnosed asthma.

Results: Grass pollen concentrations on the day were extreme (> 100 grains/m³). At 1800 AEDT, a gust front crossed Melbourne, plunging temperatures 10°C, raising humidity above 70%, and concentrating particulate matter. Within 30 hours, there were 3365 (672%) excess respiratory-related ED presentations, and 476 (992%) excess asthma-related hospitalisations. Questionnaire data from 1435/2248 (64%) ED presentations showed a mean±SD age of 32.0±18.6 years, 56% male. Only 27.5% had current doctor-diagnosed asthma. Ethnicity was 39.0% Asian/Indian [versus 24.8% (2016 census), relative risk (RR) 1.93, $p < 0.001$]. Of ten deaths, six were Asian/Indian (RR 4.54, $p=0.01$). All 35 ICU admissions had asthma, only 12 took inhaled preventers, and five died.

Conclusions: Convergent environmental factors triggered a thunderstorm asthma epidemic of unprecedented magnitude, tempo, geographical range and severity, creating a new benchmark for emergency and health service escalation. The Melbourne event showed a striking predominance of Asian/Indian ethnicity with increased risks for ED presentations, hospital/ICU admissions, and case fatality. Asian immigrants to Australia appear particularly susceptible to this migration effect of increased allergy and asthma risk, which

was exposed with a massive small airways allergen challenge resulting in tragic consequences. The “healthy migrant effect” and the “assimilation effect” may be relevant to the development of asthma and allergies. Several other hypotheses have been proposed which might contribute to this phenomenon, including the hygiene hypothesis, the dual allergen exposure, the vitamin D hypothesis and role of parasitic infections. The increased susceptibility of non-Caucasian populations to the adverse effects of ‘Westernization’ has substantial global implications with progressive urbanization and migration from the developing to the developed world.