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Practical exercises

This hands-on workbook has been designed to help you put key PhEpi concepts and methods into practice. This workbook supports the material taught in the pharmacoepidemiology course and provides a practical application framework for understanding the topics covered in lectures. The exercises bridge the gap between theory and practice, offering guided opportunities for deepening comprehension.

Lectures

Lecture 2. Measures in (Pharmaco)Epidemiology

1 Measures of frequency

These are hypothetical scenarios designed to practice the topics covered during the lecture.

Lecture 2. Measures in (Pharmaco)Epidemiology

1.0.1 Excercise 1

You conduct a survey over the next month in a neighboring city and interview all 2,000 residents. Of these, 400 people report symptoms of anxiety.

What type of prevalence are you examining? What is the point/period prevalence of anxiety symptoms in the neighboring city?

1.0.2 Excercise 2

You talk to all 200 people in your town on a spring day and find 60 of them have allergy symptoms.

What type of prevalence are you examining? What is the point/period prevalence of have allergy symptoms?

1.0.3 Excercise 3

A prevalence survey corried out from January 1 to December 31, 2020, found 1,500 cases of diabetes in a population of 3 million people. It is also known that the incidence in this population is 10 per 100,000 per year.

What percentage of these 1,500 prevalent cases were newly diagnosed in 2020?

1.0.4 Excercise 4

The annual incidence of pancreatic cancer is approximately 12 per 100,000 people in a certain country. The median survival time before diagnosis is close to 6 months (0.5 years).

What is the prevalence?

Solutions:

Excercise 3

Get the prevalence to 100,000 people

$$Prevalence = \frac{1,500 \times 100,000}{3,000,000} = 50 \text{ cases per 100,000}$$

$$\% \text{ New cases} = \frac{10}{50} = 0.2 \times 100 = 20\%$$

Excercise 4

We now that:

$$Prevalence = Incidence \times \text{Duration of the disease}$$

Then,

$$Prevalence = 12 \text{ per 100,000 people anually} \times 0.5 \text{ years} = 6 \text{ cases per 100,000 people}$$

2 Measures of effect (association)

These are hypothetical scenarios designed to practice the topics covered during the lecture.

Lecture 2. Measures in (Pharmaco)Epidemiology

2.1 Risk Ratios

2.1.1 Excercise 1

You are part of a research team conducting a cohort study to evaluate the effect of hormone replacement therapy (HRT) on the development of coronary heart disease (CHD). The research team enrolled post-menopausal women on HRT with no prior history of CHD and followed them for 7 years.

Sssume no loss to follow-up.

Remember: Exposure, HRT, is on the left side of the table, while the outcome, CHD, is on the top of the table.

	CHD (+)	CHD (-)	Total
HRT (+)	210	3290	3500
HRT(-)	250	6250	6500
Total	460	9540	10000

Task:

Calculate and interpret the relative risk (RR) for the cohort.

Calculate and interpret the risk difference (RD) for the cohort

Solution A

$$P(D+ \mid E+) = \frac{210}{3500} = 0.060$$

$$P(D+ \mid E-) = \frac{250}{6500} = 0.038$$

$$RR = \frac{0.64}{0.4} = 1.58$$

Interpretation: Women on HRT have 1.58 times the risk of CHD compared to those who do not take HRT over 7 years.

Solution B

$$RD = 0.060 - 0.038 = 0.022$$

Interpretation: There is an excess of 22 cases of CHD per 1000 women attributable to HRT use over 7 years.

2.1.2 Excercise 2

A study assesses the relationship between smoking habits and esophageal cancer. 1200 people were enrolled in the study. 450 out of 1200 participants had esophageal cancer, while 320 of the diseased participants were smokers while. The total number of smokers in the study was 550.

Fill out the 2x2 table!

	Lung Cancer (+)	Lung Cancer (-)	Total
Smoker (+)			
Smoker(-)			
Total			

Task:

What proportion of the incidence of esophageal cancer can be directly attributed to smoking?

Calculate the risk ratio for the relationship between smoking and lung cancer, interpret the result.

Solution Table

	Lung Cancer (+)	Lung Cancer (-)	Total
Smoker (+)	320	230	550
Smoker(-)	130	520	650
Total	450	750	1200

Solution A

$$\text{Atributable Risk} = \frac{320}{550} - \frac{130}{650} = 0.58 – 0.20 = 0.38$$

Interpretation: 0.38 or 38% of the cases of esophageal cancer in the cohort can be attributed to smoking

Solution B

$$RR = \frac{\frac{320}{550}}{\frac{130}{650}} = \frac{0.58}{0.20} = 2.90$$

Interpretation: The risk of esophageal cancer among the smokers is 2,90 times as high as the risk of esophageal cancer among the non-smokers.

2.1.3 Excercise 3

Coming back the investigation of the effect of HRT in post-menopausal women, you now have the following information

	With CHD (+)	Person-Years of Disease-free Follow-up
HRT (+)	28	52,106
HRT (-)	58	50,238

Task:

Calculate the Incidece rate among the exposed and unexposed women

Calculate the rate ratio for the relationship between HRT and CHD, interpret the result.

Solution A

$$IR_{exposed} = \frac{28}{52,106} = 0.0005373661 \times 100,000 = 53.74 \text{ person-years}$$

$$IR_{unexposed} = \frac{58}{50,238} = 0.001154505 \times 100,000 = 115.45 \text{ person-years}$$

Solution B

$$\text{Rate Ratio} = \frac{53.74}{115.45} = 0.465$$

Interpretation: Women on HRT had 0.47 times the rate of CHD compared to women who did not use HRT

2.2 Odds Ratios

2.2.1 Excercise 1

The influence of increased alcohol consumption on the incidence of esophageal cancer was retrospectively investigated in a clinic over a period of 5 years. Patients with other internal diseases were used as a comparison group.

	Cancer (+)	Cancer (-)	Total
Alcohol (+)	192	54	246
Alcohol(-)	208	333	541
Total	400	387	787

Task:

Calculate the odds to be exposed while diseased/not diseased (i.e. case/control)

Calculate and interpret the odds ratio for the occurrence of esophageal cancer

Solution A

$$Odds_{case} = \frac{192}{208} = 0.92$$

$$Odds_{control} = \frac{54}{333} = 0.16$$

Solution B

$$OR = \frac{0.92}{0.16} = 5.75$$

Interpretation:

- The odds of being exposed to increased alcohol consumption among cases (patients with cancer) is 5.75 times as high compared to the controls (patients with other internal diseases).

- The odds of having cancer are 5.75 times higher among individuals with increased alcohol consumption compared to those without increased alcohol consumption.

2.2.2 Excercise 2

A cohort study is investigating the impact of regular physical activity on the incidence of heart disease A total of 1500 individuals were enrolled. The prevalence of heart disease was 25%. 560 of the total participants were in the active group (those practicing physical activity). Among that group, 200 developed heart disease.

Fill out the 2x2 table!

	Phy. Activity (+)	Phy. Activity (-)	Total
Smoker (+)			
Smoker(-)			
Total			

Task:

Calculate the risk for each group and the relative risk based on the table you filled out, interpret the results.

Moving to the case-control setting, assume a case-control study instead of a cohort study. Using the same previous figures. Calculate the odds and odds ratio. Please interpret your results.

Solution Table

	Phy. Activity (+)	Phy. Activity (-)	Total
Smoker (+)	200	360	560
Smoker(-)	175	765	940

Total	560	940	1500

Solution A

$$Risk_{exposed} = \frac{200}{560} = 0.36$$

$$Risk_{unexposed} = \frac{175}{940} = 0.19$$

$$RR = \frac{0.33}{0.12} = 1.89$$

Interpretation: The risk of suffering from heart disease when practicing physical activity is 1.89 times as high compared to participants who didn't practice physical activity

Solution B

$$Odds_{case} = \frac{200}{175} = 1.14$$

$$Odds_{control} = \frac{360}{765} = 0.47$$

$$OR = \frac{1.67}{0.45} = 2.42$$

Interpretation: The odds of practicing physical activity among cases is 2.42 times as high as the odd of practicing physical activity among the controls.

2.2.3 Excercise 3

A study investigating the influence of smoking on asthma crises enrolled 1,400 participants. Among these participants, 20 experienced asthma crises, of which 50% were smokers. Additionally, among the participants who did not experience asthma crises, 430 were smokers.

Fill out the 2x2 table!

	Asthma (+)	Asthma (-)	Total
Smoker (+)			
Smoker(-)			
Total			

Task:

Calculate the relative risk and the odds ratio

Did you see that the OR and RR were similar? Explain why this may happen.

Solution Table

	Asthma (+)	Asthma (-)	Total
Smoker (+)	10	430	440
Smoker(-)	10	950	960
Total	20	1380	1400

Solution A

$$RR = \frac{\frac{10}{440}}{\frac{10}{960}} = 2.18$$

$$OR = \frac{\frac{10}{10}}{\frac{430}{950}} = 2.21$$

Solution B

Rare disease assumption: when studying diseases that have a low prevalence ($<10\%$ as a rule of thumb)in the study population, the odds ratio is a good approximation of the relative risk.

3 Bias & Condounding

3.0.1 Incidence

3.0.2 Prevalence