

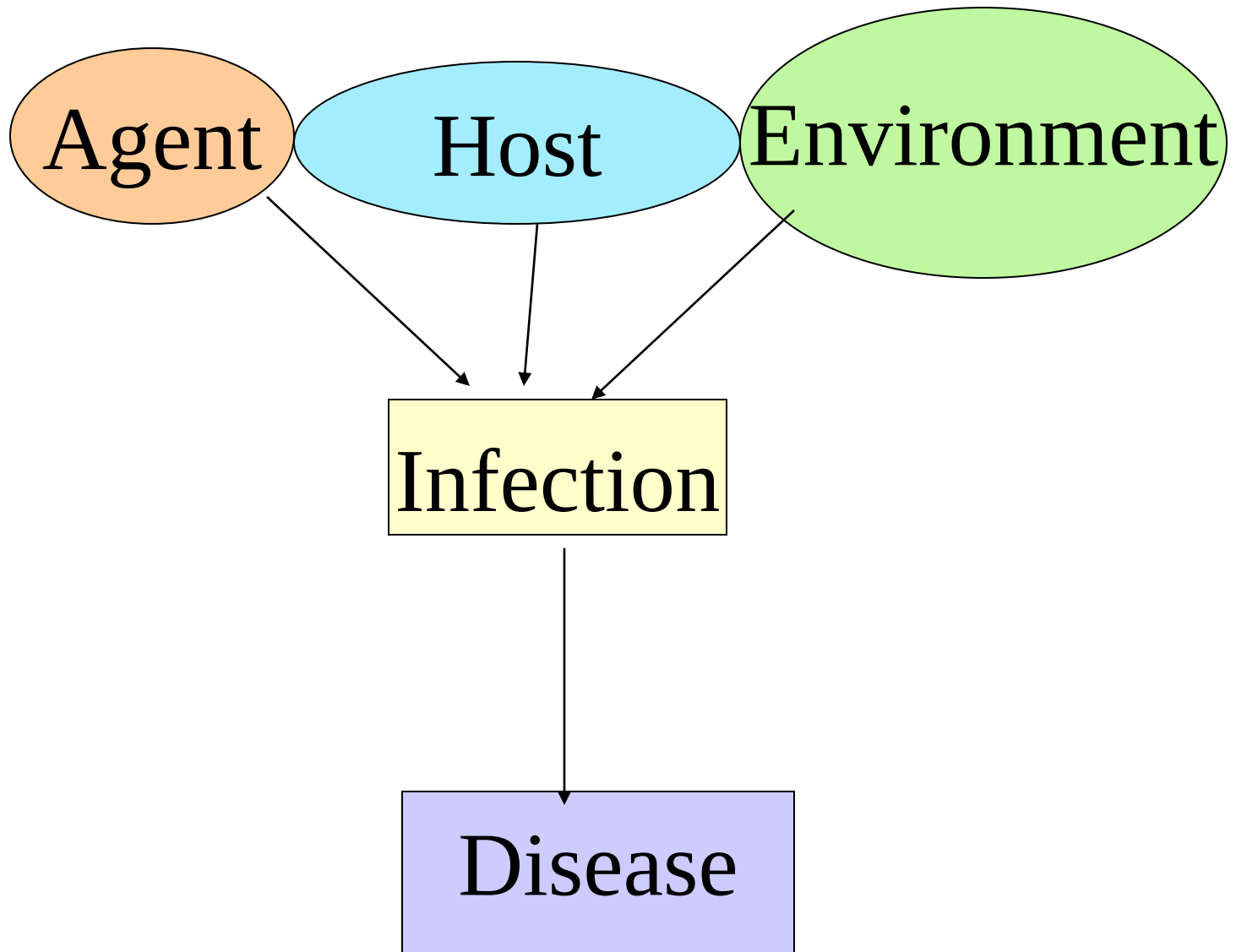
Association & Causation

Major Goal Of Epidemiology

To discover/identify the cause/s of
disease



To control & prevent the disease,
To promote health



Road accident---→ Head injury-→ Death

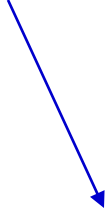
CAUSE

Defined as an event, circumstances, risk factors, characteristics or a combination of these factors, which results in disease production.

- Tobacco → cancer
- DM → CAD
- Elderly primi → Down's syndrome
- Multipara → CA cervix

- Malaria parasite in blood → Malaria
- Chromosomal anomaly → Down's syndrome

Sufficient cause



- Tobacco → cancer
- DM → CAD
- Elderly primi → Down's syndrome
- Multipara → CA cervix

- Malaria parasite in blood → Malaria
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Necessary cause



- Sufficient cause- factors/conditions which produce disease provoking stimulus/stimuli for initiating the disease process in the host
- Necessary cause – disease can not develop in its absence.

ASSOCIATION

Causation & Association

Under 5 Mortality Rate (per 1000 live birth)	
Well nourished	50
Malnourished	200

Association & relationship (causation) are often used interchangeably

ASSOCIATION

Association: Concurrence of two variables more often than would be expected by chance

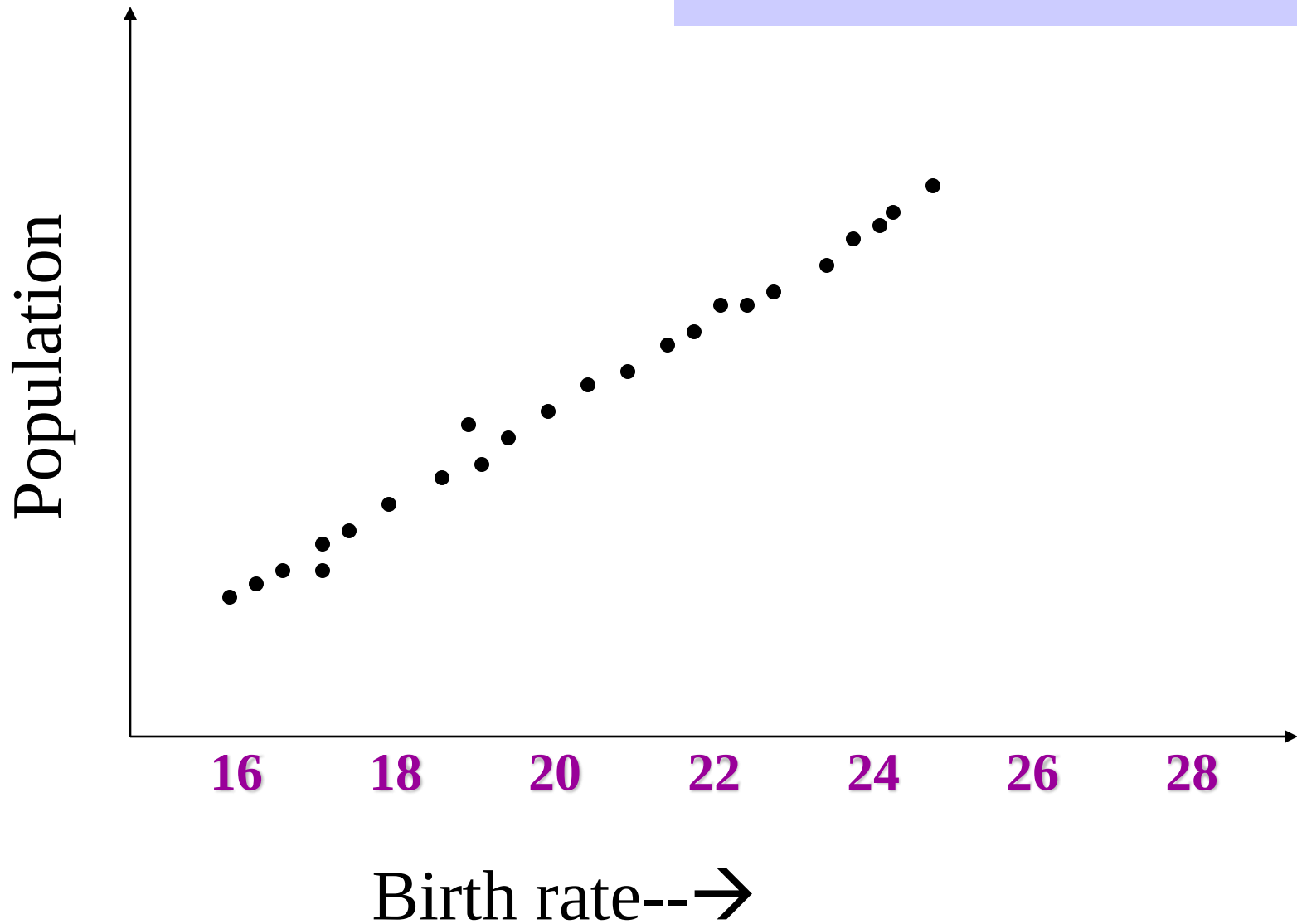
PR of CA lung	
Smoker	4%
Non smoker	1%

Maternal Mortality Rate (per 1000 delivery)	
Hospital Delivery	15
Home Delivery	5

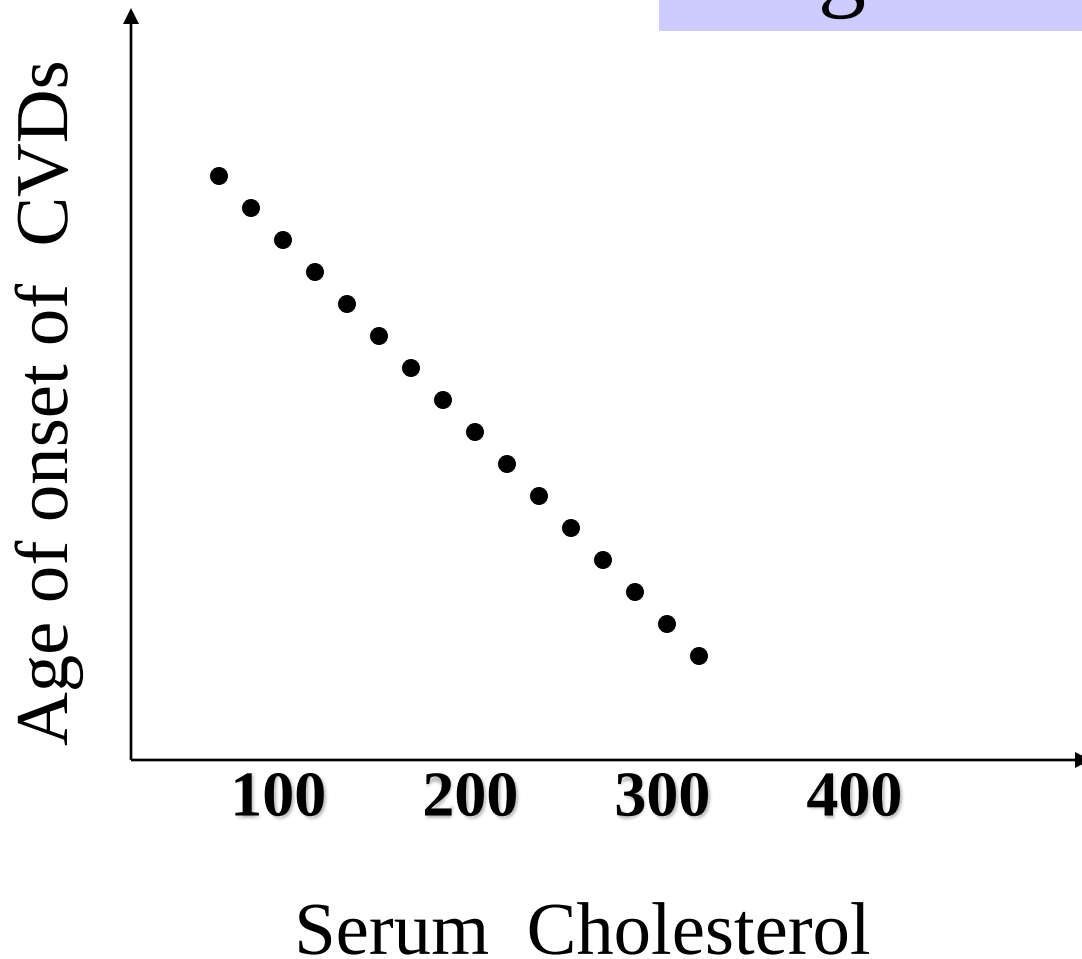
Association and Causation

- Association does not necessarily imply a causal relationship
- Co-relation: Degree of association

Positive correlation



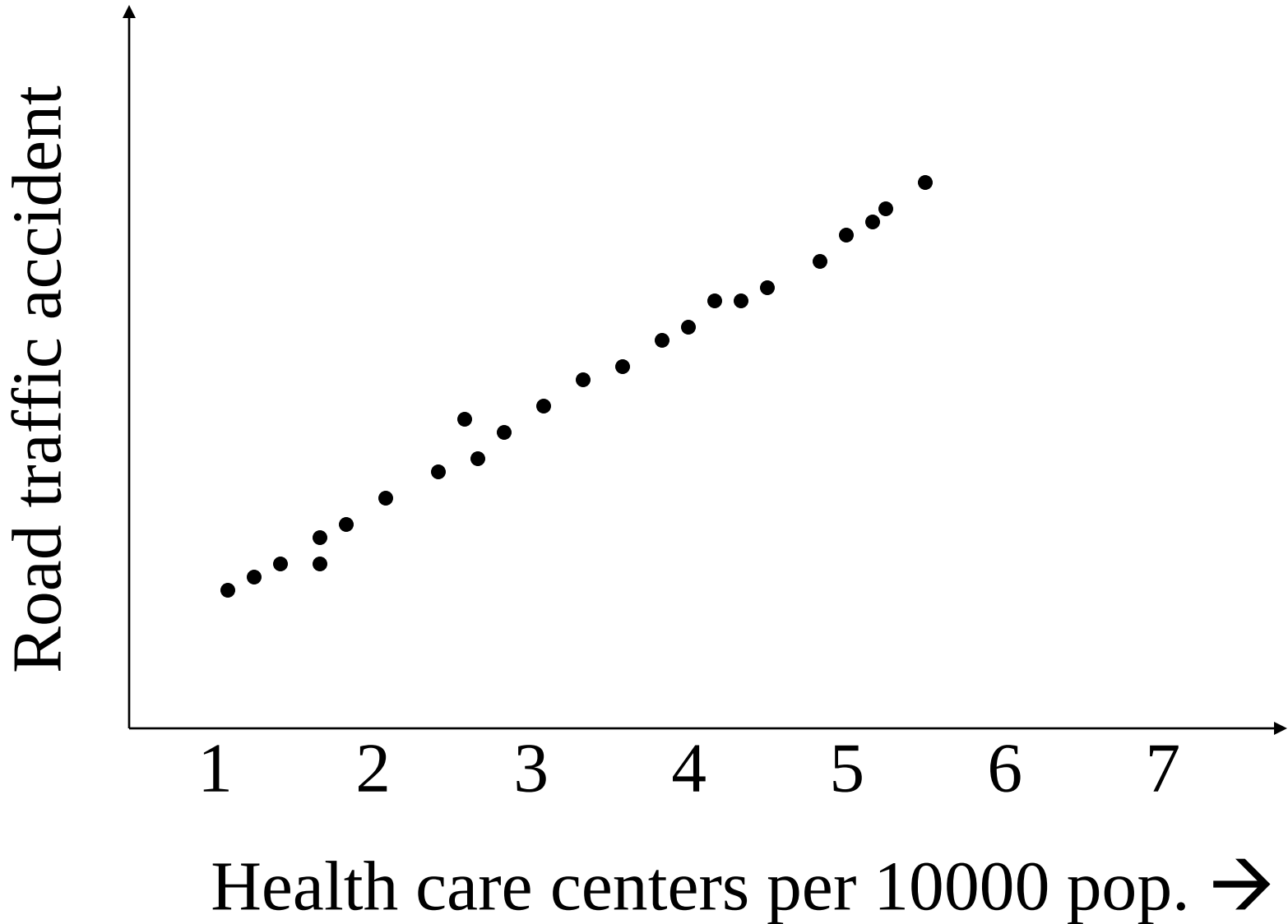
Negative correlation



Ex. A= Causation implies correlation

Parasitemia Per cml of blood	Severity of malaria
100	Mild
400	Moderate
3000	Severe

Ex. B=Correlation does not imply causation



- Causation implies correlation, Correlation does not imply causation
- Correlation does not measure the risk

TYPES OF ASSOCIATION

A

PR of CA lung	
Smoker	4%
Non smoker	1%

B

Infant Mortality Rate (per 1000 live birth)	
Illiterate women	100
Literate women	40

C

Maternal Mortality Rate (per 1000 delivery)	
Hospital Delivery	15
Home Delivery	5

Types

A-Spurious (false)

B- Indirect

C- Direct (causal)

- One to one

- Multifactorial

Spurious Association

- Observed association may not be real
e.g.-Diarrhoeal deaths in community versus hospital
 - Peri-natal mortality in a hospital and community
- Mainly because of selection bias where like is not compared with like

Indirect Association

S-E class	Infant Mortality rate
I	30
II	40
III	80
IV	100

Indirect Association

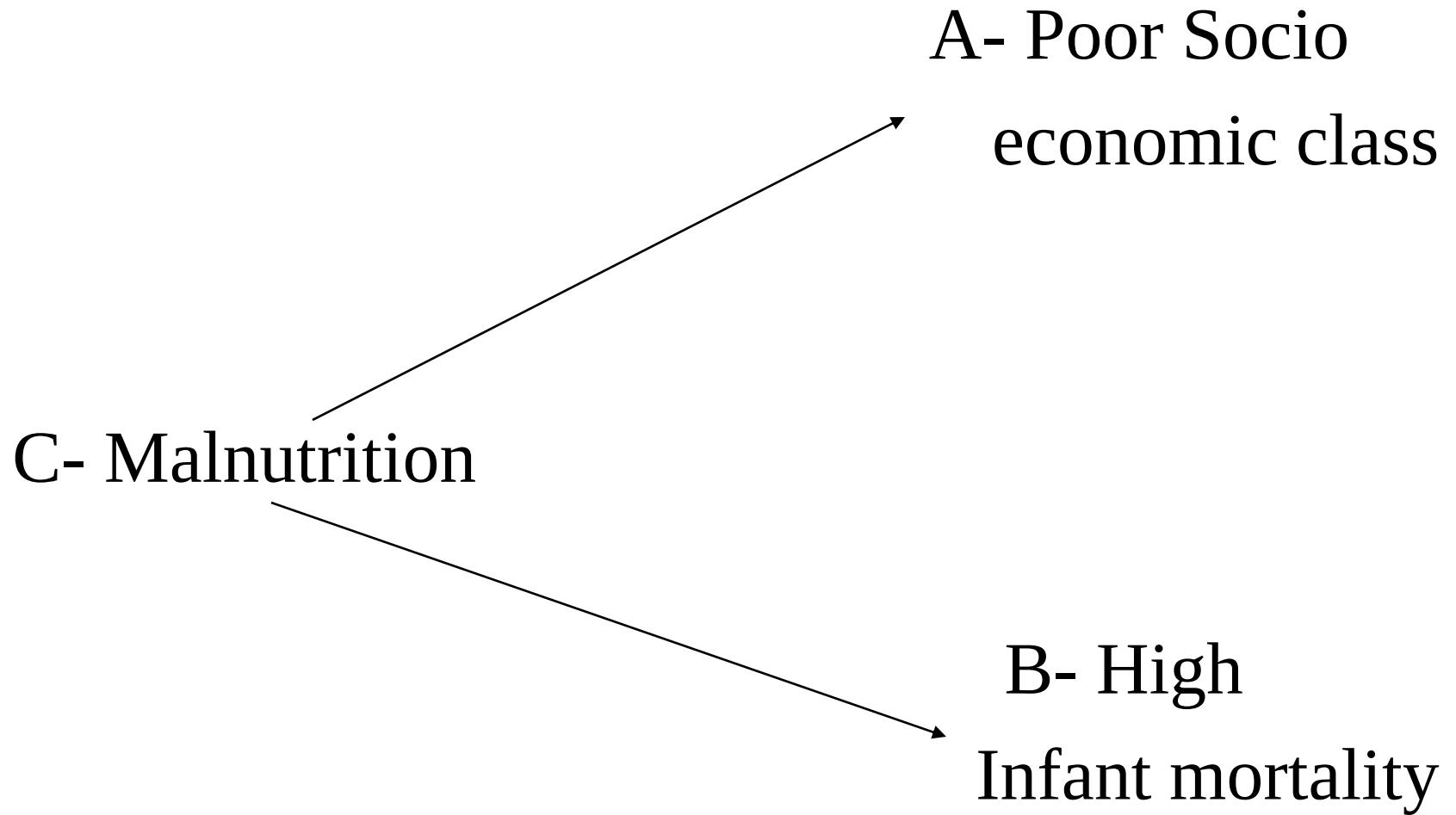
S-E class	Infant Mortality rate
I	30
II	40
III	80
IV	100



Malnutrition

The diagram illustrates an indirect association between S-E class and Infant Mortality rate. A teal oval labeled 'Malnutrition' is positioned below the table. Two arrows originate from this oval: one points to the 'S-E class' column and the other points to the 'Infant Mortality rate' column, indicating that malnutrition is a common confounding factor influencing both variables.

common/confounding factor



Indirect Association

- Association between two factors at first, looks causal – but in fact it is not so
- This is due to presence of a common factor or confounding variable

A

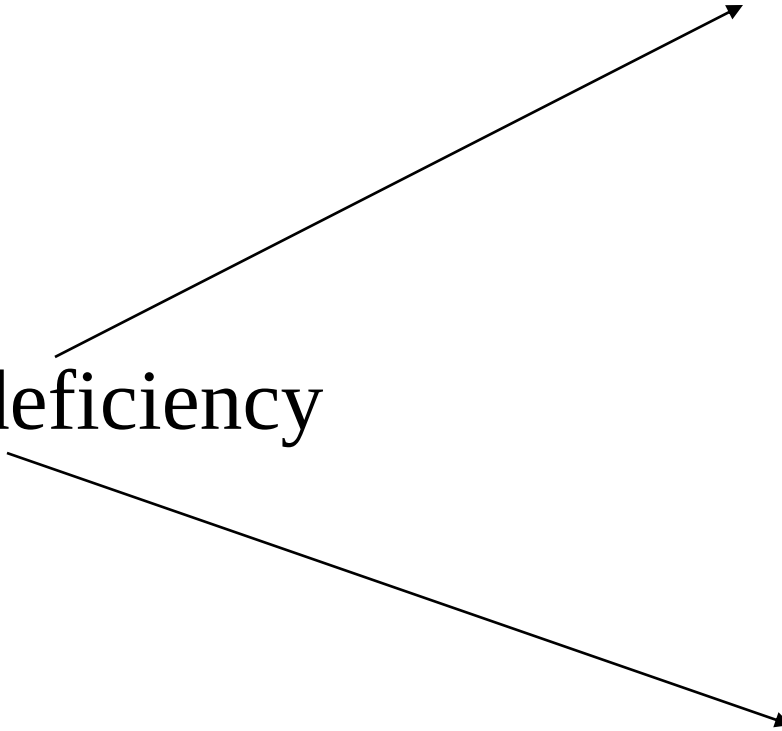
Altitude

C

Iodine deficiency

B

Endemic goitre



Direct Association

I-One to one

II -Multifactorial

Direct Association

One to one Association

- As in germ theory of disease
- The cause must be necessary and sufficient for the occurrence of a disease

Koch's postulates

- The organism is always found with the disease
- The organism is not found with any other disease
- The organisms, isolated from one who has the disease, and cultured through several generations, produce the disease in experimental animals

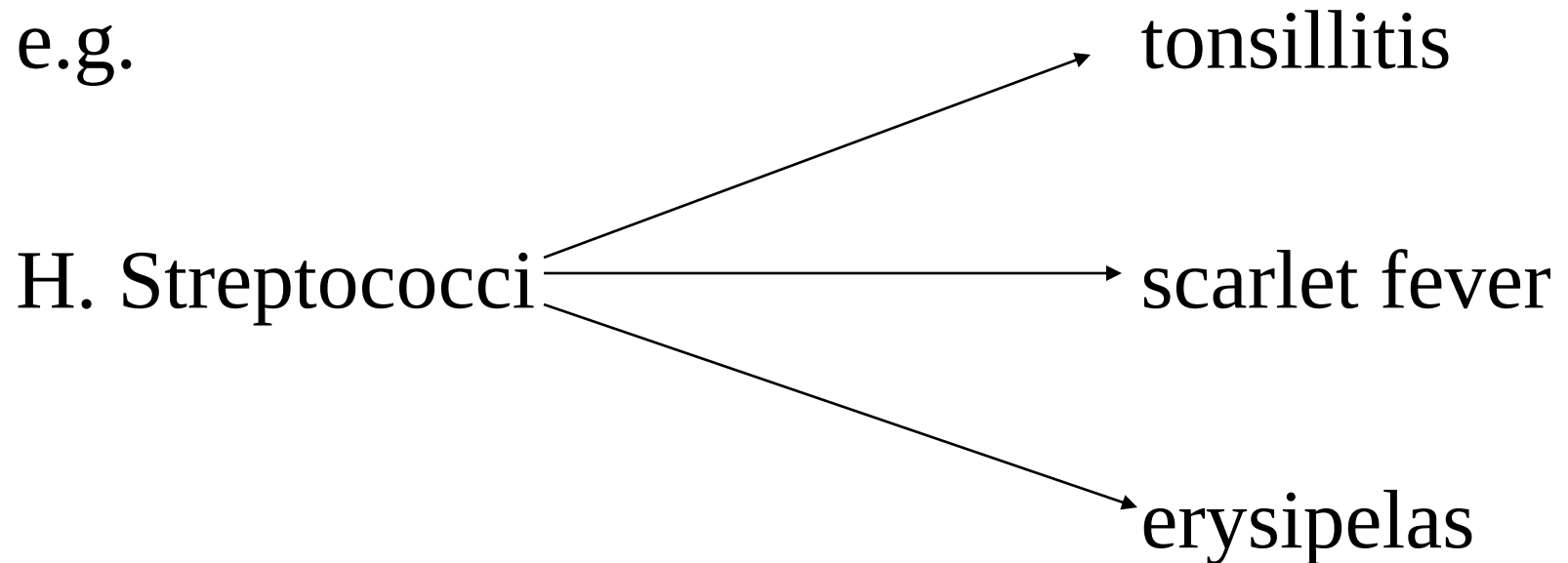
- Although Koch's postulates are theoretically sound “necessary and sufficient ” does not fit well for many diseases

Direct (causal) Association

- E.g. Tuberculosis
- Sputum negative TB
- Bacilli detection (sufficient) but host immune hence not susceptible and disease is not produced in the host

- One cause may lead to more than one outcome

e.g.

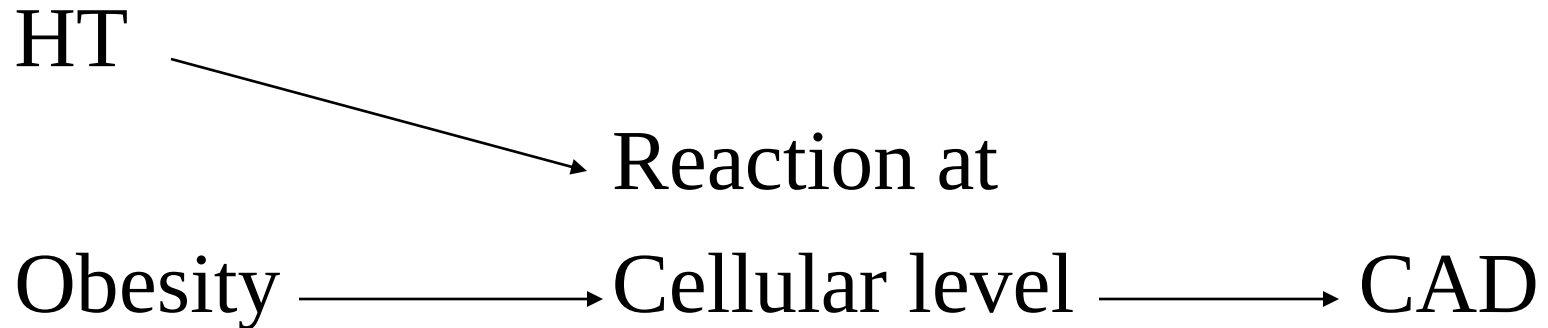


Direct Association

Multifactorial causation

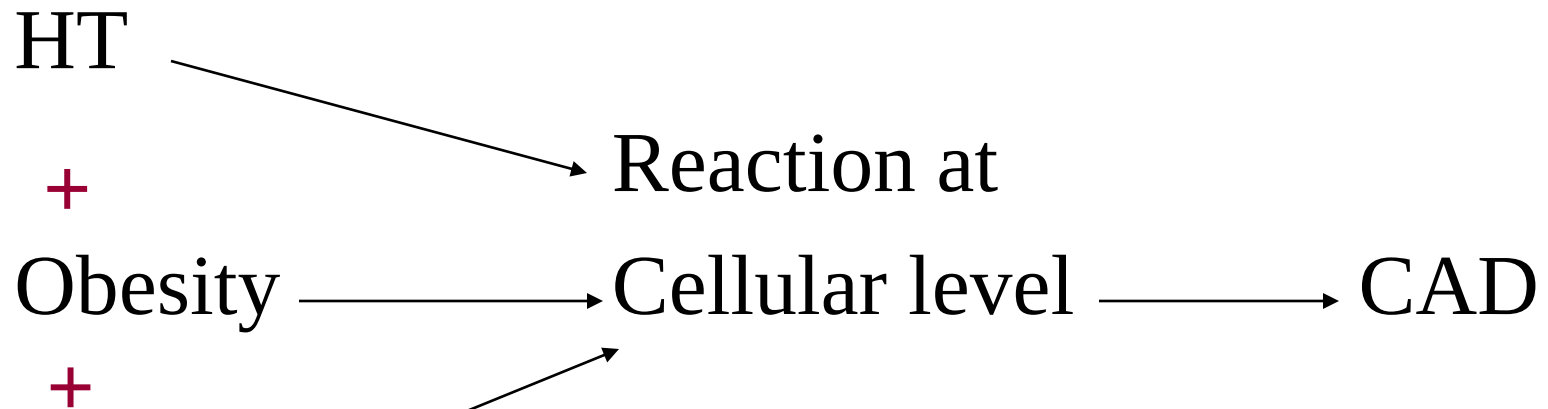
- Mainly seen in non-communicable diseases

Multifactorial causation



Factor1, 2,3
(independently)
– Disease

Multifactorial causation



-Factor1+2+3
(Synergistic action)

Multifactorial causation

- Mainly seen in non-communicable diseases
- Two types of situations
 - Factor1, 2,3 (independently) – Disease
 - Factor1+2+3 (Synergistic action) - Disease

Guidelines for judging whether an association is causal

- 1. Temporal Association**
- 2. Strength of association**
- 3. Specificity of association**
- 4. Consistency of association**
- 5. Biological plausibility**
- 6. Coherence of association**

Guidelines for judging whether an association is causal

1. Temporal Association

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Temporal Association

It is a relationship with the time/duration of exposure

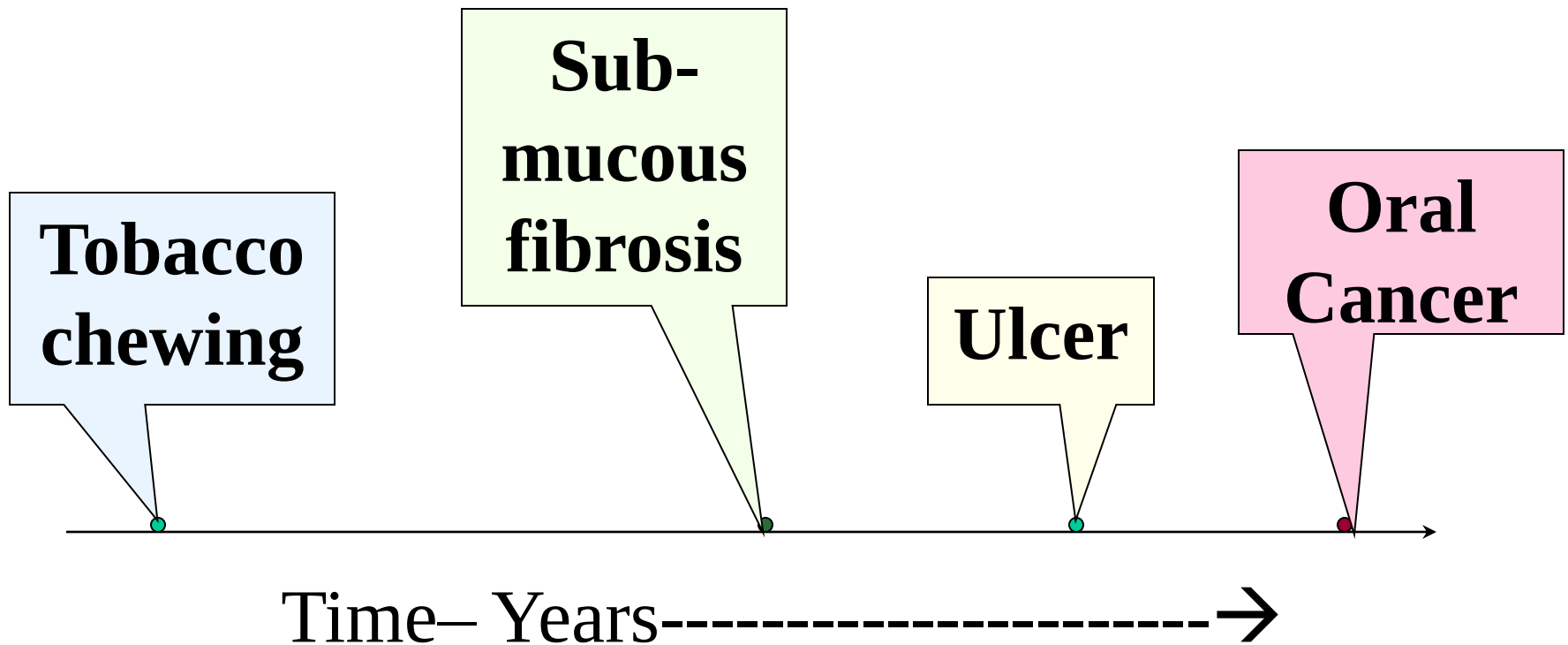
- Cause must precede the effect >>> Exposure to the factor must have occurred before the disease developed

e.g.

- Contaminated food/water → Diarrhoea
- Lead exposure → Lead poisoning
(acute/chronic)

The exposure to lead & its effect in the body can be measured every 6 month.....

- Time gap between the lead exposure & onset of S/s



To establish cause & effect relationship

Chronic disease

- Repeated lead measurement at more than one point of time at different location may provide useful & strong evidence than only one measurement at one point of time.
- Thus the time series studies & temporal relationship between cause & effect can provide better evidence to establish cause of an effect.

Temporal Association

- Easy to establish for acute diseases than chronic diseases
- Easier to establish in Cohort studies (Longitudinal) than in Case- control studies (cross sectional)
- Not only order in which exposure and disease occur but also the interval between two (latent period) must be established
- E.g.
 - conc. Of air-borne particles and mortality in London in 1952
 - Asbestos exposure and lung cancer

Guidelines for judging whether an association is causal

1. Temporal Association
- 2. Strength of association**
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Strength of association

- Relative risk- is it large?
- Odds ratio- is it large?
- Is there dose response / duration response relationship?
- Decrease in risk on cessation of smoking

- $RR/ OR > 2$ ----- Association is causal
- $RR > 10$ Stronger evidence that exposure is cause to effect.

Specificity of association

- One to one relationship between cause and effect
- Most difficult criteria to establish in Multifactorial causation
- E.g.

Cigarette smoking leading to lung cancer is not specific as there are several outcomes

Specificity of association

- Specificity supports causal interpretation but lack of specificity does not neglect it

Guidelines for judging whether an association is causal

1. Temporal Association
2. Strength of association
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5. Biological plausibility
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Consistency of association

If the result of several studies done in different parts of the country/world—similar result--- can be concluded that evidence of the causal relationship exist.

- E.g. efficacy of BCG vaccine- 0-80%

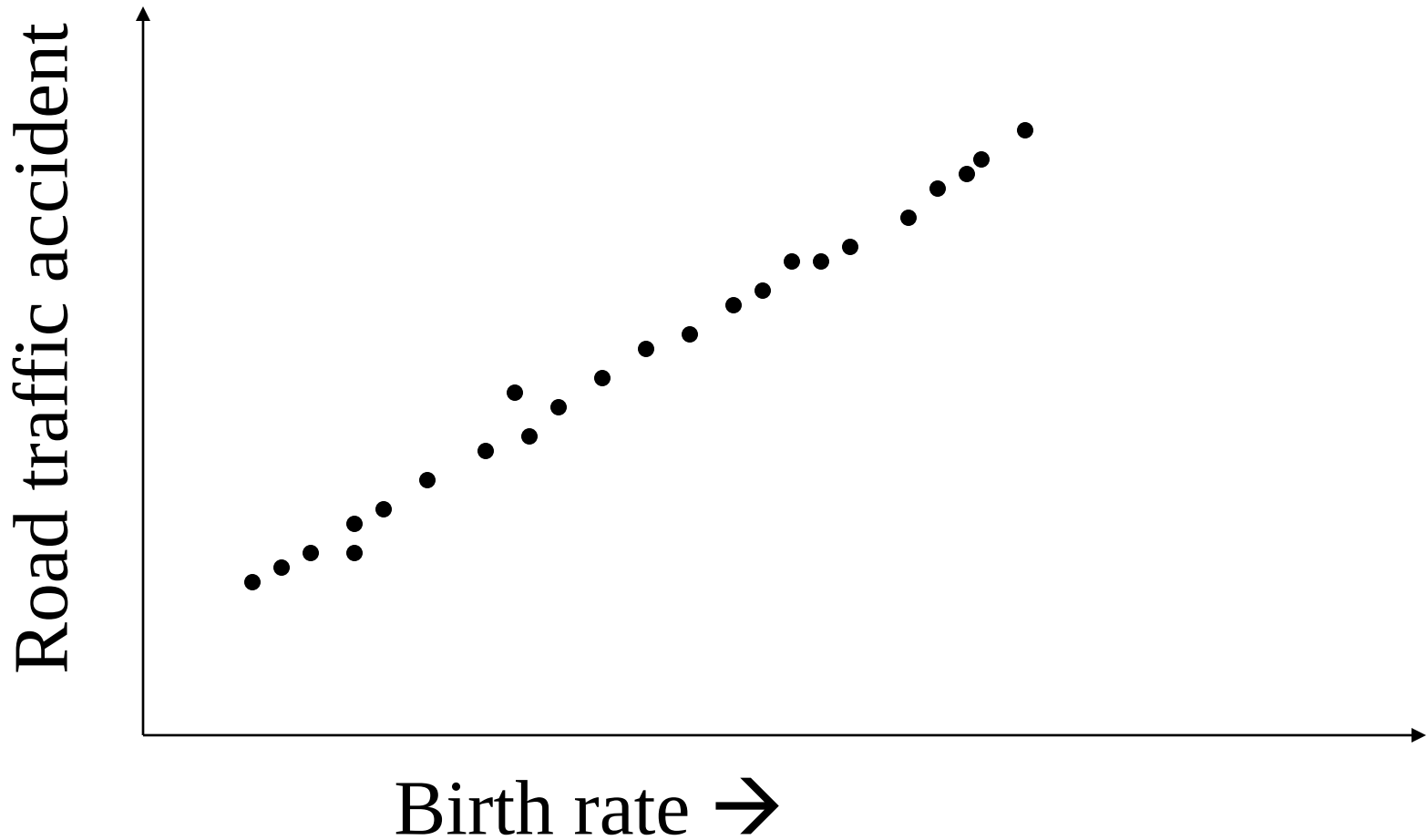


BCG does not reduce incidence/prevalence of TB but protect against milliary TB

Guidelines for judging whether an association is causal

1. Temporal Association
2. Strength of association
3. Specificity of association
4. Consistency of association
- 5. Biological plausibility**
6. Coherence of association

Means cause to effect relationship should be consistent with knowledge.



Biological Plausibility

- Association agrees with current understanding of the response of cells, tissues, organs and systems to stimuli
- Cigarette smoking and lung cancer is biologically plausible

Guidelines for judging whether an association is causal

1. Temporal Association
2. Strength of association
3. Specificity of association
4. Consistency of association
5. Biological plausibility
- 6. Coherence of association**

Coherence of association

Coherence = Logical connection

- Coherence with the known factors which are thought to be relevant
- Historical evidence of rising tobacco consumption and rising lung cancer are coherent
- Male and female difference and its trend is also coherent
- Occurrence of lung cancer from occupational exposures to other carcinogens like asbestos and uranium enhance the significance of causal association

Thank you

Q- Association & causation– 4 marks

- Define association
- Sufficient, necessary cause
- Types- spurious, direct, indirect– with e.g.s

Q- Association & causation– 6 marks

- + Additional criteria for judging causality