**Instructions**

Please complete the following lab assignment. You may work on the assignment in groups or on your own. However, to get credit, you must submit your own answers in Canvas. This lab is open note and open book. You may also ask the instructor and the TA questions. Please note that in most cases we will try to guide you towards answering your own question rather than directly providing you with an answer.

# Textbook questions that I decided not to use

# Q2. Confounding in veteran study

In a study of serum dioxin levels and risk of diabetes among Air Force veterans, the odds ratio of diabetes comparing those with high serum dioxin with those with low serum dioxin levels was found to be 1.71. After adjustment for serum triglyceride levels, however, the estimated odds ratio for high serum dioxin decreased to 1.56.

a. Assuming that triglyceride levels are not in the causal pathway of the suspected dioxin → diabetes association and that there is no random or measurement error, what is the best explanation for this finding?

b. Assuming, instead, that triglyceride level is in the causal pathway of the dioxin → diabetes association, how do you explain the fact that the association remained positive even after adjustment for triglyceride levels? To answer this question, assume that there is no random or measurement error.

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5408-5415). Jones & Bartlett Learning. Kindle Edition.

# Q2. Feedback

a. Triglyceride level is a positive confounder of the association between serum dioxin and diabetes, but because the odds ratio remains > 1.0 upon adjustment, the association cannot be entirely explained by the confounding effect of triglycerides.

b. Serum triglycerides explain part of the association between serum dioxin and diabetes, but other variables may be in the causal pathway of the dioxin → diabetes association, explaining the fact that the association did not disappear after adjustment for triglycerides. There could also be a direct effect of dioxin on diabetes by means of, for example, pancreatic damage (that is, without any effects of mediating factors).

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q3. Confounding using a table

By examining the following exhibit, indicate whether, in a case-control study, positive or negative confounding has occurred:

|  |  |  |  |
| --- | --- | --- | --- |
| Situation | Confounder associated with exposure | Confounder more common in cases | Confounder more common in controls |
| 1 | Positively | Yes |  |
| 2 | Negatively | Yes |  |
| 3 | Positively |  | Yes |
| 4 | Negatively |  | Yes |

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5415-5416). Jones & Bartlett Learning. Kindle Edition.

# Q3. Feedback

By situation number:

1—Positive confounding

2—Negative confounding

3—Negative confounding

4—Positive confounding

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# 

# 

# Q4.

Severe restrictions on the transfer of mentally disturbed prisoners to psychiatric hospitals were introduced in Auckland in 1983, whereas the policy in other parts of New Zealand remained unchanged. The data to support the contention that this policy resulted in an increase in suicides are shown in the following table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Auckland | | Other areas in New Zealand | |
|  | 1973-1982 | 1983-1987 | 1973-1982 | 1983-1987 |
| Number of suicides | 2 | 18 | 5 | 6 |
| number of prisoner-years | 5396 | 3277 | 20,059 | 9815 |
|  | Suicide rates (per 100,000) | | | |
| Crude | 37.1 | 549.3 | 24.9 | 61.1 |
| Adjusted for sentence length\* | 26.8 | 367.9 | 27.1 | 54.4 |

\* Because longer sentences (years to be spent in prison) are associated with an increased risk of suicide, the suicide rates were adjusted for the effect of sentence length.

a. In areas of New Zealand other than Auckland, adjustments for sentence length caused only a small increase in the rate for 1973–1982 but a marked decrease in the rate for 1983–1987. What do these data tell you about what happened to the average length of sentences from the earlier to the later period?

b. What else would you like to know before inferring that the temporal difference in the Auckland suicide rates resulted from the changes in policy?

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5418-5421). Jones & Bartlett Learning. Kindle Edition.

# Q4. Feedback

a. The sentence lengths were longer at the later period. The fact that the suicide rate was attenuated after adjusting for sentence length represents positive confounding, which occurs when the exposure–confounder and the outcome–confounder associations are in the same direction. We know from the footnote to the table that increased sentence length is associated with an increased suicide rate, so the confounder–calendar time (exposure) association must be in the same direction (i.e., later time period associated with longer sentences).

b. Temporal changes in other variables (i.e., characteristics of the population of prisoners that could also be related to suicide risk should be considered—for example, whether there are other confounders or selection biases that changed over time). In other words, as with all attempts to infer causal associations, one must consider residual confounding, other potential biases, and other potential causes for the temporal change in suicide rates.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q5.

In a hypothetical case-control study examining the relationship of exposure X to disease Y, the unadjusted odds ratio was found to be 1.5 ( p < 0.05). The authors examined the possibility that current smoking could be a confounding factor. The percentages of current smokers were found to be 32% in cases and 37% in controls ( p = 0.25). The relative risk for the association of smoking with the exposure in this study was found to be very strong (OR = 20.0, p < 0.001). Based on the small difference in current smoking percentage between cases and controls, would you conclude that current smoking is not a confounder? Why?

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5430-5433). Jones & Bartlett Learning. Kindle Edition.

# Q5. Feedback

Statistical significance is not a good criterion to establish the presence of a confounding effect. Because smoking is very strongly related to the disease, even a small difference between cases and controls may explain an association between X and Y. In this example, it would be important to adjust for smoking to see whether the adjusted odds ratio differs from the unadjusted odds ratio.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q6.

Based on the unadjusted and adjusted relative risks in the following table, for each example, state whether the direction of the confounding is positive, negative, or qualitative. Assume that there is no bias or random variability.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative risks | |  |
| Example no. | Unadjusted | Adjusted | Direction of confounding |
| 1 | 4.3 | 3.1 | [1] |
| 2 | 3.0 | 0.6 | [2] |
| 3 | 0.5 | 0.2 | [3] |
| 4 | 2.5 | 1.0 | [4] |
| 5 | 0.2 | 0.8 | [5] |
| 6 | 0.4 | 0.6 | [6] |
| 7 | 3.1 | 5.4 | [7] |
| 8 | 6.1 | 3.5 | [8] |

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5435-5437). Jones & Bartlett Learning. Kindle Edition.

# Q6. Feedback

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative risks | |  |
| Example no. | Unadjusted | Adjusted | Direction of confounding |
| 1 | 4.3 | 3.1 | Positive |
| 2 | 3.0 | 0.6 | Qualitative |
| 3 | 0.5 | 0.2 | Negative |
| 4 | 2.5 | 1.0 | Positive |
| 5 | 0.2 | 0.8 | Positive |
| 6 | 0.4 | 0.6 | Positive |
| 7 | 3.1 | 5.4 | Negative |
| 8 | 6.1 | 3.5 | Positive |

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q7.

In a population-based case-control study of the relationship between dietary pattern and risk of Hodgkin lymphoma, 17% of cases and 20% of controls were found to be aged ≥ 50 years. ‡

a. Assuming that this difference is not significant, under which circumstance could age be a confounder? In the same study, the unadjusted proportions of cases and controls with previous diagnosis of mononucleosis were virtually the same.

b. Can diagnosis of mononucleosis still be a confounder? If so, under which circumstance?

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5439-5445). Jones & Bartlett Learning. Kindle Edition.

# Q7. Feedback

a. If age were strongly related to dietary pattern, it could be a confounder.

b. Yes, if there is conditional confounding; that is, mononucleosis may be a confounder once adjustment for its confounders were done.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q8.

A clinical trial was conducted to evaluate the effectiveness of cognitive-behavioral and nicotine replacement therapies for smoking cessation in 1199 volunteers who were randomly assigned to 10 groups stratified according to use of nicotine patch and number of cognitive-behavioral therapy sessions they attended. The sample size was, on average, approximately 102 per group except the two control groups (1 session of brief counseling plus nicotine patch and 1 session of brief counseling without nicotine patch), with sample sizes of about 190 volunteers. §

a. Is confounding a potential problem in this study? If so, what is its source?

b. In a large randomized clinical trial, is confounding likely? Why or why not?

Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 5445-5447). Jones & Bartlett Learning. Kindle Edition.

# Q8. Feedback

a. Yes, random differences between the groups resulting from the relatively small sample sizes.

b. Confounding is unlikely in a large clinical trial, as random allocation results in random samples of the study base (e.g., intervention vs placebo), which are very likely to have the same distributions of both known and unknown confounders.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Last Question Feedback

Please make sure you understand why the example answer is correct. You may use the "Previous" button to update your answer if you feel like you can now give a more correct/complete answer.

Click the "Submit" button below if you are ready to submit this lab.

# 

**Feedback**

**Optional**: Please feel free to leave any comments below about the usefulness of this lab. Which parts were helpful? What could I do to improve it? What is still unclear?

Fix this (2022-08-29)

**Instructions**

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# Calculations

[R calculations are available here](https://www.dropbox.com/s/gn19tm3657bf9i5/lab_effect_modification.Rmd?dl=0).

[Google sheet calculations are available here](https://docs.google.com/spreadsheets/d/1QK2ZH9YAopJ-YBWL3E_MbjZnNFBP4Taks2WPbqHesvs/edit#gid=961627830).

# Q1. Interpret a DAG

[Fill in table]

Given the causal DAG below,

# Diagram Description automatically generated

|  |  |
| --- | --- |
|  | we can identify the causal effect of diabetes on heart attack if we correctly adjust for smoking in our analysis. |
|  | we can identify the causal effect of diabetes on heart attack if we restrict our study population to never smokers. |
|  | we cannot identify the causal effect of diabetes on heart attack if smoking is not measured. |
| ✅ | All of the above |

# Q1. Feedback

We can identify the causal effect of diabetes on heart attack if we correctly adjust for smoking in our analysis. This would block the back door path from diabetes to smoking to heart attack.

We can identify the causal effect of diabetes on heart attack if we restrict our study population to never smokers. This would block the back door path from diabetes to smoking to heart attack.

We cannot identify the causal effect of diabetes on heart attack if smoking is not measured. without a measure of smoking, we will not be able to block the backdoor path from diabetes to smoking to heart attack.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

**Q2. Traditional criteria**

[True/False]

Consider a variable associated with the treatment A, associated with the outcome Y within levels of A, and not on a causal pathway from A to Y. Adjustment for such a variable will always reduce bias.

|  |  |
| --- | --- |
|  | True |
| ✅ | False |

# Q2. Feedback

Consider a variable associated with the treatment A, associated with the outcome Y within levels of A, and not on a causal pathway from A to Y. Adjustment for such a variable will always reduce bias.

This is FALSE.

Consider the following DAGs: In both DAGs, C is associated with the treatment A, associated with the outcome Y within levels of A, and not on a causal pathway from A to Y. However, adjustment for C would only be expected to reduce bias in DAG 1.

A picture containing clock

Description automatically generatedPlease make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

**Q3. Interpret DAG**

[Multiple choice]

Given the causal DAG below, which variable(s) should be conditioned on to eliminate the confounding for the effect of oral contraceptives (OC) use on the risk of ovarian cancer?

Diagram

Description automatically generated

|  |  |
| --- | --- |
|  | Insurance report |
|  | Medical visits |
| ✅ | Age at first birth |
|  | Medical visits and age a first birth |

# Q3. Feedback

The correct answer is Age at first birth.

Conditioning on insurance report does not close the backdoor path from OC use to age at first birth to ovarian cancer.

Conditioning on medical visits does not close the backdoor path from OC use to age at first birth to ovarian cancer, and it does open a backdoor path from OC use to medical visits to ovarian cancer that was previously blocked by the collider at medical visits.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

**Q4. Interpret DAG**

[Multiple choice]

According to the causal DAG below, which of the following statements is correct? (Note: U is an unmeasured variable)

Diagram

Description automatically generated

|  |  |
| --- | --- |
|  | There is no open backdoor path between A and Y. |
| ✅ | We should adjust for L in order to eliminate confounding. |
|  | There is no way to eliminate confounding because of the unmeasured common cause U. |
|  | All of the above |

# Q4. Feedback

We should adjust for L in order to eliminate confounding. Without adjusting for L, there is an open backdoor path from A to L to U to Y.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

**Q5. Interpret a DAG**

[True/False]

Use the causal DAG below to answer the following questions.

Diagram

Description automatically generated

Adjusting for maternal history of diabetes will introduce bias for the effect of children’s diet pattern on risk of diabetes.

|  |  |
| --- | --- |
| ✅ | True |
|  | False |

# Q5. Feedback

Adjusting for maternal history of diabetes will introduce bias for the effect of children’s diet pattern on risk of diabetes.

Currently, the backdoor path from children's diet pattern to diabetes is blocked by the collider at maternal history of diabetes. If we adjust for maternal history of diabetes that backdoor path would be opened.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q6. Interpret a DAG

[True/False]

Use the causal DAG below to answer the following questions.

Diagram

Description automatically generated

Adjusting for family income during childhood will introduce bias for the effect of children’s diet pattern on risk of diabetes.

|  |  |
| --- | --- |
|  | True |
| ✅ | False |

# Q6. Feedback

Adjusting for family income during childhood will NOT introduce bias for the effect of children’s diet pattern on risk of diabetes.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q7. Interpret a DAG

[Multiple choice]

Use the causal DAG below to answer the following questions.

Diagram

Description automatically generated

Which of the below statements is correct?

|  |  |
| --- | --- |
|  | There is no open backdoor path between children’s diet pattern and risk of diabetes. |
|  | There is no confounding for the effect of children’s diet pattern on risk of diabetes. |
|  | Children’s diet pattern and diabetes are d-separated. |
| ✅ | All of the above |

# Q7. Feedback

There is no open backdoor path between children’s diet pattern and risk of diabetes is TRUE.

There is no confounding for the effect of children’s diet pattern on risk of diabetes is TRUE.

Children’s diet pattern and diabetes are d-separated is TRUE.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q8. Randomization

[True/False]

Randomization, when possible, is the preferred approach to eliminating confounding.

|  |  |
| --- | --- |
|  | True |
| ✅ | False |

# Q8. Feedback

In theory, ideal randomized experiments (i.e., no loss to follow- up, full adherence to the assigned treatment over the duration of the study, a single version of the treatment, and double-blind assignment) with a large enough sample size always lead to estimates of association that can be interpreted as causal. Unfortunately, randomized experiments often do not meet this standard. Additionally, randomized experiments are often unethical, impractical, or untimely.

Despite these limitations, randomization remains the preferred approach to eliminate confounding when it is possible.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q9. Direction of confounding

[Fill in blank]

Based on the unadjusted and adjusted relative risks in the following table, for each example, state whether the direction of the confounding is positive, negative, or qualitative. Assume that there is no bias or random variability.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative Risks | |  |
| Example no. | Unadjusted | Adjusted | Direction of confounding |
| 1 | 4.3 | 3.1 | [1] |
| 2 | 3.0 | 0.6 | [2] |
| 3 | 0.5 | 0.2 | [3] |
| 4 | 2.5 | 1.0 | [4] |
| 5 | 0.2 | 0.8 | [5] |
| 6 | 0.4 | 0.6 | [6] |
| 7 | 3.1 | 5.4 | [7] |
| 8 | 6.1 | 3.5 | [8] |

# Q9. Feedback

Based on the unadjusted and adjusted relative risks in the following table, for each example, state whether the direction of the confounding is positive, negative, or qualitative. Assume that there is no bias or random variability.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative Risks | |  |
| Example no. | Unadjusted | Adjusted | Direction of confounding |
| 1 | 4.3 | 3.1 | Positive |
| 2 | 3.0 | 0.6 | Qualitative |
| 3 | 0.5 | 0.2 | Negative |
| 4 | 2.5 | 1.0 | Positive |
| 5 | 0.2 | 0.8 | Positive |
| 6 | 0.4 | 0.6 | Positive |
| 7 | 3.1 | 5.4 | Negative |
| 8 | 6.1 | 3.5 | Positive |

Please make sure you understand why the example answer is correct. You may use the "Previous" button to update your answer if you feel like you can now give a more correct/complete answer.

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**Feedback**

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