

Teaching Prevalence Ratios

Calculated from a 2x2 Contingency Table. Generally speaking we are thinking of two variables: the disease (present or absent) and the risk factor (present or absent). Note that “disease” is a catch-all determination referring to an ailment or general “bad thing.”

		Disease	
		Yes +	No -
Exposure	Yes+		
	No -		

Prevalence Ratio = Prob(disease+|Exposure +)/Prob(disease+|Exposure -)

Example:

In a prospective study of pregnant women, Magann et al. collected extensive information on exercise level of low-risk pregnant working women. A group of 217 women did no voluntary or mandatory exercise during the pregnancy, while a group of 238 women exercised extensively. One outcome variable of interest was experiencing preterm labor. The table below summarizes the results,

Risk Factor	Cases of Preterm Labor	Non-cases of Preterm Labor	Total
Extreme Exercising	22	216	238
Not Exercising	18	199	217
Total	44	415	455

SOURCE: Everett F. Magann, Sharon F. Evans, Beth Weitz, and John Newnham, “Antepartum, Intrapartum, and Neonatal Significance of Exercise on Healthy Low-Risk Pregnant Working Women,” *Obstetrics and Gynecology*, 99 (2002), 466-472.

We wish to estimate the relative risk of preterm labor when pregnant women exercise extensively.

$$\widehat{PR} = \frac{22/238}{18/217} = \frac{.0924}{.0829} = 1.1$$

Interpretation: The probability of the ailment is PR times higher for those in the risk group than those in the non-risk group **OR** the probability of the ailment is % higher for those in the risk group than those in the non-risk group.

The probability of preterm labor is 1.1 times higher for women who engage in extreme exercising than women not exercising. **OR** the probability of preterm labor is 10% higher for women who engage in extreme exercising than women not exercising.

Example 2:

Davy et al. reported the results of a study involving survival from cervical cancer. The researchers found that among subjects younger than age 50, 16 of 371 subjects had not survived for a year after diagnosis. In subjects age 50 or older, 219 of 376 had not survived for a year after diagnosis. Compute the prevalence ratio of death among subjects age 50 or higher compared to their younger counterparts. Does it appear from these data that older subjects diagnosed as having cervical cancer are prone to higher mortality rates?

SOURCE: Margaret L. J. Davy, Tom J. Dodd, Colin G. Luke, and David M. Roder, "Cervical Cancer: Effect of Glandular Cell Type on Prognosis, Treatment, and Survival," *Obstetrics and Gynecology*, 101 (2003), 38-45.

		Death		
		Yes	No	Total
Age	<50	219	157	376
	=50	16	355	371

$$\widehat{PR} = \underline{\hspace{10em}}$$

Interpretation:

Conditional Probability/Prevalence Ratio Exercise

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I. Background

- A. General Abuse Statistics
 1. 11% or 4 million women physically assaulted annually
 2. 3-4% or approx. 2 million women experience severe violence¹⁻⁵
 3. 3-20% of women emotionally abused who are not assaulted^{5,6-10}
 4. Varies widely, centers at 15-20% sexually abused and 50% of physically abused¹¹⁻¹⁷
 5. Cost to employers estimated at 3-10 billion annually¹⁸
 6. Health costs unknown

II. Preliminary study

- A. Objectives
 1. Determine what patients in this setting wanted physicians and providers to do to help abused women
 2. Determine the feasibility of a large scale study
 3. Preliminary estimates of health outcomes of abused women compared to women never abused
- B. Ages 18 to 44
- C. Surveyed from
 1. Community Health Plan centers (local HMO)
 2. Outreach programs at local domestic violence programs
 3. Shelter residents
 4. Staff of domestic violence services
- D. Outcome Variables
 1. Headache
 2. Fatigue
 3. Insomnia
 4. Shortness of breath
 6. Stomach Pain
 7. Chest pain
 8. Pelvic pain
 9. Vaginal infections
- E. 146 women with abuse category known
- F. 36 women never abused
- G. 110 (75%) experienced some kind of physical or emotional abuse in last year

Probability/Prevalence Ratio Activity

The main command to use for this exercise in SPSS is the **Crosstabs** command. We get to it by clicking on **Analyze\Descriptive Statistics\Crosstabs** and then we click the risk factor variable [in this study] **abuse** in the **row** box and the outcome variable **sxlhead** in the column box.

ABUSED * SXLHEAD Crosstabulation

Count		SXLHEAD		Total
		No	Yes	
ABUSED	No	10	25	35
	Yes	11	95	106
Total		21	120	141

Calculate the probability of reporting a severe headache	
Calculate the probability of reporting abuse	
Calculate the probability of reporting severe headaches and reporting abuse	
Calculate the probability of reporting severe headaches or reporting abuse	
Calculate the probability of a headache given the woman was abused	
Calculate the probability of a headache given the woman was not abused	
Calculate the Prevalence Ratio of headaches for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLINSOM Crosstabulation

Count

		SXLINSOM		Total
		No	Yes	
ABUSED	No	22	10	32
	Yes	36	66	102
Total		58	76	134

Calculate the probability of insomnia	
Calculate the probability of insomnia given the woman was abused	
Calculate the probability of insomnia given the woman was not abused	
Calculate the Prevalence Ratio of insomnia for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLCHEST Crosstabulation

Count

		SXLCHEST		Total
		No	Yes	
ABUSED	No	29	3	32
	Yes	62	39	101
Total		91	42	133

Calculate the probability of chest pain	
Calculate the probability of chest pain given the woman was abused	
Calculate the probability of chest pain given the woman was not abused	
Calculate the Prevalence Ratio of chest pain for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLPELV Crosstabulation

Count

		SXLPELV		Total
		No	Yes	
ABUSED	No	26	8	34
	Yes	65	35	100
Total		91	43	134

Calculate the probability of pelvic pain	
Calculate the probability of pelvic pain given the woman was abused	
Calculate the probability of pelvic pain given the woman was not abused	
Calculate the Prevalence Ratio of pelvic pain for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLSTOM Crosstabulation

Count

		SXLSTOM		Total
		No	Yes	
ABUSED	No	23	10	33
	Yes	37	65	102
Total		60	75	135

Calculate the probability of stomach pain	
Calculate the probability of stomach pain given the woman was abused	
Calculate the probability of stomach pain given the woman was not abused	
Calculate the Prevalence Ratio of stomach pain for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLCHOK Crosstabulation

Count

		SXLCHOK		Total
		No	Yes	
ABUSED	No	31	1	32
	Yes	72	21	93
Total		103	22	125

Calculate the probability of choking	
Calculate the probability of choking given the woman was abused	
Calculate the probability of choking given the woman was not abused	
Calculate the Prevalence Ratio of choking for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLBREA Crosstabulation

Count

		SXLBREA		Total
		No	Yes	
ABUSED	No	26	8	34
	Yes	42	57	99
Total		68	65	133

Calculate the probability of shortness of breath	
Calculate the probability of shortness of breath given the woman was abused	
Calculate the probability of shortness of breath given the woman was not abused	
Calculate the Prevalence Ratio of shortness of breath for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLVAG Crosstabulation

Count

		SXLVAG		Total
		No	Yes	
ABUSED	No	23	12	35
	Yes	63	33	96
Total		86	45	131

Calculate the probability of frequent vaginal infections	
Calculate the probability of frequent vaginal infections given the woman was abused	
Calculate the probability of frequent vaginal infections given the woman was not abused	
Calculate the Prevalence Ratio of frequent vaginal infections for abused women	

Interpret the meaning of the Prevalence Ratio

ABUSED * SXLFAT Crosstabulation

Count

		SXLFAT		Total
		No	Yes	
ABUSED	No	22	12	34
	Yes	36	69	105
Total		58	81	139

Calculate the probability of fatigue	
Calculate the probability of fatigue given the woman was abused	
Calculate the probability of fatigue given the woman was not abused	
Calculate the Prevalence Ratio of fatigue for abused women	

Interpret the meaning of the Prevalence Ratio

Other Thoughts

There are generally three types of studies of this kind:

1. Prospective study – follow a group of subjects with and without the risk factor over a period of time. Evaluate at a preset end point frequency of disease. The calculation is done the same way – but the statistic is called the relative risk. Example: track a group of smokers and non-smokers for ten years and then determine the counts of lung cancer.
2. Cross-sectional study – examine a group of subjects at a certain point in time. Take random samples of those with and without the risk factor and count how many have had the disease. The statistic is called the prevalence ratio. Example: the women in the domestic violence study.
3. Case-control study – here you have subjects with and without the disease and then you look back in time to see if they had evidence of the risk factor. Example: a study that examines 100 MI subjects and 100 non-MI subjects and look to see if they had high cholesterol. The odds ratio is the test statistic and it is used as the estimate of the relative risk. [The odds ratio can be calculated for prospective and cross-sectional studies, but in those situations, the ratio is more meaningful.]

		Disease	
		Yes +	No -
Exposure	Yes+	n_{11}	n_{12}
	No -	n_{21}	n_{22}

$$\widehat{OR} = \frac{n_{11}n_{22}}{n_{21}n_{12}}$$

Interpretation: The odds of disease are \widehat{OR} more likely for those with the risk factor than those without the risk factor.

or if I define

$$\hat{p}_1 = \hat{P}(\text{disease+} | \text{risk+}) = n_{11} / (n_{11} + n_{12})$$

$$\hat{p}_2 = \hat{P}(\text{disease+} | \text{risk-}) = n_{21} / (n_{21} + n_{22})$$

$$\widehat{OR} = \frac{\hat{p}_1 / (1 - \hat{p}_1)}{\hat{p}_2 / (1 - \hat{p}_2)} = \frac{\hat{p}_1}{\hat{p}_2} * \left(\frac{1 - \hat{p}_2}{1 - \hat{p}_1} \right) = \widehat{PR} * \left(\frac{1 - \hat{p}_2}{1 - \hat{p}_1} \right)$$

General accepted practice is to use the odds as an estimate of relative risk or prevalence ratio when \hat{p}_1 and \hat{p}_2 are below .10.

NOTE:

4. These issues are subtle. I do not point them to students. When looking for examples – just be aware of the case-control studies. Generally the tip-off is that they have approximately the same number of subjects with and without the disease instead of the risk factor.

Fact Sheet: Alcohol-Related Traffic Fatalities

December 5, 1997
Contact: Media Relations Division
(404) 6393286

- Motor vehicle-related injuries are the leading cause of death for persons aged 1 - 24 years in the United States.
- Over 40% or 17,126 of the 41,907 traffic fatalities in 1996 were alcohol-related.
- A driver with a blood-alcohol concentration of 0.10 or greater is 7 times more likely to be involved in a fatal motor vehicle crash than is a driver who has not consumed alcoholic beverages; if the concentration is 0.15 or greater, the risk rises to 25 times more likely.
- Fatal crashes that occur at night, on weekends, and that involve only one vehicle have the highest percentage of alcohol involvement.
- Men who die in motor vehicle crashes are almost twice as likely than women to be legally intoxicated.
- Among young persons who drive after drinking alcohol, the risk of being involved in a crash is greater for young persons at all blood-alcohol concentrations than it is for older persons.
- The highest intoxication rates in fatal crashes in 1995 were recorded for drivers aged 21-24 years (27.8%).
- In 1994, 29% of the 2,610 traffic fatalities involving persons aged 15-17 and 44% of the 3,616 traffic fatalities involving persons aged 18-20 were alcohol-related.
- Young adult drivers aged 21-34 years who have been arrested for driving while impaired are more than four times as likely to die in future alcohol-related crashes.
- Effective prevention measures for preventing alcohol-related traffic fatalities include prompt license suspension for persons who drive impaired; lowering permissible blood-alcohol levels to 0.8 for adults and 0.02 for those younger than age 21 years; sobriety checkpoints; and public education, community awareness, and media campaigns about the dangers of driving while impaired.

<http://www.cdc.gov/od/oc/media/fact/alctrfa.htm>

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