#### Environmental and Occupational Epidemiology

#### · As Environmental Health (4) on 22 Oct. 2015

#### Key Concepts

Epidemiology: study of distribution and determinants of health and disease in human populations (incl. causal inference)

Environmental/Occupational epidemiology studies the role of exposures in the general environment/workplace by common methods

Epidemiological data complement other data (incl. toxicological data)

Optimal study design depends mainly on population's feature, exposure, and disease

Strength of conclusion is based on large sample size, accurate and precise measurement of exposure and disease

Avoiding bias (selection bias, information bias, and confounding) is important for valid causal inference

Necessary for risk assessment, standard-setting, policy-making

### A primer on epidemiology

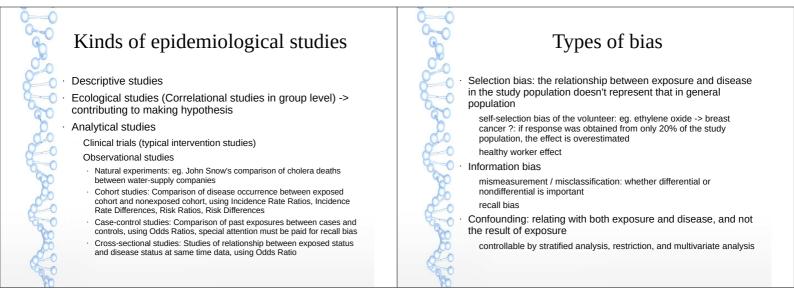
Epidemiology pursues causal inference on exposure and disease: philosophical framework was given by Karl Popper (Rothman and Greenland, 1998)

- All hypotheses are tentative and may be disproved by further testing A hypothesis has a greater scientific value when it has more possibility (test methods) of disproval
- Several checklists of causation (Hill's criteria, 1965)

Temporal relationship (absolutely required!): Exposure must precede disease

Consistency: The association is repeatedly observed in many studies Large effect size: The exposed have much more disease than nonexposed

Positive dose-response: More exposure causes more disease Biological plausibility: Some biological explanation makes it reasonable that A (exposure) causes B (disease) etc.



#### Types of data analyses For category variables (esp. dichotomous variables) Rate Ratios. Odds Ratios - with confidence intervals Fisher's exact test - calculating p-values (probability of getting the actual data under the null-hypothesis of independence): strong effect of sample size should be noted For continuous variables Typically regression analysis (for exposure and disease) · linear regression model logistic regression model poisson regression model

- multilevel model

#### Environmental epidemiology

Environmental agents, large number of people are exposed involuntarily (vs. individual voluntary exposure to tobacco, alcohol)

Both possibility to cause epidemics and endemic diseases

- Neuropathy outbreak in Madrid in 1981 <- oil contaminant
- Gastrointestinal illness outbreak in Milwaukee in 1993 <drinking water contamination by cryptosporidium
- Endemic diseases are caused by constant, low level exposure
- possible contribution of radon gas in homes to lung cancer
- dioxin in the diet contributing to cancer rates

environmental lead exposure to children causes neurological deficits Relationship between environmental agents and background levels of disease in developed countries is a kind of endemic diseases' study (becoming a large study focus, but difficult to detect such associations)

# Occupational epidemiology

Illness or injury associated with workplace exposures

Stressful repetitive motion ~ carpal tunnel syndrome (手根管症候群 in Japanese)

- Welding ~ lung cancer Silica ~ kidney disease

Poor office ventilation ~ respiratory illness

Relatively high level exposure to relatively small number of people, comparing with the target of environmental epidemiology

Scientifically easy to study, but economically and politically controversial (often faces conflict of interest)

Historically, occupational cancer was studied in relation to high level exposure to many kinds of occupational contaminants (asbestos, aniline dyes, silica, nickel, cadmium, arsenic, dioxin, beryllium, acid mists, radon gas, diesel fumes): It's already clear. Studies completed.

Much lower level environmental exposure has the same carcinogenicity? is still the target of the study (radon gas in homes, arsenic in water, asbestos are already clear, but dioxin's low level carcinogenicity is still unclear)

Nowadays, subjects of occupational epidemiology involves issues more difficult to study (job stress ~ heart disease?, lifting ~ back strain?)

# Finding the occurrence of clusters

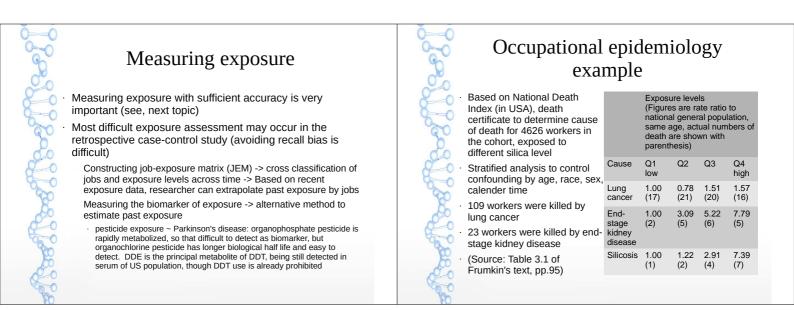
In both environmental and occupational epidemiology, finding disease clusters is important

Cluster: an apparently elevated number of disease cases in a limited area over a limited period, suggests common cause

Sometimes difficult to find: eg. 3 cases of childhood leukemia were found in the same street -> unusual, but not found due to the ward of disease statistics being composed of a dozen streets

For rare diseases, statistical power is too small to detect the effect by cohort study, so that only case-control study is applicable to such situation

In most cases, researchers cannot find common cause from the cluster. (exceptions) Cluster of asthma in Barcelona in the early 1980s had common cause of soybean dust in the air.



### Environmental epidemiology example

Recreational water quality: the number of gastroenteritis outbreaks ~ exposure to recreational water -> increased 3-4 times from 1978 to 2004

Haile and others (1999): gastrointestinal illness ~ swimming in marine waters incl. untreated runoff from storm drains in Santa Monica Bay?

Are there different risks of adverse health outcomes among subjects swimming at different distances from the storm drains? Are risks of specific health outcomes associated with the concentration of specific bacterial indicators of water quality or with the presense of enteric viruses?

- Adjusted RR for 400 yards away from drains: 1.2 for eye discharge, sore throat, HCGI (highly credible gastrointestinal illness), 2.3 for earache
- Adjusted RR for within 50 yards from drains: 1.2 for cough, diarrhea,

#### chills, 1.9~2.3 for eye discharge, vomiting, HCGI

#### Epidemiology and risk assessment

Past: Qualitative literature review

Today:

Quantitative meta-analysis: Weighted average of quantitative results (already published) across studies. (Originally used in clinical trials, but now used for observational studies, it can combine different kinds of studies and measures.)

Pooled analysis: If raw data are available, this gives a common exposure-response coefficients.

Risk assessment: Determination of permissible (acceptable) exposure level. Occupational exposure usually permit higher level than general public.