Observational study II

(QUANTITATIVE METHOD IV)

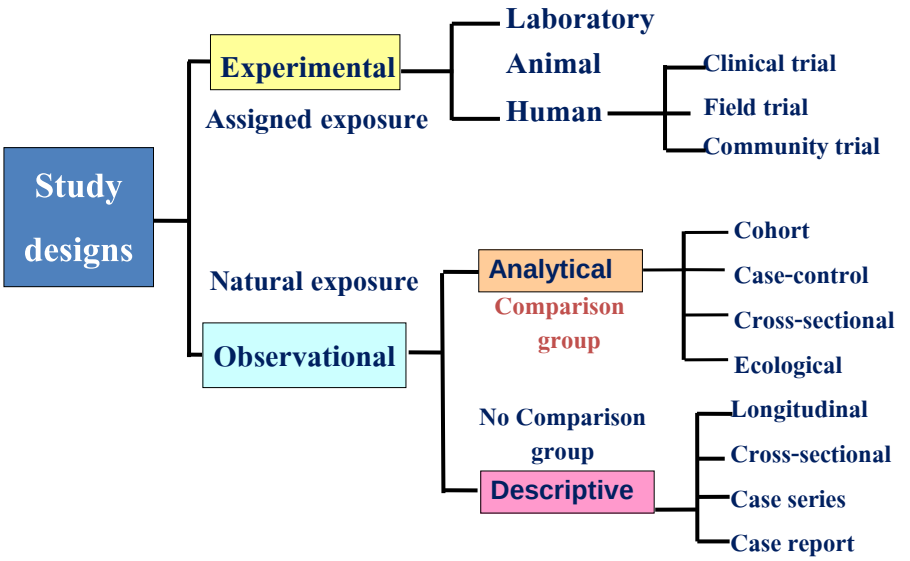
หลักสูตรเวชศาสตร์ชุมชน

RACM 302

AIMS

- **Observational study and analytic study designs :**
  - **Case-control study**
  - **Cross-sectional study**
  - **Ecological study**
- **Calculate the odds ratio and interpret the result**
- **Errors in epidemiology**
  - **Systematic error (bias)**
  - **Non-systematic (random) error**
- **Identify bias in case-control studies**
- **Advantages and disadvantages of cohort and case- control study**
- **Criteria of causation**

EPIDEMIOLOGICAL STUDY



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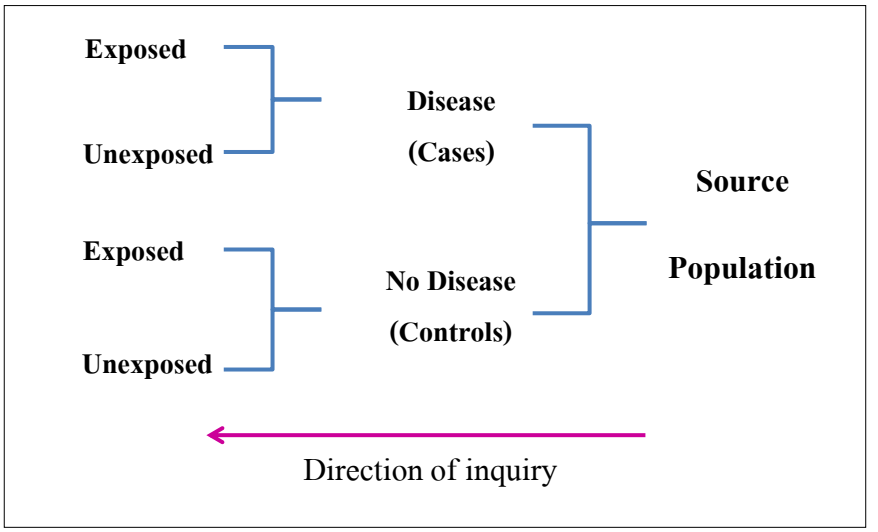
Case-control study



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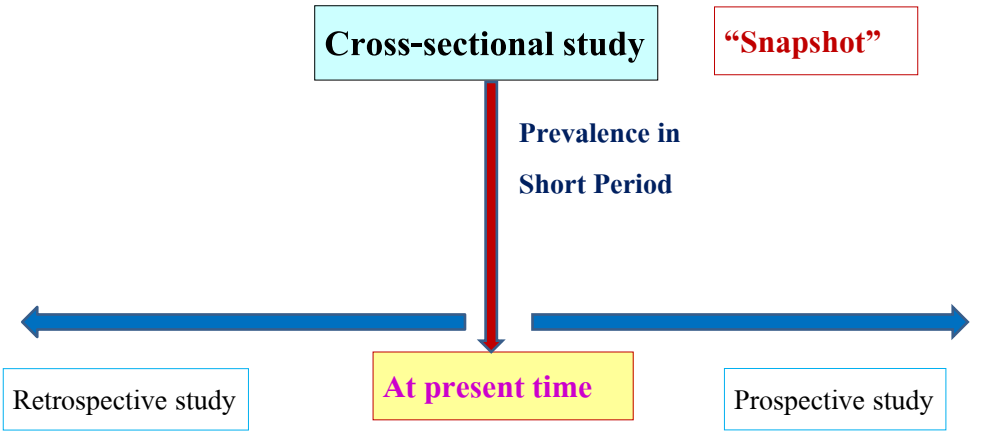
Cross-sectional study



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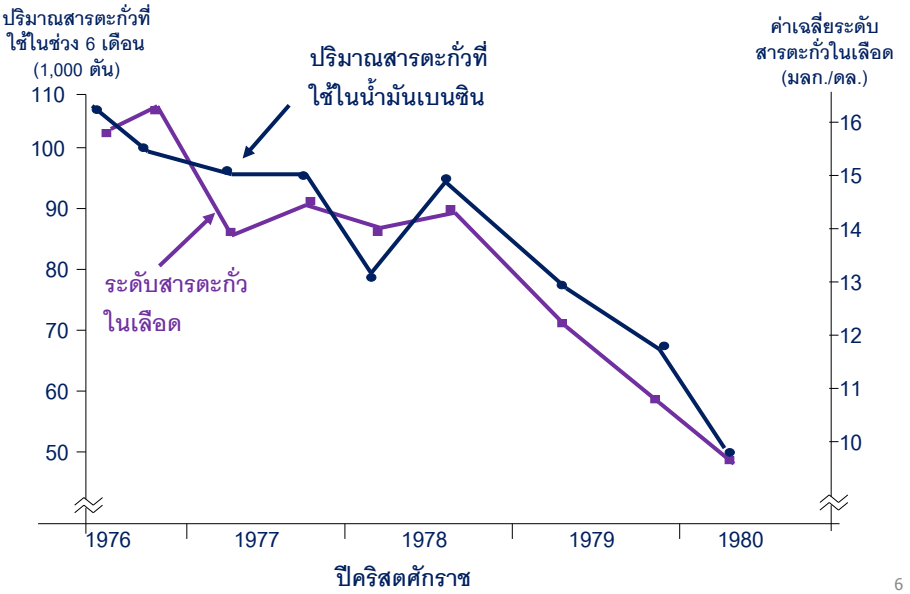
Ecological study



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Case-control study

is an observational study in which subjects are sampled based on the presence or absence of disease and then information about the exposure to risk factors of interest is collected

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Design of case-control study

- Basic assumption: cases and controls are random samples of source population
- At baseline: selection of cases and controls based on disease status (exposure status is unknown)
- Validity depends on : which cases and controls are selected, how exposure is measured, and how confounders are controlled

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Selecting cases (1)

- Define the source population (the population from which case arise)
- Select cases after the diagnostic criteria (sensitive & specific) and definition of case is clearly established
- Study cases should be representative of all cases : all cases or a random sample of all cases in the defined population

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Selecting cases (2)

- Cases may be selected from community, hospitals, clinics, disease registries, screenings, etc.
- Incident cases are preferable to prevalent cases for reducing recall bias and over-representation of cases of long duration
- The best way to obtain cases is to include all incident cases in a defined population over a specified period of time

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Principles of control selection

- Controls should be chosen at random from the source population

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Selecting controls

- Population controls:
  - registries, households, telephone sampling
- Hospital controls:
  - patients at the same hospital as the cases (usually a biased sample)
- Others :
  - community, school, spouses, siblings, neighborhood or associates of cases, etc.

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Measuring exposure

- Validity depends on avoiding bias in measurement of exposure
- Ideally, complete and accurate records of exposure status were collected before disease developed (no interviewer and recall bias)
- Measurement bias :
  - Observers
  - Instruments
  - Subjects

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MEASURE OF ASSOCIATION

- **Strength (magnitude) of association**
  - **Case-control ---> Odds ratio (OR)**
  - **Analytic cross-sectional ---> Odds ratio (OR)**
- **Measure of statistical association**

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Case-control study

	Case	Control	Total
Exposed	**a**	**b**	**a+b**
Unexposed	**c**	**d**	**c+d**
Total	**a+c**	**b+d**	**a+b+c+d**

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Strength of association

Sample estimate :

odds of exposure among case = $\frac{a}{a+c} / \frac{c}{a+c} = \frac{a}{c}$

odds of exposure among control = $\frac{b}{b+d} / \frac{d}{b+d} = \frac{b}{d}$

odds ratio = $\frac{ad}{bc}$

Population estimate :

95% confidence interval (CI)

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Reye's syndrome and aspirin use

	Reye's syndrome	No Reye's syndrome	Total
Aspirin use	26	53	79
No Aspirin use	1	87	88
Total	27	140	167

odds of exposure among case = 26/1

odds of exposure among control = 53/87

odds ratio = 42.68

95 % confidence interval (CI) = 5.89-869.47

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Cross-sectional study

Environmental Health

BioMed Central

Research

Open Access

Respiratory and skin health among glass microfiber production workers: a cross-sectional study

Penpatra Sripaiboonkij[1], Nintita Sripaiboonkij[2], Wantanee Phanprasit[3] and Maritta S Jaakkola*[4]

A cross-sectional study of 102 workers from a microfiber factory (response rate 100%) and 76 office workers (73%) from four factories in Thailand was conducted. They answered a questionnaire on respiratory health, occupational exposures, and lifestyle factors, and performed spirometry.

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Analytic cross-sectional study

Table: Odds ratio (OR) of respiratory and skin symptoms and asthma in relation to exposure to glass microfiber in factory workers compared to office workers

Symptom/disease	Odds Ratio*	95%CI
Cough	2.85	1.38-5.86
Phlegm	0.84	0.44-1.61
Wheezing	1.26	0.52-3.07
Breathlessness	3.80	1.83-7.92
Nasal	2.06	1.08-3.91
Eye	0.85	0.44-1.65
Skin	3.45	1.83-6.49
Asthma ever	1.52	0.37-6.29

***Office workers formed the reference category (OR=1)**

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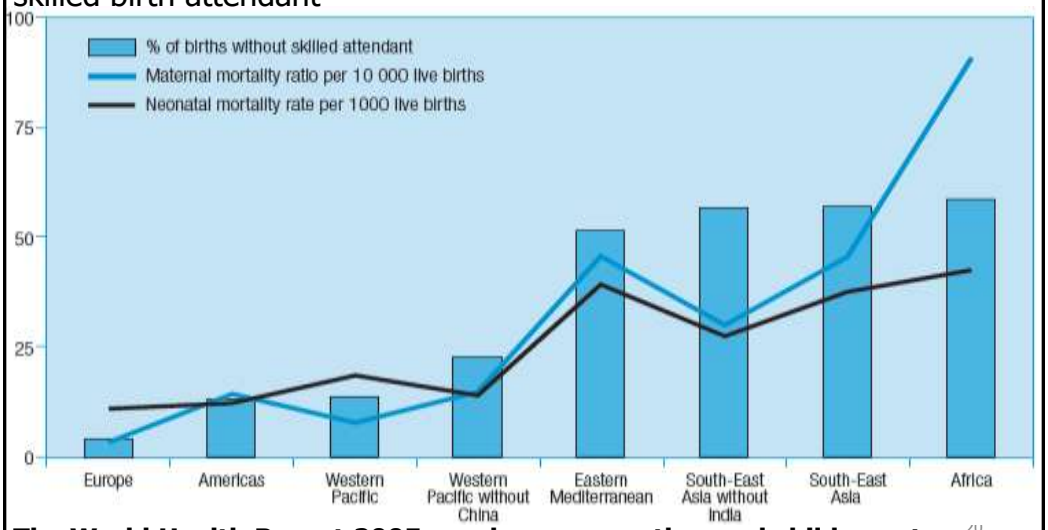
Ecological study

Neonatal and maternal mortality are related to the absence of a skilled birth attendant



The World Health Report 2005 - make every mother and child count

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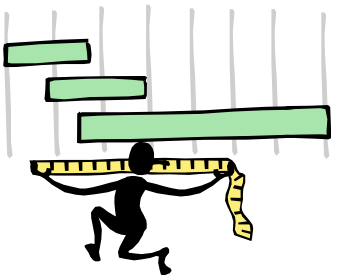
ERRORS IN EPIDEMIOLOGY



- **Systematic error (bias)**
- **Non-systematic (random) error**

Systematic error (bias)

- **Any systematic error in an epidemiological study which results in an incorrect estimate of the association between exposure and risk of disease**

& Selection bias

& Information (misclassification) bias

& non- differential

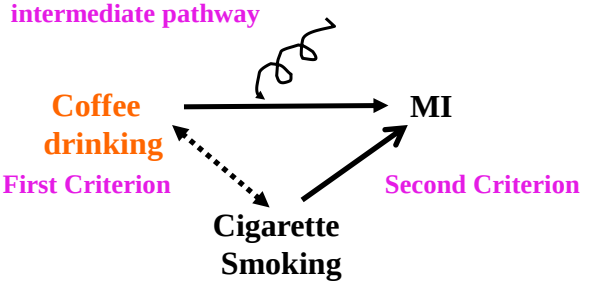
& differential

& Confounding

Confounding Bias

- **A confounding variable is independently associated with both the exposure and outcome.**
- **cigarette smoking confounds the relation between coffee drinking and myocardial infarction (MI)**

Third Criterion : cigarette smoking is not in the intermediate pathway



Confounder

Smokers and nonsmokers combined

	MI	No MI
Coffee	90	60
No Coffee	60	90

Odds ratio for MI associated with coffee

= 90*90/60*60 = 2.25

Confounder

	Smokers		Nonsmokers	
	MI	No MI	MI	No MI
Coffee	80	40	10	20
No Coffee	20	10	40	80

Odds ratio for MI associated with coffee

smokers = 80*10/20*40 = 1

nonsmokers = 10*80/40*20 = 1

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Confounder

	MI and no MI combined	
	Coffee	No coffee
Smokers	120	30
Non smokers	30	120

Odds ratio =120 *120 /30*30 = 16

	Coffee and no coffee combined	
	MI	No MI
Smokers	100	50
Non smokers	50	100

Odds ratio =100*100/50*50 = 4

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Bias in case-control studies

- **Selection bias**
  - **cases and controls are identified not independently of the exposure**
    - **prevalent case if risk factor is the prognostic factor**
    - **hospital control**
  - **non-response during data collection**

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Bias in case-control studies

- Misclassification bias, classifications of diseases or exposures are inaccurate
  - Misclassification of cases and controls
    - observer bias
    - instrument bias : poor validity of diagnostic test

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Bias in case-control studies

- Misclassification of exposure status
  - —Observers : interviewer bias, respondent's predisposition to the interviewer or the interviewer's interpretation
  - —Instruments : no instrument calibration
  - —Subjects : recall bias, cases are more likely to remember exposure than control
- Confounder : Difference in other risk factors between exposed and non-exposed

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Bias in cross-sectional study

- **Selection bias**
  - **— If study population is not representative of target population**
- **Misclassification bias**
  - **— exposure**
  - **— outcome จะได้แต่ prevalent case**
- **Confounder**

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Ecological fallacy

เป็นการสรุปผิด เนื่องจากนำข้อสรุปจากระดับกลุ่มมาใช้แทนระดับบุคคล

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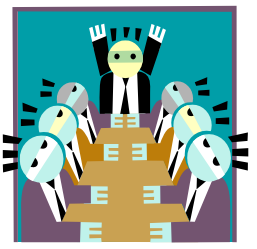
การแก้ไข Systematic error (bias)

- เลือกรูปแบบการศึกษา ที่เหมาะสม
- จัดระบบการวัดให้ถูกต้องทั้ง
  - ผู้วัด (observer)
  - ผู้ถูกวัด (subject)
  - เครื่องมือที่ใช้วัด (instrument)
- ใช้ศาสตร์ทางสถิติ กรณี confounding (statistical modeling)



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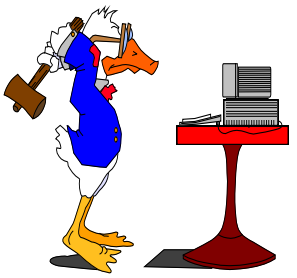
Non-systematic (random) error



- **Sampling error**
- **Biological variation**

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Advantages & disadvantages

	Cohort	Case control	Cross-sectional	Ecological
Advantages	•temporality •measure of risk •rare exposures •multiple outcome	• rapid & low cost •long latency •rare disease •multiple exposures •small sample size	•rapid & low cost •measure prevalence •multiple outcomes and exposures •no loss to follow up	•rapid & low cost •generating hypothesis
disadvantages	•cost & time consuming •latency period •loss to follow up • exposures can change •large sample size	•no measure of risk • ⬆ recall bias •rare exposures •temporality	•rare diseases •rare exposures •temporality	•ecological fallacy

CRITERIA OF CAUSATION

- **Temporal relationship**
- **Strength of association**
- **Dose-response relationship**
- **Biological plausibility**
- **Consistency**
- **Reversibility**
- **Specificity**
- **Analogy**

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ภาคผนวก

- ตัวอย่างแสดง ผลของ differential misclassification และ non differential misclassification ที่มีต่อค่า odd ratio

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Differential misclassification

	Cases	Controls	Total
Exposed	90	100	190
Unexposed	60	100	160
Total	150	200	350

Odds ratio = 1.5

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Differential misclassification

	Cases	Controls	Total
Exposed	105	100	205
Unexposed	45	100	145
Total	150	200	350

Odds ratio = 2.33

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Differential misclassification

	Cases	Controls	Total
Exposed	100	90	190
Unexposed	50	110	160
Total	150	200	350

Odds ratio = 2.44

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Differential misclassification

	Cases	Controls	Total
Exposed	100	110	210
Unexposed	50	90	140
Total	150	200	350

Odds ratio = 1.63

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Non differential misclassification

	Cases	Controls	Total
Exposed	90	90	180
Unexposed	60	110	170
Total	150	200	350

Odds ratio = 1.83

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	100	100	200
Unexposed	50	100	150
Total	150	200	350

Odds ratio = 2

Non differential misclassification

	Cases	Controls	Total
Exposed	105	110	215
Unexposed	45	90	135
Total	150	200	350

Odds ratio = 1.91

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Misclassification

True Classification

	Cases	Controls	Total
Exposed	**a**	**b**	**a+b**
Unexposed	**c**	**d**	**c+d**
Total	**a+c**	**b+d**	**a+b+c+d**

Odds ratio = ad/bc

Non differential misclassification

	Cases	Controls	Total
Exposed	**0.9a**	**0.9b**	**0.9a+0.9b**
Unexposed	**c+0.1a**	**d+0.1b**	**c+d+0.1a+0.1b**
Total	**a+c**	**b+d**	**a+b+c+d**

Odds ratio = 0.9ad+.09ab/0.9bc+.09ab= ad+0.1ab/bc+0.1ab

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