환경역학

단국의대 권호장

What is environment?(Last 1995)

- All that which is external to the individual human host
- It can be divided into physical, biological, social, cultural, any or all of which can influence health status in populations

Traditional hazards

- Shortage of food and drinking water
- Plants with natural toxin
- Infections and parasites
- Injuries from falls, fires, and animal attack
- Cold and hot temperature, natural disasters

Modern hazards - chemical and physical agents

- Diet and food contaminants
- Water: chlorinated hydrocarbons and infectious agent
- Air pollution
- Environmental tobacco smoke
- Radiation including EMF
- Pesticide
- Patterns of disease in population struck by disasters(war, earthquakes, floods, etc.)
- Global environmental changes(ozone depletion, global warming)

What is epidemiology? (Last,1995)

- The study of the distribution and determinants of health- related states or events in specified populations, and the application of this study to control of health problems.

Unique features in EE

- Very large number of exposures
- Low concentrations
- Little difference among individuals with certain area
- Very low relative risks
- Indirect and long term effects
- Involuntary exposures

사업장 및 환경 기준농도 비교

	사업장 허용농도 (OSHA PEL)	대기환경기준 (환경부)
SO2	2 ppm(TWA) 5 ppm(STEL)	0.05ppm(24h) 0.15ppm(1h)
CO	35 ppm(TWA)	9 ppm(8hr)
Ozone	0.1 ppm(TWA) 0.3 ppm(STEL)	0.06 ppm(8hr) 0.1 ppm(1hr)

Exposure assessment

- Interviews, questionnaires, structured diaries
- Measurement in external media
- Concentrations in the personal or microenvironment
- Individual dose
- Measurements of concentrations in human tissues
- Markers of physiologic effects

Overview of study designs

- All the standard designs
- Chronic low lead exposure vs lower IQ(Needleman et al.)
  - IQ vs lead content of deciduous teeth(cross-sectional study)
  - Follow up of cohort identified in cross-sectional study
- Community intervention study: the evaluation of dental benefits from fluoridation of public water system

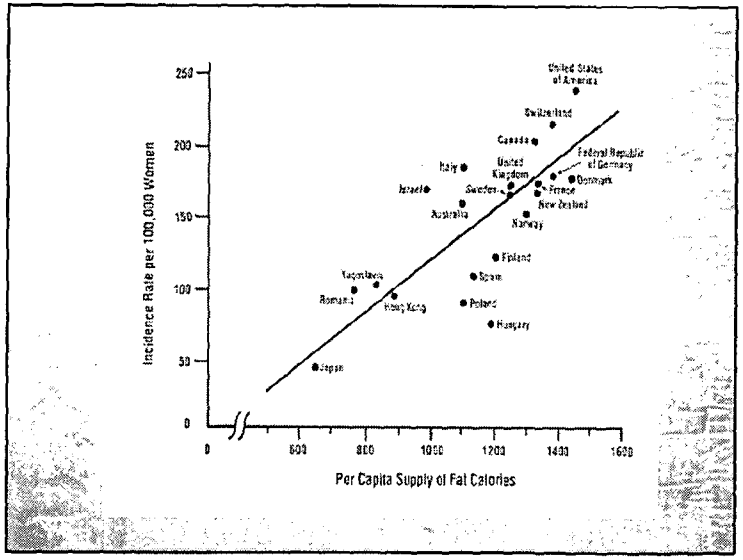
Ecologic studies in environmental epidemiology

- Can be useful when

(1) the goal is to screen hypothesis inexpensively

(2) the goal is to determine the effectiveness of programs, policies, or regulations that are implemented at the ecologic level

(3) Variation across individuals is outweighed by between group variance



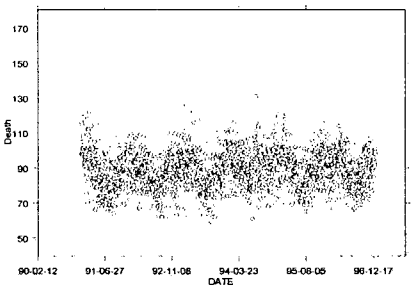
Three useful study designs based on ecological data

- Investigation of regional variations through mapping
- Investigation of within- group changes through time trend or time series analysis
- Evaluation of differences in time trends across regions or changes in spatial patterns over time

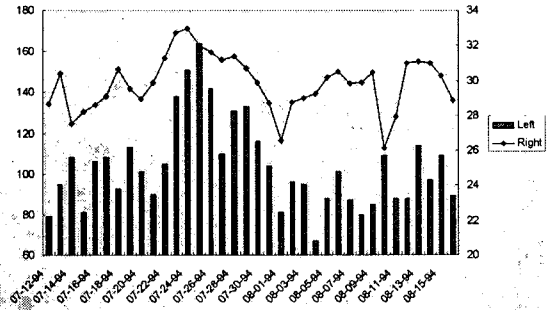
Time-related analysis

- Time clustering
  - accidents, outbreak of deaths during London smog
- Cyclic pattern
  - CV death rise in winter and decline in summer
- Longitudinal trend
  - hypothesis about causal factor in heart disease, breast cancer, and asthma

서울시의 일별 사망자 수 분포(1991-1996)



혹서기의 일별 평균기온 및 사망자 수



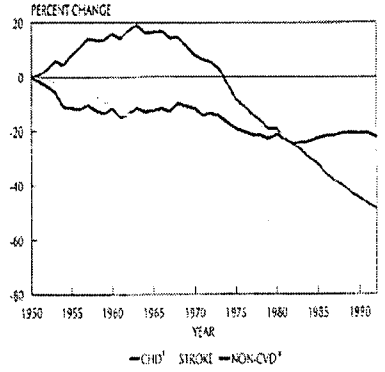


FIGURE 1-12. Photograph of John Snow (From the Wellcome Historical Medical Museum and Library, London.)

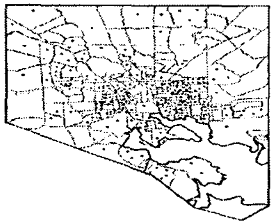
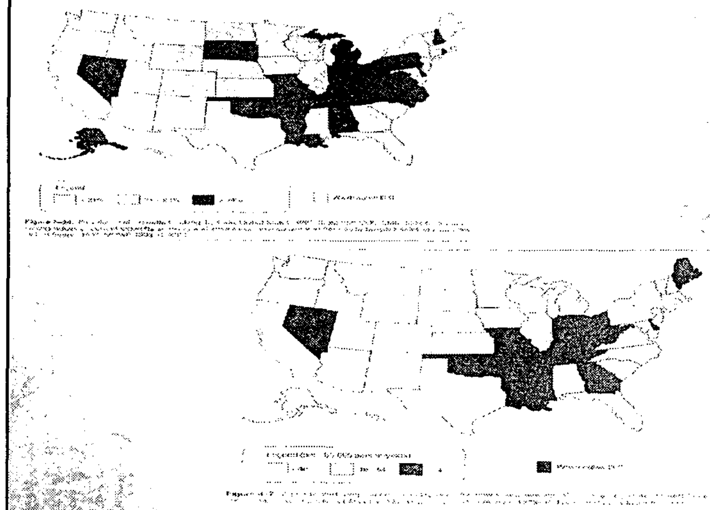


TABLE 1-2. *Deaths from Cholera per 10,000 Houses, by Source of Water Supply, London, 1854*

Water Supply	No. of Houses	Deaths from Cholera	Deaths per 10,000 Houses
Southwark and Vauxhall Co.	40,046	1,263	315
Lambeth Co.	26,107	98	38
Other districts in London	256,423	1,422	[illegible]



Three stages in air pollution studies

- 1st generation: health impact of incidents with extremely high levels of air pollution
- 2nd generation: less extreme levels of pollution
- 3rd generation: even lower levels of air pollutants and more subtle design

1st generation

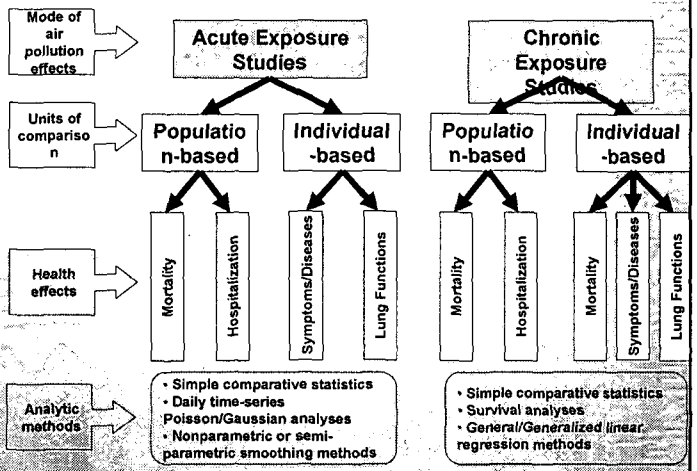
- In Meuse valley of Belgium in 1930; in Donora, Pennsylvania, in October 1948; in London winter of 1952
- Methodologically similar to the reports of infectious disease epidemics
- Within community comparisons using a before and after design

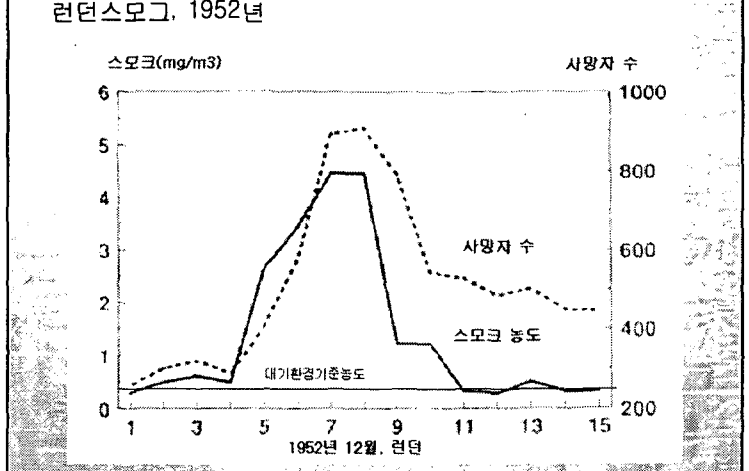
2nd generation

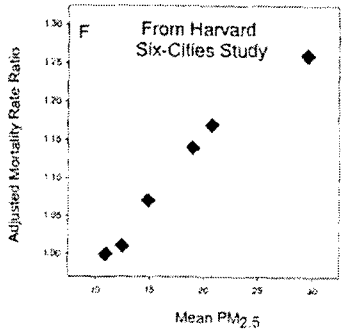
- Conducted in the 1950s and 1960s
- A design that compared communities with higher pollutant levels to ones with lower level
- Strong correlation between socioeconomic level and air pollution level
- Demonstrated the threat from ordinary ambient air pollution to the general pop.
- Contributed to the establishment of air standards

3rd generation

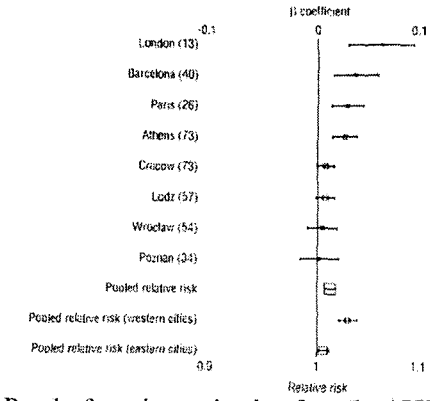
- Relied heavily on within community time series analyses that examine the effects
- Time series analysis avoids problems from confounders that differ across individuals(smoking prevalence, distribution of social class, age)
- Fairly consistent associations



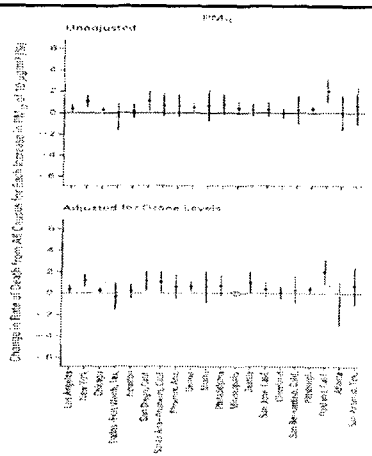




N Engl J Med 1993;329:1753-1759



Results from time series data from the APHEA project;
BMJ 1997;314:1658



All cause death vs PM10 in 20 cities and metropolitan area;
N Engl J Med 2000;343:1742-1749

Time Series Analysis

- The same population is examined repeatedly under varying exposure conditions
- Time invariant characteristics such as sex and race are not potential confounders
- Covariates with time trend or seasonality should be controlled by modelling
- Poisson Regression Model
- $\text{Log}(E(Y))=\beta_0+\beta_1X_1+\beta_pX_p$

Modelling Issues

- Potential Confounders in time series analysis
  - Season and trend
  - Weather factors(temperature, humidity,barometric pressure)
  - Calendar specific day(day of the week, holiday)

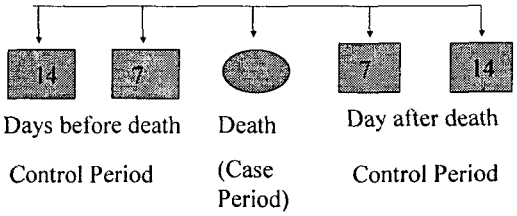
Generalized Additive Model

- $Log(E(Y))=S_1X_1+::::+S_p X_p$
  Xp : the predictor variable
  Sp : the smooth function
- Digit span
- gam(Y~lo(Date, span=) + lo(Temperature) + lo(Humidity) + Dummy variable + Pollutant, family=poisson, data=dataset)
- Autocorrelation
- Diagnostic plot

Case Crossover Design

- An adaptation of the case-control design for the analysis of transient effects on the risk of acute events
- Control information is based on his/her past exposure
- Matched sets of a case period and one or more control periods may be analysed using conditional logistic regression
- This approach control for time trends and seasonal pattern by design
- The unit of observation is individual

Control Sampling in Case-Crossover Design



Precautionary principle

- *When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically*
- Environ Health Perspect 109(9):871–876 (2001)

Four central components

- Taking preventive action in the face of uncertainty
- Shifting the burden of proof to the proponents of an activity
- Exploring a wide range of alternatives to possibly harmful actions
- Increasing public participation in decision making

Historical links

- "Do no harm"
- Came from German word *Vorsorgeprinzip* (foresight principle)
- Served as a central element in international environmental treaties addressing ozone depletion chemical, climate change, etc.
- One of the guiding principles of environmental laws in the EU

View of many policymakers

- "How much risk does this activity pose, and is it significant? or what level of risk is acceptable?
- Focus on the qualification of potential hazards rather than the prevention of *pollution*

Precautionary way of thinking

- Is the proposed activity needed, and if so, how much contamination can be avoided while still achieving societal goals?
- And are there alternatives to this activity that clearly avoid hazards?

Points of opposition

- Current regulatory procedures are already precautionary
- Precautionary principle is not scientifically sound
- It would stifle innovation by requiring proof of safety before new technology could be introduced

Case illustrations – cellular phones in airplane

- Very limited evidence that electronic devices may interfere with the control system of the aircraft
- Talking on the phone in flight vs a small risk of airplane crash
- *If someone want to change the rule on cellular phone use in flight……*
- *If concerns about cellular phone in the flight had not been raised initially*
- The availability of an economically viable alternative(in-flight telephones)

Limitations of conventional scientific methods

- Hypothesis formulation
- Emphasis on independent effects, not interaction
- Narrow definition of uncertainty
- Setting type I and type II error rates
- Type III errors
- Disciplinary divisions