Do air quality alerts benefit public health? New evidence from Canada

Many policy interventions intended to benefit public health can only be evaluated as so-called natural experiments, because implementation is not controlled by researchers seeking to assess effectiveness. Such assessments can be complicated by non-comparability between people affected and not affected by the intervention. Various quasi-experimental designs have been proposed to address this problem of non-comparability, one being the regression discontinuity design, which has had little use in public health. This design has application when treatment assignment depends on the value of a variable—referred to as the assignment variable—reaching a threshold. For example, assignment of clinical treatment might depend on a clinical variable being measured above a specific value—eg, diastolic blood pressure greater than 90 mm Hg. Underlying the regression discontinuity design are assumptions of arbitrariness of a threshold value and of comparability of treated and not-treated individuals in a sufficiently narrow window around the threshold. If a strict cutoff is not adhered to, or the assignment variable is measured with error, the regression discontinuity design is termed fuzzy and data are considered analogous to those of a randomised clinical trial with non-adherence.

In The Lancet Planetary Health, Hong Chen and colleagues report a regression discontinuity analysis of the effectiveness of air quality alerts for seven selected morbidity and mortality outcomes in Toronto, Canada. During the period covered, air quality alerts were announced based on air pollution forecasts on that day reaching threshold values or the expectation of high ozone or particulate matter pollution, making the regression discontinuity design applicable. Chen and colleagues estimated two separate sets of effects for the seven health outcomes: the first corresponded to the day being eligible for an alert, not necessarily called; and the second estimated the effect of announcing an alert. The findings were clear in indicating a reduction in emergency room visits for asthma, and some evidence was found for fewer hospital admissions for chronic obstructive pulmonary disease and asthma. No evidence was reported of reduced mortality or for beneficial effects for cardiovascular disease morbidity.

An air quality alert has potential public health benefits through a chain of possible responses that reduce exposure (figure). In Canada, air quality alerts are used mainly to advise on individual actions to be taken by the general population and those at risk. The measures mostly relate to changes in activity patterns. In some countries, an air quality alert—particularly if triggered by high concentrations of ozone or particulate matter—can lead to emergent measures to reduce emissions and limit exposures (eg, closing schools). In Beijing, for example, the most severe episodes lead to a red alert with mandatory provisions, including suspending primary and middle schools, banning use of specific vehicles, stopping some outdoor construction work, closing predesignated industrial facilities, and banning fireworks. At times of high pollution, individuals might also choose to use personal respiratory protection and air cleaning devices in their residences. Mullins and Bharadwaj showed that an air quality alert system reduced mortality in Santiago, Chile; high levels of ozone and particulate matter prompted both public warnings and governmental actions to reduce emissions.

If air quality alerts are to work as intended for individuals, awareness of the warnings and adherence to the protective recommendations are essential steps in the chain. Scant evidence—summarised in a systematic review—indicates that the level of adherence to...
warning is suboptimum. A study using the regression discontinuity design showed that air quality alerts in southern California reduced attendance at two outdoor venues. In the UK, a quasi-experimental study found that text messaging about air quality unexpectedly increased use of health services among a group judged at risk for adverse effects of air pollution exposure.

Considering the findings of Chen and colleagues in the context of the response chain, the beneficial outcomes noted in people with asthma could be anticipated. Generally, people with asthma and their care providers are aware of the adverse effect of air pollution, and clinical guidelines address indoor and outdoor air pollution. Self-guided modification of treatment can be made—e.g., increasing use of rescue inhalers—and activity patterns can be changed. For cardiovascular disease, awareness of the relevance of air pollution alerts is possibly less. The findings of Chen and colleagues should be generalised with caution, in view of the study population from Toronto, which has good access to medical care. Moreover, estimates using the regression discontinuity design have applicability around the threshold assessed but cannot be extended readily to the far more severe air pollution now affecting much of the world. Nonetheless, the study nicely documents the use of the regression discontinuity design for assessing the outcomes of air pollution policies.

Air pollution alerts remain fundamental to public-health protection, particularly in large urban areas where air pollution concentrations routinely spike well beyond air quality standards and guidelines. In the future, there could be a shift towards personalised systems, because small low-cost sensors are being used with increasing frequency; crowdsourcing enriches data at small scales; and mobile technologies are used as conduits for warnings and guidance. These initiatives will need careful assessment using quasi-experimental approaches.

Jonathan M Samet
Colorado School of Public Health, University of Colorado, Aurora, CO 80045, USA
jon.samet@ucdenver.edu
I declare no competing interests.

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