

**Faculty of medical laboratory science  
public health MLS-PUBH-322  
sem.6**

***Association and Causation***

# *Association Vs. Causation*

- Epidemiological research is aimed to uncovering the cause of disease.
- Epidemiology is studying whether there is an existing association between the exposure and the outcome of interest and estimate the size of such association.

# *Explanation of observed association in epidemiological research?*

- Four basic explanation:
  - I. Chance.
  - II. Bias.
  - III. Confounding.
  - IV. Causal relationship (Causality).

# *How to reach Causality*

- Bias can be avoided by good study design.
- Confounding can be avoided by good study design and at analysis stage.
- Role of chance can be evaluated by inferential Statistics.
- After exclusion of the above explanations, causality can be suggested and strengthen by B.Hill Criteria.

# *Cause: definition*

- A cause is something which has an effect.
- In epidemiology a cause can be considered to be something that alters the frequency of disease, health status or associated factors in a population.
- Any factor that plays an essential role in producing occurrence of the disease.

# *Epidemiological Principles and Causality*

- Most important of the cause and effect ideas by epidemiology is that disease is virtually always a result of the interplay of the environment, the genetic and physical makeup of the individual, and the agent of disease.

***“ Epidemiological Triangle “***

# *Henle-Koch's Postulates*

## *(1877,1882)*

- For infectious agents and disease, it was stated that before accepting causality:
  - I. Agent must shown to present in every case of disease (isolation and culture).
  - II. Agent must not be in other disease.
  - III. Isolation agent must reproduce disease in lab.
  - IV. Agent must be recovered from experimental disease produced.

# *The Web of causation*

- There is no single cause.
- Causes of disease are interacting.
- Illustrates the interconnectedness of possible causes.



# *Groups of association*

- I. Spurious association.
- II. Indirect association.
- III. Direct (causal) association:
  - (i) One-to-one causal association.
  - (ii) Multi-factorial causation .

# *Types of causal Relationship* *: “Necessary” and “Sufficient”*

## **Necessary Cause:**

- A condition that must be present for the effect to follow.
- **Sufficient Cause :**
- A condition that if present, guarantees the effect will follow.
- ✓ Cause that are both necessary and sufficient are the most satisfying outcome in research !

# *Types of Cause*

- **TB:** although *M. bovis* is a necessary cause it is not sufficient since many animals may have foci of *M. bovis* without clinical disease.
- **Lung cancer:** tobacco smoking is not a sufficient cause since many smokers do not get disease. It is not necessary either since exposure to other chemicals are also component causes.
- **Coronary heart disease:** has no necessary cause but a range of causes which become sufficient when some or all occur together in an individual and interact to result in disease.

# *Models of Casual Relationships*

- The 4 Models of Casual Relationships:
  - ✓ **Necessary and Sufficient.**
  - ✓ **Necessary But Not Sufficient.**
  - ✓ **Sufficient But Not Necessary.**
  - ✓ **Neither Necessary Nor Sufficient.**

# *Sir Bradford Hill's Criteria*

## *(1897 -1991)*

- The Environment and Disease Causation:
  1. Strength.
  2. Consistency.
  3. Specificity.
  4. Temporality.
  5. Dose-response relationship.
  6. Biological plausibility.
  7. Coherence.
  8. Experimental evidence.
  9. Analogy .

# *Strength*

- The stronger the relationship between exposure and outcome, the more likely it is to be a causal relationship.
- Ratio measures (OR, RR) are the best way to quantify the strength of the relation.
- (RR= 10 is much stronger evidence for causality than RR=2 ).

# *Consistency*

- Observing a relationship in multiple occasion strengthens the case for causation :
  - ✓ Different population.
  - ✓ Different instruments.

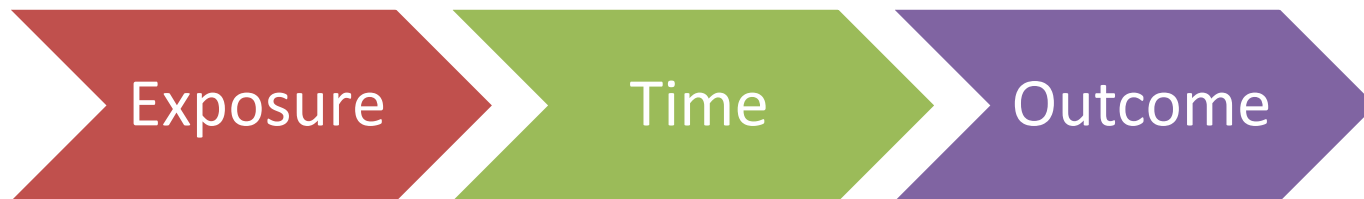
# *Specificity*

- Outcome is best predicted by one primary factor.
- Ideally, each factor predicts one primary outcome.



# *Temporality*

- Exposure must precede outcome
- Exposure precede disease by a reasonable amount of time .

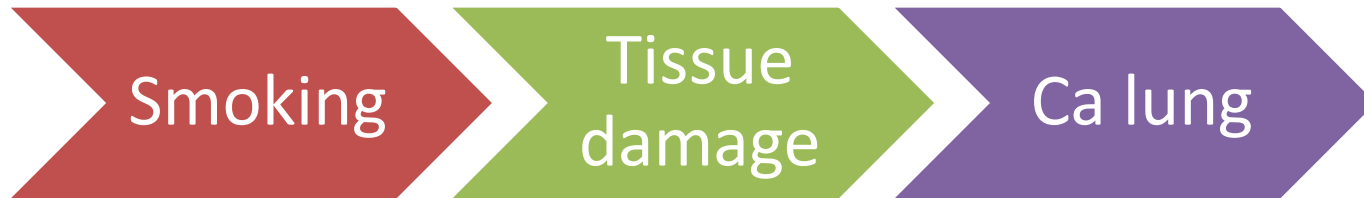


# *Dose-Response Relationship*

- Dose response relationship between exposure and outcome.

# *Biological Plausibility*

- Is there a rational and theoretical basis for such conclusions.
- Biology:



- Plausibility define: appearing worthy of belief.

# *Coherence*

- It implies that a cause and effect interpretation for an association does not conflict with what is known of the natural history and biology of the disease.
- So, is association coherent with other knowledge?

# *Experimental Evidence*

- Experimental evidence supports the epidemiological evidence ?

# *Analogy*

- Similarities among things that are otherwise different.
- Weak form of evidence.
- ***Example:*** before HIV was discovered, epidemiologists noticed that AIDS and Hepatitis B had analogous risk groups, suggesting similar types of agents and transmission.

