Exam 1
Research Methods
2/6/2024

1. As we discussed in class, while poverty is related to fatal drug overdose and/or misuse, explanations centered on poverty as a primary causal mechanism are lacking. One reason is due to the following observation that we discussed in class: many impoverished neighborhoods have low rates of drug overdose, and conversely, we can identify wealthy neighborhoods with relatively higher rates of drug overdose compared to impoverished neighborhoods.

   As you know, during COVID-19, we saw a huge spike in fatal drug-related overdoses, particularly in areas of high deprivation. Whether the COVID-19 pandemic was responsible for driving the drug overdose epidemic is largely unknown. Drug use increased in the US dramatically in the decade prior to COVID. So, is not satisfying to merely claim that COVID exacerbated pre-existing socioeconomic vulnerabilities particularly because COVID-19 affected everyone, albeit not equally.

   I am working on a study that links the contagion of an infectious disease outbreak with the contagion of social behavior, such as drug misuse. The idea is that drug misuse, the human social layer, co-evolves with an infectious disease, in the present case, COVID-19. As stated in our work, the central idea is that while an infectious disease can be characterized as spreading via physical contact, its affects and may be moderated by social behaviors which themselves spread similar to infectious disease contagion. One caveat: we have no data about the nature of interpersonal relationships; we are rather claiming that behaviors spread by virtue of proximity in both space and time, similar to an infectious disease (clearly you need not know someone to be infected by them with COVID). So, to summarize, our model assumes that social behavior can be spread through personal networks without regard to whether the individuals know each other or not, their behaviors 'spread' by virtue of them being in proximity of each other in space and time, and further than the spread of social behavior is influenced by the disease spread. Social networks that form by virtue of "being at the same place at the same time" are referred to as proximity-based social networks. Following through with the example, two people who seek to purchase drugs can come from anywhere in the city to a neighborhood that is known as an area where drugs are readily available, and by virtue of being in the same place at the same time, may die from a fatal drug overdose after purchasing drugs.

   In this question, I am asking you to think through the causal mechanisms to identify the strengths and weaknesses of the study. Please do your best to answer the questions below:

a. In our model, the spread of behaviors, or social contagion, is the result of a "pathogen-induced response." **Describe** <u>two</u> mechanisms by which the physical spread of COVID-19 may result in the spread of drug misuse in a *proximity-based* social network and the posited relationships. **Draw** a picture of the conceptual model to represent the relationships.

b. There may be some factors that alter the association between the spread of disease and the social contagion of drug misuse. **Describe** <u>two</u> such factors and the posited relationships between them. Draw a picture of the conceptual model to describe the relationships.

c. **Now focus only on the social contagion piece. We need to demonstrate that drug misuse spreads between individuals. Clearly, for this to be true, individuals must be co-located in an area at the same time.** In other words, if the drug misuse spreads via person-to-person contact, then to demonstrate social contagion, we need to show that using drugs at a given location at time 1 influences drug use at a nearby location at time 2. Behaviors that take place at similar times and locations is called dependence. For example, we might consider drug use behavior within 3 city blocks. If someone uses drugs at 2pm then if someone located within those 3 blocks uses drugs at 2:05pm we have evidence that drug use behavior 'spreads.' Or do we?

The risk of drug misuse *may* vary in space and time because of differences in neighborhood level risks, including but not limited to socio-economic characteristics, police presence, land use patterns, and transportation accessibility. To properly characterize the spread of drug misuse from person to person we need to account for the underlying spatial risks. If we do not, then it is impossible to tell whether the spread is due neighborhood level risk factors, or rather due to person to person contact as influenced by the spread of COVID-19.

Therefore, there is a clear need for the study to incorporate both spatial risk factors and dependence before a determination can be made that dependence (resulting from proximity alone) is causing the behavior to spread. Stated differently, some drug use may result from features of the local environment (low police presence) rather than being influenced by others using drugs in the same area (dependence).

Describe how these two different causal mechanisms of spread may lead to confounding. Then, draw a picture that describes the confounding relationship between dependence and spatial risk. (Hint: start with what I am trying to show, which is that drug misuse at time 1 (exposure) influences drug misuse at time 2 (outcome)).

d. Let's assume that after we conduct our study, we find that drug use behaviors' spread is affected by the spread of the infectious disease and also by home ownership (the proportion of persons who own their own house versus rent in the neighborhood). Discuss the results in terms of multifinality, equifinality, necessary and sufficient causes.

2. We have talked about the role that science has played in maintaining social constructions. One of the most enduring, and misunderstood, concepts has been 'race.' Many social science/public health endeavors seek to reduce racial inequities without being critical about the measurement of 'race' much less how it is used in extant research. Obviously, how our interventions respond to different racial categories depends on the scientific evidence of disparity. Clearly, our measure of race implies that race is 1) discrete; 2) measurable; 3) scientifically meaningful; and 5) unchangeable. It is not coincidence that elements of our racial hierarchy include similar characteristics. Our racial hierarchy similarly views race as discrete, rank ordered (i.e., one group is "superior"), immutable, and linked to biology. In light of our measure of race, discuss how science has socially constructed racial identity in the United States through the measurement and classification of racial categories. Identify 1-2 policy implications that directly resulted.

3. A researcher is interested in developing a school-based intervention to prevent youth from future criminal justice system involvement. The researcher suspects that youth in middle school are more likely to engage in delinquent acts and hence targets this group. He collects data on the families of 20 delinquent and 20 nondelinquent children from the records of a local middle school and checks how many children from each group come from broken homes.

    a. What are the null and research hypotheses? Explain why the research hypothesis is directional or nondirectional.

    b. How might the researcher make a Type I error?

    c. How might the researcher make a Type II error?

        i. The agency funding the study accepts that targeting this specific age group in the intervention will not cost any extra money. They feel that the study is worth pursuing even if the study doesn't find enormous differences in the delinquency levels between youth from broken homes and other youth of the same age. What are the policy implications of failing to reject the null hypothesis for this study? How should these considerations affect the researchers' decision on what level of significance to set? **Comment on this in light of the way the study is framed.**

4. The case of Sally Clark, which was litigated in 1999, has been called a 'spectacular miscarriage of justice.' Sally Clark was convicted of murder after both her infant sons died. There was testimony in the case regarding the likelihood that two babies in the same household would die from SIDS, sudden infant death syndrome. A physician testified that the odds that two infants would die from SIDS was about 1 in 73 million, meaning that it is extremely likely that the babies did NOT die from SIDS. This figure was derived from multiplying 1/8543 times 1/8543 which is essentially zero. The physician used the figure in the table below for 'no risk factor present.' The physician likened the odds to those of gambling, specifically that the odds of two infants dying from SIDS is like: *"... the chance of backing that long odds outsider at the Grand National, you know; let's say it's a 80 to 1 chance, you back the winner last year, then the next year there's another horse at 80 to 1 and it is still 80 to 1 and you back it again ...."*

   a. Comment on 1) the interpretation of the odds given by the physician in this case.

Rate for groups with different factors	
Household Factor	**SIDS incidence in this group***
Risk: Anybody smokes in the household Protective: Nobody smokes in the household	in 737 in 5041
Risk: No waged income in the household Protective: At least one waged income in the household	in 486 in 2088
Risk: Mother <27 years and parity Protective: Mother > 26 years and parity	in 567 in 1882
None of these protective factors One of these protective factors Two of these protective factors All three of these protective factors	in 8543 in 1616 in 596 in 214

b. Interestingly, in 1991, a study was published in Lancet titled "Prospective cohort study of prone sleeping position and sudden infant death syndrome" indicating that prone sleeping position was significantly associated with increased risk of SIDS. The table from this paper is replicated below. The main exposure in this study was sleeping position (prone / not prone) and the outcome was 'died from SIDS.'

   i. Using the table, compute the relative risk, risk difference (difference between relative risks) and odds ratio of dying from SIDS for infants in prone positions (versus not). Interpret the practical and legal significance of the results in regards to the Sally Clark case (as mentioned above the results are statistically significant).

Cohort Study of SIDS (outcome) by sleeping position (Exposure)			
	Upper Class	Lower Class	
Prone	9	837	846
Non-prone	6	1755	1761
	15	2592	2607