Study Designs

Experimental studies
Observational studies

Analytic studies
Descriptive studies

Randomized Controlled trials
Case control
Cohort
Cross sectional

Cohort Study: Two by two table

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>a</td>
</tr>
<tr>
<td>No</td>
<td>c</td>
</tr>
</tbody>
</table>

Risk of outcome in exposed ($R_E$) = a / a + b
Risk of outcome in non-exposed ($R_Ē$) = c / c + d
Relative risk (RR) = $\frac{R_E}{R_Ē} = \frac{a}{a + b} \div \frac{c}{c + d}$
Attributable risk (AR) = ($R_E$) - ($R_Ē$)

Cohort Study: Direction of inquiry

Start with EXPOSURE → Follow up → Check for OUTCOME

Cohort Study: Example 1

Determine the association between smoking while pregnant and low birth weight (LBW) babies:

- **Exposure**: Smoke
- **Outcome**: LBW

- **Sample of people exposed**
  - Pregnant females in first month
    - Smoke
      - LBW
    - Do not smoke
      - No LBW

- **Sample of people not exposed**
  - Pregnant females in first month
    - No LBW

Start
November 2004
End
August 2005
Cohort Study: Example 1

### Relative Risk

**Relative Risk** provides the best estimate of the strength or magnitude of the exposure-outcome association and is useful in making causal inferences.

- **RR = 1** indicates no exposure-outcome association: risk in exposed = risk in non-exposed
- **RR < 1** indicates negative association (protective): risk in exposed < risk in non-exposed
- **RR > 1** indicates positive association (causal): risk in exposed > risk in non-exposed

### Attributable Risk

**Attributable risk**: useful for public health purposes: indicates the frequency with which the outcome can be attributed to exposure in the sample studied.

- Risk among non-exposed
- Risk attributed by smoking
- Risk among exposed

<table>
<thead>
<tr>
<th>Smoking</th>
<th>LBW Yes</th>
<th>LBW No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>45</td>
</tr>
</tbody>
</table>

Risk of outcome in exposed \(R_E\) = \(\frac{a}{a+b} = \frac{12}{50} = 0.24\)

Risk of outcome in non-exposed \(R_{\bar{E}}\) = \(\frac{c}{c+d} = \frac{5}{50} = 0.10\)

Relative Risk = \(\frac{0.24}{0.1} = 2.4\)

The risk of having a LBW baby among smoking mothers is 2.4 times more than non-smoking mothers.

Attributable risk = 0.24 - 0.1 = **0.14** → **14%**
**Cohort Study:** Example 2

<table>
<thead>
<tr>
<th>Pets</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pets</td>
<td>53</td>
<td>165</td>
</tr>
<tr>
<td>No pets</td>
<td>23</td>
<td>322</td>
</tr>
</tbody>
</table>

- Risk of asthma among exposed = 53/218 = 0.24
- Risk of asthma among non-exposed = 23/345 = 0.07
- Relative Risk for asthma = 0.24/0.07 = 3.9

Children who have pets at home are almost 4 times more likely to develop asthma than children who do not have pets.

**Cohort Study:** Example 3

<table>
<thead>
<tr>
<th>Breast cancer</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women who breastfed</td>
<td>10</td>
<td>290</td>
</tr>
<tr>
<td>Women who did not breastfeed</td>
<td>45</td>
<td>255</td>
</tr>
</tbody>
</table>

- Risk of breast cancer among breastfed = 10/300 = 0.03
- Risk of breast cancer among women who did not breast feed = 45/300 = 0.15
- Relative Risk = 0.3/0.15 = 0.2

Women who breastfed are 80% less likely to develop breast cancer than those who did not breastfeed.

**Cohort Study:** Example 4

<table>
<thead>
<tr>
<th>MI</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy smoker</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Light smoker</td>
<td>12</td>
<td>88</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>15</td>
<td>185</td>
</tr>
</tbody>
</table>

- Risk of MI in non-smokers = 15/200 = 0.075
- Risk of MI in light smokers = 12/100 = 0.12
- Relative Risk for light smokers = 0.12/0.075 = 1.6
- Attributable risk (AR) for light smokers = 12% – 7.5% = 4.5%

If pets are eliminated from homes, there will be 17% decrease in asthma among children.
Cohort Study: Example 4

<table>
<thead>
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</tbody>
</table>

- Risk of MI in heavy smokers = 20/100 = 0.2
- Relative Risk for heavy smokers = 0.2/0.075 = 2.6
- Attributable risk (AR) for heavy smokers = 20% – 7.5% = 12.5%

Cohort Study: Retrospective study

- Investigate the association between noise exposure and noise Induced Hearing Loss (NIHL).
- Starting date of study: February 2007
- Review files of workers at steel-making company (workers employed in 1995)

Prospective study
- Assess Exposure at the present time

Retrospective study
- Assess Exposure in the past through Review of medical records

Cohort Study: Design types

<table>
<thead>
<tr>
<th>1995 Charts</th>
<th>Name</th>
<th>Age</th>
<th>Gender</th>
<th>Department</th>
<th>Transfer department</th>
<th>Years of transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cohort Study: Retrospective study

- Exposure > 85 DBA
- Exposure ≤ 85 DBA

Feb. 2007 – Aug. 2007
Cohort Study

Advantages
- Direct measurement of incidence: The temporal sequence of exposure and disease can be directly addressed
- Possible to examine a range of outcomes
- Suitable for investigation of a rare exposure

Disadvantages
- Costly / time consuming
- If latent period is long, prolonged follow up is required (time consuming).
- Loss to follow-up
- Not suitable for investigation of rare disease

Hypothesis
Is Hockey associated with Asthma?

In-class questions
True or False:
- Cohort studies are adopted to study relationship of one characteristic to different outcomes.
- Cohort studies are good for studying rare exposures.
- One of the main disadvantages of cohort studies is loss to follow up.
- The temporal sequence of exposure and disease can be directly addressed in a cohort design as well as in a cross sectional study.
- Correlational studies cannot directly assess causal inference because they measure disease and exposure in a person at the same point in time.

**BACKGROUND:** Artificial turf is becoming increasingly popular, although the risk of injury on newer generations of turf is unknown. **AIM:** To investigate the risk of injury on artificial turf compared with natural grass among young female football players.

**STUDY DESIGN:** Prospective cohort study.

**METHODS:** 2020 players from 109 teams (mean (SD) 15.4 (0.8) years) participated in the study during the 2005 football season.

**RESULTS:** 421 (21%) players sustained 526 injuries, leading to an injury incidence of 3.7/1000 playing hours (95% CI 3.4 to 4.0).

The incidence of acute injuries on artificial turf and grass did not differ significantly with respect to match injuries (rate ratio (RR) 1.0, 95% CI 0.8 to 1.3; p = 0.72) or training injuries (RR 1.0, 95% CI 0.6 to 1.5, p = 0.93). In matches, the incidence of serious injuries was significantly higher on artificial turf (RR 2.0, 95% CI 1.3 to 3.2; p = 0.03).

**CONCLUSION:** In the present study among young female football players, the overall risk of acute injuries was similar between artificial turf and natural grass.

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Ankle sprain was the most common type of injury (34% of all acute injuries), and there was a trend towards more ankle sprains on artificial turf than on grass (RR 1.5, 95% CI 1.0 to 2.2; p = 0.06).