Increased risk of emergency hospital admissions for children with renal diseases during heatwaves in Brisbane, Australia

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Background: Heatwaves have a significant impact on population health including both morbidity and mortality. In this study we examined the association between heatwaves and emergency hospital admissions (EHAs) for renal diseases in children (aged 0-14 years) in Brisbane, Australia.

Methods: Daily data on EHAs for renal diseases in children and exposure to temperature and air pollution were obtained for Brisbane city from January 1, 1996 to December 31, 2005. A time-stratified case-crossover design was used to compare the risks for renal diseases between heatwave and non-heatwave periods.

Results: There were 1565 EHAs for renal diseases in children during the study period. Heatwaves exhibited a significant impact on EHAs for renal diseases in children after adjusting for confounding factors (odds ratio: 3.6; 95% confidence interval: 1.4-9.5). The risk estimates differed with lags and the use of different heatwave definitions.

Conclusions: There was a significant increase in EHAs for renal diseases in children during heatwaves in Brisbane, a subtropical city where people are well accustomed to warm weather. This finding may have significant implications for pediatric renal care, particularly in subtropical and tropical regions.

Key words: climate change; environmental health; hot temperature; renal diseases

Introduction

Heatwaves, which are likely to become more common and intense in the future as climate change continues,[1] can cause significant health consequences such as increased mortality and morbidity, particularly among the elderly with chronic illnesses and of low social class.[2-7] Exposure to extreme hot weather can cause heat-related conditions including hyperthermia and heat stress in susceptible individuals, whilst the thermoregulatory physiological and circulatory adjustments necessary to cope with extreme heat can place stress on the kidneys and compromise the function of the renal system.[3,8] Several studies[3,4,8-13] have reported increases in mortality and hospital admissions for renal dysfunction among the elderly during periods of high ambient temperatures. Most patients affected by hyperthermia experienced renal failure shortly after admissions, and severe renal diseases were amongst the prominent causes of excess mortality among the elderly.[12,13] Although it is suggested that climate change may affect children's health and put them in jeopardy,[14-18] there is relatively little empirical research into possible impact of climate change on children's health. To date, there is no specific report about the effect of heatwaves on renal diseases in children.

The Brisbane heatwave study started in 2009. Our preliminary results show that the definitions of heatwave used in previous studies may be not suitable for tropical/subtropical regions such as Brisbane and heatwaves seem to have a significant impact on excess deaths and hospital admissions in Brisbane even though people are well accustomed to warm weather.[5,6,19] Our data also show that a small change in the heatwave definition can produce an apparent difference in risk estimates.[5] The present study investigated the impacts of heatwaves on emergency hospital admissions (EHAs) for renal diseases in children in Brisbane, using a case-crossover design.
Methods

Study population
Brisbane is the capital city of the state of Queensland. It is located in the south-east corner of the state (27°29’S, 153°8’E), and has a sub-tropical climate. It is Australia’s third largest city (after Sydney and Melbourne), covering an urban area of 1326.8 km² with a population of 991 260 on June 30, 2006 (the year for the latest census with available data). The target population in this study included 175 625 children (aged 0-14 years) in Brisbane (18% of the total population).

Data collection
Daily climate data including maximum temperature (Tmax) and relative humidity for the period of January 1, 1996 to December 31, 2005 in Brisbane were obtained from the Australian Bureau of Meteorology. Daily air pollution data on airborne particulate matter with diameter less than 10 micrometers (PM₁₀), nitrogen dioxide (NO₂), and Ozone (O₃) for the same period were provided by the Queensland Department of Environment and Resources Management (formerly Queensland Environmental Protection Agency). The air pollution data were extracted from all available monitoring stations in Brisbane and averaged for each day. When data were missing for a particular monitoring station on a given day, the observations recorded from the other monitoring stations were used to compute the daily average values.

Daily data on EHAs were provided by the Health Statistics Unit (formerly Health Information Centre) at Queensland Health. The hospital dataset we acquired covers usual residents of Brisbane Local Government Area. The data included counts of admissions by date, principal diagnosis, age groups, and the number of admitted patient episodes of care. In this study, renal diseases were categorized according to the International Classification of Diseases (ICD) - revision 9 (ICD 9, 580-599) up to June 1999 and revision 10 (ICD 10, N00-N39) after that.

Statistical analysis
In a previous study we assessed heat-related health outcomes using multiple heatwave definitions (HDW). Based on those results, we defined a heatwave in Brisbane as a daily maximum temperature of at least 37°C (top 0.5%) for two or more consecutive days (i.e., HWD 1). Case-crossover analyses were performed to assess the relationship between heatwaves and children’s renal diseases in which each child serves as his or her own control. We considered exposure to heatwave as an independent variable and EHAs for renal diseases as a dependent variable. Our hypothesis was that the likelihood of the EHAs for renal diseases in children would increase during heatwave periods. Delayed effects of heatwaves on children’s renal diseases of up to two days between exposure and admission were also explored as previous research suggests that heat effects are usually acute and short-term. Conditional logistic regression model was used to assess the impact of heatwave on children’s renal diseases.

Fig. Heatwaves and daily EHAs for renal diseases in children in Brisbane, Australia, 1996-2005 (the solid lines are maximum temperature; the dotted lines are minimum temperature; the bars are EHAs for renal diseases and the shaded areas are heatwaves). A heatwave was defined as a daily maximum temperature of at least 37°C (top 0.5%) for two or more consecutive days. EHAs: emergency hospital admissions.