REPEATED SHORT TERM PEAKS OF PM_{10} EXPOSURE HAVE A GREATER EFFECT ON MORTALITY: A NEW APPROACH TO TIME SERIES STUDIES

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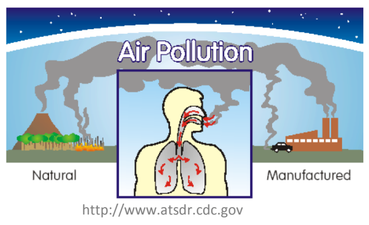
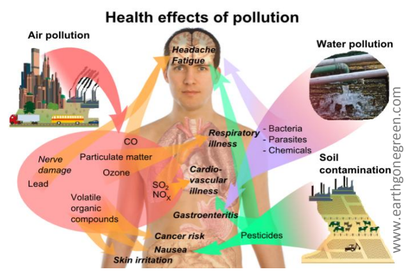
BACKGROUND

- Air pollution is the presence of harmful gaseous and particulate substances above the 'normal' level.



- It is a major environmental risk to health (3.7 million premature deaths in 2012).[1]

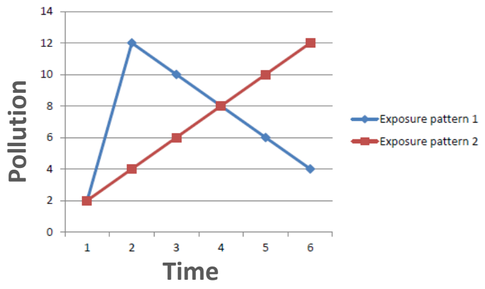


- Health risk from pollution is often reported as percentages.

- Thus, a 1% increase in mortality risk per 10 units increase in pollution compares two days, say with 2 and 12 units; the days need not be sequential.

- But a change from 2 to 12 could follow different patterns—
  - increase by 2 units each day for 5 days
  - all in one go over 1 day, etc (Figure 1).

Figure 1: Hypothetical pollution exposure patterns



- Conventional studies on health effects of air pollution do not take into account such variation in exposure patterns.

AIM

- To assess the impact of short term patterns in pollution exposure on mortality risk estimates associated with air pollution.

METHODS

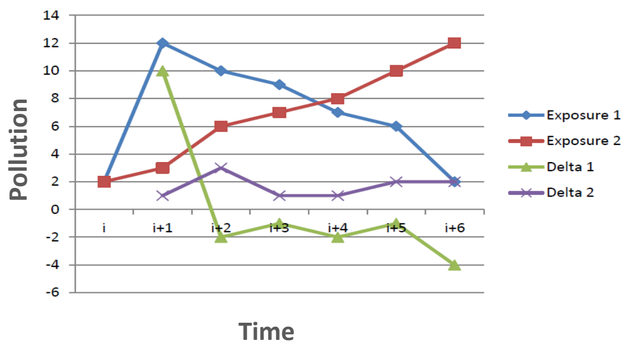
- Data on daily particulate matter pollution (PM_{10}), mortality and weather were obtained from London (2000-2005).

- The daily PM_{10} data were used to define exposure patterns on each day by counting number of:

1- Positive changes in PM_{10} over successive days (delta)
2- PM_{10} peaks and
3- Delta peaks

each for the week just before the mortality day.

Figure 2: Peaks for PM_{10} and delta metrics



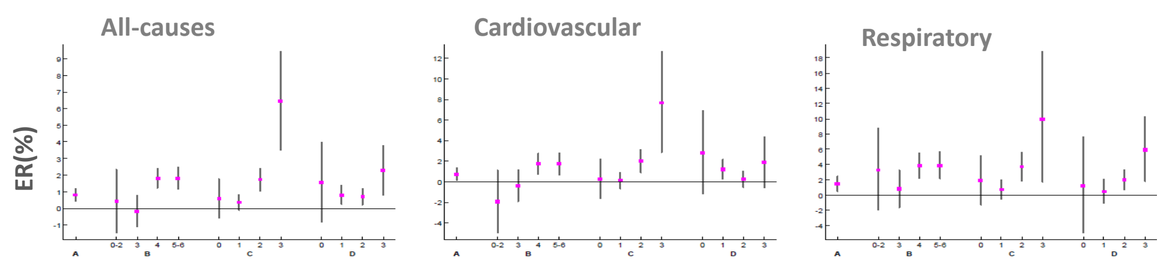
- Regression models (Poisson GAMs) were used to study the association between PM_{10} and mortality taking into account exposure patterns.

- Models adjusted for time trends, seasonality, day of the week and temperature effects.

RESULTS

- Excess risk (ER) in mortality was generally higher for larger number of positive deltas, PM_{10} and delta peaks (Figure 3).

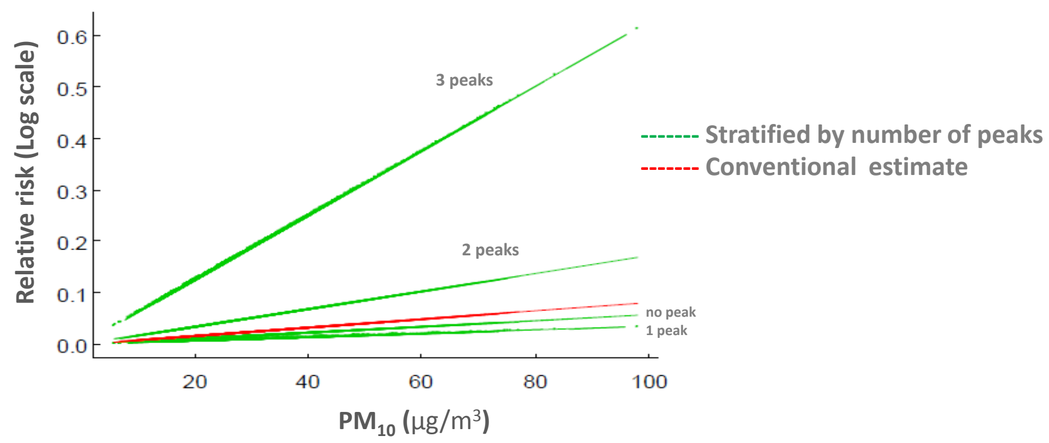
Figure 3: ER estimates in PM10 related mortality stratified by exposure patterns (A) Unadjusted (B) Number of positive delta (C) PM_{10} peaks and (D) Delta peaks



- The association was similar for cardiovascular and respiratory mortality.

- These were well above the conventional estimate which ignored exposure patterns.

Figure 4: Exposure-response relationship between mortality and PM_{10} with and without accounting for number of PM_{10} peaks



DISCUSSION

- The results have major implications on

(A) estimation of public health risk

(B) control in relation to air pollution

- For (A), results indicated higher risks for weeks with larger number of peaks— current approach underestimates risk.

- For (B), study showed that excess risk in mortality could be reduced by minimizing the number peaks in air pollution.

- This could be done for example through short term policy interventions.

CONCLUSION

- Epidemiologic studies should take into account *patterns of exposure* in addition to exposure concentration and the time period of exposure.

- Further investigations focusing on mechanistic implications are highly needed as well as replication in multiple locations.

REFERENCES

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