Tutorials on Calculating the Odds Ratio (OR)

Building upon our understanding of the Odds Ratio (OR) from the lecture, these tutorials will guide you through various scenarios where you can apply the OR to assess the association between different exposures and outcomes. Each tutorial presents a unique example, complete with step-by-step solutions to enhance your comprehension and application skills.

1 Tutorial 1: Smoking and Lung Cancer Risk

1.1 Scenario

Investigate whether smoking is a risk factor for developing lung cancer. A study is conducted with 400 participants, divided into smokers and non-smokers. The occurrence of lung cancer among these groups is recorded.

1.2 Data Collected

Result	**No Lung Cancer (-)**	**Lung Cancer (+)**	**Effect**
Smoker (+)	50	150	Effect
Non-Smoker (-)	100	100	

Table 1: Data Collected for Tutorial 1

- **a = 150:** Smokers who developed lung cancer.
- **b = 50:** Smokers who did not develop lung cancer.
- **c = 100:** Non-smokers who developed lung cancer.
- **d = 100:** Non-smokers who did not develop lung cancer.

1.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 150**
   - **b = 50**
   - **c = 100**
   - **d = 100**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{150 \times 100}{50 \times 100} = \frac{15,000}{5,000} = 3.0$$

4. **Interpretation:** An Odds Ratio of **3.0** indicates that smokers are **3 times** more likely to develop lung cancer compared to non-smokers.

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2 Tutorial 2: Alcohol Consumption and Liver Disease

2.1 Scenario

Examine whether excessive alcohol consumption is associated with liver disease. A survey of 300 individuals categorizes them based on their alcohol consumption habits and the presence of liver disease.

2.2 Data Collected

Result	**No Liver Disease (-)**	**Liver Disease (+)**	**Effect**
Excessive Drinkers (+)	40	120	Effect
Moderate Drinkers (-)	100	40	

Table 2: Data Collected for Tutorial 2

- **a = 120:** Excessive drinkers with liver disease.
- **b = 40:** Excessive drinkers without liver disease.
- **c = 40:** Moderate drinkers with liver disease.
- **d = 100:** Moderate drinkers without liver disease.

2.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 120**
   - **b = 40**
   - **c = 40**
   - **d = 100**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{120 \times 100}{40 \times 40} = \frac{12,000}{1,600} = 7.5$$

4. **Interpretation:** An Odds Ratio of **7.5** suggests that excessive drinkers are **7.5 times** more likely to develop liver disease compared to moderate drinkers.

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3 Tutorial 3: Physical Activity and Heart Disease

3.1 Scenario

Assess whether lack of physical activity increases the risk of heart disease. A cohort study follows 600 individuals, categorizing them based on their physical activity levels and the incidence of heart disease.

3.2 Data Collected

Result	No Heart Disease (-)	Heart Disease (+)	Effect
Inactive (+)	180	120	Effect
Active (-)	120	180	

Table 3: Data Collected for Tutorial 3

- **a = 120:** Inactive individuals with heart disease.
- **b = 180:** Inactive individuals without heart disease.
- **c = 180:** Active individuals with heart disease.
- **d = 120:** Active individuals without heart disease.

3.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 120**
   - **b = 180**
   - **c = 180**
   - **d = 120**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{120 \times 120}{180 \times 180} = \frac{14,400}{32,400} \approx 0.444$$

4. **Interpretation:** An Odds Ratio of **0.444** indicates that inactive individuals are **less likely** to develop heart disease compared to active individuals. (Note: This result may suggest an unexpected trend and warrants further investigation.)

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4 Tutorial 4: Vaccination and Disease Incidence

4.1 Scenario

Determine if receiving a specific vaccination reduces the incidence of a particular disease. A study observes 800 individuals, recording their vaccination status and disease occurrence.

Result	No Disease (-)	Disease (+)	Effect
Vaccinated (+)	320	80	Effect
Unvaccinated (-)	160	240	

Table 4: Data Collected for Tutorial 4

4.2 Data Collected

- **a = 80:** Vaccinated individuals who developed the disease.
- **b = 320:** Vaccinated individuals who did not develop the disease.
- **c = 240:** Unvaccinated individuals who developed the disease.
- **d = 160:** Unvaccinated individuals who did not develop the disease.

4.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 80**
   - **b = 320**
   - **c = 240**
   - **d = 160**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{80 \times 160}{320 \times 240} = \frac{12,800}{76,800} \approx 0.167$$

4. **Interpretation:** An Odds Ratio of **0.167** indicates that vaccinated individuals are **approximately 0.167 times** as likely to develop the disease compared to unvaccinated individuals, suggesting a protective effect of the vaccine.

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5 Tutorial 5: Diet and Obesity

5.1 Scenario

Explore the relationship between a high-fat diet and obesity. A cross-sectional study surveys 700 participants, classifying them based on their dietary habits and obesity status.

5.2 Data Collected

- **a = 210:** Individuals on a high-fat diet who are obese.
- **b = 140:** Individuals on a high-fat diet who are not obese.
- **c = 0:** Individuals on a low-fat diet who are obese.
- **d = 350:** Individuals on a low-fat diet who are not obese.

Result	Non-Obese (-)	Obese (+)	Effect
High-Fat Diet (+)	140	210	Effect
Low-Fat Diet (-)	350	0	

Table 5: Data Collected for Tutorial 5

5.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 210**
   - **b = 140**
   - **c = 0**
   - **d = 350**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{210 \times 350}{140 \times 0}$$

   Note: Since **c = 0**, the denominator becomes zero, making the Odds Ratio undefined (infinite).
4. **Interpretation:** An undefined or infinite Odds Ratio suggests a perfect association where individuals on a low-fat diet do not exhibit obesity. However, this result should be interpreted with caution due to the absence of obese individuals in the low-fat diet group, which may indicate sample bias or other confounding factors.

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6 Tutorial 6: Exercise Frequency and Diabetes

6.1 Scenario

Analyze whether regular exercise is associated with a lower incidence of diabetes. A longitudinal study tracks 550 participants, recording their exercise habits and diabetes diagnosis over five years.

6.2 Data Collected

Result	No Diabetes (-)	Diabetes (+)	Effect
Regular Exercise (+)	275	55	Effect
Irregular Exercise (-)	110	110	

Table 6: Data Collected for Tutorial 6

- **a = 55:** Individuals who exercise regularly and developed diabetes.
- **b = 275:** Individuals who exercise regularly and did not develop diabetes.
- **c = 110:** Individuals who exercise irregularly and developed diabetes.
- **d = 110:** Individuals who exercise irregularly and did not develop diabetes.

6.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 55**
   - **b = 275**
   - **c = 110**
   - **d = 110**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{55 \times 110}{275 \times 110} = \frac{6,050}{30,250} \approx 0.2$$

4. **Interpretation:** An Odds Ratio of **0.2** indicates that individuals who exercise regularly are **5 times** less likely to develop diabetes compared to those who exercise irregularly, highlighting the protective effect of regular physical activity against diabetes.

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7 Tutorial 7: Use of Protective Gear and Sports Injuries

7.1 Scenario

Determine if wearing protective gear reduces the risk of injuries in contact sports. A study observes 450 athletes, noting their use of protective gear and occurrence of injuries.

7.2 Data Collected

Result	**No Injury (-)**	**Injury (+)**	**Effect**
Protective Gear (+)	270	30	Effect
No Protective Gear (-)	90	60	

Table 7: Data Collected for Tutorial 7

- **a = 30:** Athletes who wore protective gear and sustained injuries.
- **b = 270:** Athletes who wore protective gear and did not sustain injuries.
- **c = 60:** Athletes who did not wear protective gear and sustained injuries.
- **d = 90:** Athletes who did not wear protective gear and did not sustain injuries.

7.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 30**
   - **b = 270**
   - **c = 60**
   - **d = 90**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{30 \times 90}{270 \times 60} = \frac{2,700}{16,200} \approx 0.167$$

4. **Interpretation:** An Odds Ratio of **0.167** suggests that athletes who wear protective gear are **approximately 0.167 times** as likely to sustain injuries compared to those who do not wear protective gear, indicating a significant protective benefit.

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8 Tutorial 8: Dietary Supplement Use and Nutrient Deficiency

8.1 Scenario

Evaluate whether the use of dietary supplements is associated with a lower incidence of nutrient deficiencies. A survey of 500 individuals records their supplement usage and nutrient deficiency status.

8.2 Data Collected

Result	**No Deficiency (-)**	**Deficiency (+)**	**Effect**
Supplement Use (+)	300	50	Effect
No Supplement (-)	100	50	

Table 8: Data Collected for Tutorial 8

- **a = 50:** Individuals who use supplements and have nutrient deficiencies.
- **b = 300:** Individuals who use supplements and do not have nutrient deficiencies.
- **c = 50:** Individuals who do not use supplements but have nutrient deficiencies.
- **d = 100:** Individuals who do not use supplements and do not have nutrient deficiencies.

8.3 Step-by-Step Solution

1. **Identify the Components:**
   - **a = 50**
   - **b = 300**
   - **c = 50**
   - **d = 100**
2. **Apply the Odds Ratio Formula:**

$$\text{OR} = \frac{a \times d}{b \times c}$$

3. **Plug in the Values:**

$$\text{OR} = \frac{50 \times 100}{300 \times 50} = \frac{5,000}{15,000} \approx 0.333$$

4. **Interpretation:** An Odds Ratio of **0.333** indicates that individuals who use dietary supplements are **3 times** less likely to experience nutrient deficiencies compared to those who do not use supplements, highlighting the effectiveness of supplementation in preventing deficiencies.

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9 Tutorial 9: Handwashing Frequency and Respiratory Infections

9.1 Scenario

Investigate whether frequent handwashing reduces the risk of respiratory infections. A study monitors 350 individuals, recording their handwashing habits and occurrence of respiratory infections.

9.2 Data Collected

Result	No Infection (-)	Infection (+)	Effect
Frequent Handwashing (+)	175	35	Effect
Infrequent Handwashing (-)	70	70	

Table 9: Data Collected for Tutorial 9

- **a = 35:** Individuals who wash hands frequently and developed respiratory infections.
- **b = 175:** Individuals who wash hands frequently and did not develop respiratory infections.
- **c = 70:** Individuals who wash hands infrequently and developed respiratory infections.
- **d = 70:** Individuals who wash hands infrequently and did not develop respiratory infections.