



- **Causality or causal relationship**: it is the principle of or relationship between a cause and its effect. Notice that for this relationship to exist, there has to be an association between the outcome of your interest (either morbidity or mortality) and the presumed cause. Due to random variation, an association must be statistically significant.
- **What is the classification of causal association?**

<b>Direct causal association</b>	A factor shows its effect in absence of intermediary factors
<b>Indirect causal association</b>	A factor shows its effect through intermediary factors

- **What is non-causal association?**
  - The relationship between two variables is statistically significant, but no causal relationship exists because the temporal relationship is incorrect (the presumed cause comes after, rather than before, the effect of interest) or because another factor is responsible for the presumed cause and the presumed effect.
- **Austin Bradford Hill’s criteria of causation:**

<b>Strength of association</b>	A strong association is more likely to have a causal component than is a modest association
<b>Consistency</b>	A relationship is observed repeatedly
<b>Specificity</b>	A factor influences specifically a particular outcome or population
<b>Temporality</b>	The factor must precede the outcome it is assumed to affect
<b>Biological gradient</b>	The outcome increases monotonically with increasing dose of exposure or according to a function predicted by a substantive theory
<b>Plausibility</b>	The observed association can be plausibly explained by substantive matter (e.g. biological) explanations
<b>Coherence</b>	A causal conclusion should not fundamentally contradict present substantive knowledge
<b>Experiment</b>	Causation is more likely if evidence is based on randomized experiments
<b>Analogy</b>	For analogous exposures and outcomes an effect has already been shown

- **What are the steps followed in determination of a cause and its effect?**
  - **Investigation of the statistical association:**
    - ✓ The risk factor (the cause) must be present more often in persons with the disease of interest (the outcome) than in persons without the disease.
    - ✓ OR the protective factor (for example: a vaccine against a specific disease) must be present less often in persons with the disease than in persons without it.
  - **Investigation of the temporal relationship:**
    - ✓ This is sometimes difficult to establish (why?) → for example, obesity can cause osteoarthritis (due to increased load on weight-bearing joints) that results in inactivity which in turn makes obesity worse (a cycle!).
  - **Elimination of all known alternative explanations.**
- **What are the measures of association?**

<b>Types of study designs</b>	<b>Measures of association</b>
Prospective cohort study	Relative risk, attributable risk
Case-control study	Odds ratio
Cross sectional study	Odds ratio



**Table 6-1 Standard 2 × 2 Table for Showing Association between a Risk Factor and a Disease**

Risk Factor	Disease Status		Total
	Present	Absent	
Positive	<i>a</i>	<i>b</i>	<i>a + b</i>
Negative	<i>c</i>	<i>d</i>	<i>c + d</i>
TOTAL	<i>a + c</i>	<i>b + d</i>	<i>a + b + c + d</i>

*Interpretation of the Cells*

*a* = Participants with both the risk factor and the disease  
*b* = Participants with the risk factor, but not the disease  
*c* = Participants with the disease, but not the risk factor  
*d* = Participants with neither the risk factor nor the disease  
*a + b* = All participants with the risk factor  
*c + d* = All participants without the risk factor  
*a + c* = All participants with the disease  
*b + d* = All participants without the disease  
*a + b + c + d* = All study participants

- **What are the types of Attributable Risk (AR)?**

<b>Attributable risk/ risk difference</b>	(Incidence of a disease in exposed persons – incidence of the disease in non-exposed persons) / 1000
<b>Attributable risk (%)</b>	$\frac{(\text{Incidence of disease in exposed persons} - \text{incidence of disease in nonexposed persons})}{\text{incidence of disease in exposed persons}} \times 100$ It indicates the extent to which disease can be attributed to the risk factor
<b>Population attributable risk</b>	It suggests the % of cases that can be avoided in a population if the risk factor was removed