EPI 202 Lab 4 Practice Problem

1) The crude association between low dietary diversity score and child wasting is a risk ratio of 3.0. You know that children who have mothers with low education have 2 times the risk of being wasted than children with mothers who have high education. Additionally, the odds of having a low dietary diversity score among children whose mothers have low education is 2.2 times the odds of having a low dietary diversity score among children whose mothers have high education.

a. Could maternal education completely explain the observed association between dietary diversity score and child wasting?

   No, it could not. The observed association is larger than either of the two effects of the confounding variable, so at least some of the association must be due to factors other than maternal education.

b. Would you be more concerned about confounding by maternal education in a population where 80% of mother have low education or in a population where 50% of mothers have low education?

   I would be more concerned in a population where 50% of mothers have low education. The extent of confounding is maximized when the prevalence of the confounder is 50% and decreases as the confounder prevalence tends towards 0% *or* towards 100%.

Part 2 - Misclassification

The following table is based on the **Table 2** from the following paper, Lin, K.J., Mitchell, A.A., Yau, W., Louik, C., Hernández-Diaz, S. (2012). *Maternal exposure to amoxicillin and the risk of oral clefts.* Epidemiology, 23(5): 699-705.

	Cleft palate + (cases)	Cleft palate – (controls)
Likely exposure to amoxicillin in first trimester	28	144
No likely exposure to amoxicillin in first trimester	810	6379

1. Using the data in your table, calculate the crude odds ratio (OR) for 'likely exposure to amoxicillin in the first trimester' compared to 'no exposure to amoxicillin during pregnancy' and the outcome of cleft lip with or without cleft palate.

OR = (28*6379) / (810*144) = 1.53

The odds of cleft lip with or without cleft palate in infants who were likely exposed to amoxicillin in the first trimester are 1.53 times the odds of cleft lip with or without cleft palate in infants who were not exposed to amoxicillin during pregnancy (assuming no confounding, no selection bias, no information bias).

Suppose the authors had conducted a validation study within the Birth Defects Study comparing self-reported amoxicillin use during pregnancy to true amoxicillin use during pregnancy based on a review of records (considered a "gold standard" for the purpose of this question). The table below shows the results from the hypothetical validation study.

		Review of medical/pharmacy records	
		Amoxicillin use during first trimester	No amoxicillin use during pregnancy
Self-report	Amoxicillin use during first trimester	63	4
	No amoxicillin use during pregnancy	21	196

2. Calculate the sensitivity, specificity, false positive rate, false negative rate, positive predictive value, and negative predictive value.

$$\text{Sensitivity} = \Pr(T+|E+) = \frac{\text{TP}}{\text{TP}+\text{FN}} = \frac{63}{63+21} = .75$$

$$\text{Specificity} = \Pr(T-|E-) = \frac{\text{TN}}{\text{TN}+\text{FP}} = \frac{196}{196+4} = .98$$

$$\text{False Positive Rate} = 1 - \text{Specificity} = \Pr(T+|E-) = \frac{\text{FP}}{\text{FP}+\text{TN}} = \frac{4}{196+4} = .02$$

$$\text{False Negative Rate} = 1 - \text{Sensitivity} = \Pr(T-|E+) = \frac{\text{FN}}{\text{TP}+\text{FN}} = \frac{21}{63+21} = .25$$

$$\text{Positive Predictive Value} = \Pr(E+|T+) = \frac{\text{TP}}{\text{TP}+\text{FP}} = \frac{63}{63+4} = .94$$

$$\text{Negative Predictive Value} = \Pr(E-|T-) = \frac{\text{TN}}{\text{TN}+\text{FN}} = \frac{196}{196+21} = .903$$

3. Determine the true odds ratio for 'likely exposure to amoxicillin in the first trimester' compared to 'no exposure to amoxicillin during pregnancy' and the outcome of cleft lip with or without cleft palate. For this question, assume non-differential misclassification of the exposure and no other sources of bias. Show your work, including a new 2x2 table that is not misclassified.

$$a = \frac{[(specificity * m_1) - B]}{sensitivity + specificity - 1} = \frac{[(838 \times .98) - 810]}{.75 + .98 - 1} = 15.4$$

$$b = \frac{[(sensitivity * m_1) - A]}{sensitivity + specificity - 1} = \frac{[(838 \times .75) - 28]}{.75 + .98 - 1} = 822.6$$

$$c = \frac{[(specificity * m_0) - D]}{sensitivity + specificity - 1} = \frac{[(6523 \times .98) - 6379]}{.75 + .98 - 1} = 18.5$$

$$d = \frac{[(sensitivity * m_0) - C]}{sensitivity + specificity - 1} \frac{[(6523 \times .75) - 144]}{.75 + .98 - 1} = 6504.5$$

	Likely Exposure to Amoxicillin in 1st Trimester	No Exposure to Amoxicillin	
Cases	15.4	822.6	838
Controls	18.5	6504.5	6523
	33.9	7327.1	7361

$$OR_{true} = \frac{ad}{bc} = \frac{15.4 \times 6504.5}{822.6 \times 18.5} = 6.58$$

Rounded to the nearest integer:

	Likely Exposure to Amoxicillin in 1st Trimester	No Exposure to Amoxicillin	
Cases	15	823	838
Controls	19	6504	6523
	34	7327	7361

$$OR_{true} = \frac{ad}{bc} = \frac{15 \times 6504}{823 \times 19} = 6.24$$

4. In what direction did misclassification of the exposure bias the true association? Is this what you expected? Explain your answer.

Misclassification of the exposure biased the true association towards the null. The true odds ratio was 6.58 while the biased odds ratio was 1.53. This was expected as **non-differential misclassification** of a **binary exposure** generally yields bias towards the null.

1. Magnitude of confounding? L&A, L&Y the Ratio (care about hypothesis testing?)

2. How to distinguish whether a misclassification is differential or non-differential? By knowledge? (Like how to identify confounding using DAG)