Neighborhood Disadvantage in Context: the Influence of Urbanicity on the Association Between Neighborhood Disadvantage and Adolescent Mental Health

Online Resource 2
Social Psychiatry and Psychiatric Epidemiology

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Sensitivity Analysis for an Unobserved Confounder. We used two bias equations for the odds ratio proposed by VanderWeele and Arah to assess the sensitivity of our results to an unobserved confounder. [1] For each equation, we made the following three assumptions as discussed by VanderWeele and Arah: (1) the association between the outcome and unobserved confounder is consistent across levels of exposure and observed covariates; (2) the unobserved confounder is binary; and (3) the prevalence of the unobserved confounder is constant across levels of the covariates. Let A denote the exposure received by an adolescent. In this study, a1 represents residence in a disadvantaged neighborhood and a0 represents residence in a non-disadvantaged neighborhood. Let Y denote the observed outcome, past 12-month emotional disorder present or absent. Let X denote the observed covariates, and let U denote the unobserved binary confounder.

First, we used VanderWeele and Arah’s bias equation for the conditional odds ratio that makes the simplifying rare disease assumption.

\[
d^{OR}(x) \approx \frac{1 + \gamma - 1)P(u = 1|a = 1, x)}{1 + \gamma - 1)P(u = 1|a = 0, x)}
\]

We calculated the bias and resultant corrected lower 95% confidence bound across an array of input parameter values. We allowed the association between the outcome and unobserved confounder, \(E(Y|u=1, a) / E(Y|u=0, a) = \gamma\), to range from 1 to 5. And the association between the exposure and the unobserved confounder \(Pr(u=1|a=1,x) / Pr(u=1|a=0,x) = \delta\) also ranged from 1 to 5. The prevalence of the unobserved confounder in the exposed population ranged from 0.1 to 0.8.

Figure 1, below, plots the corrected lower 95% CI bound (on the y-axis) against the value of gamma (on the x-axis). The different colored curves in each subplot show the relationship for different values of delta. Each of the four subplots corresponds to different input values for the prevalence of the unobserved confounder in the exposed population (e.g., 0.1, 0.3, 0.5, and 0.8). For \(\delta=2\) and \(P(u|a=1,x)=0.3\), \(\gamma\) would have to be at least 3.3 to render our effect estimate nonsignificant.
Second, we used VanderWeele and Arah’s bias equation for the conditional odds ratio without making the simplifying rare disease assumption.

\[ d^{OR}(x) = \left( \frac{E(Y|a=1,x,u=1)P(u=1|a=1,x) + E(Y|a=1,x,u=0)P(u=0|a=1,x)}{(1-E(Y|a=1,x,u=1))P(u=1|a=0,x) + E(Y|a=0,x,u=0)P(u=0|a=0,x)} \right) / \left( \frac{1-E(Y|a=0,x,u=1))P(u=1|a=0,x) + (1-E(Y|a=0,x,u=0))P(u=0|a=0,x)}{(1-E(Y|a=1,x,u=1))P(u=1|a=x) + (1-E(Y|a=1,x,u=0))P(u=0|a=x)} \right) \]  

The rare disease assumption is considered appropriate if the prevalence is less than ten percent. The unadjusted prevalence of emotional disorder in the population of adolescents living in non-disadvantaged neighborhoods was 0.24.

We specified input values for \( \gamma \), \( \delta \), and \( \Pr(u=1|a=1,x) \) as detailed above. However, the exact calculation of the conditional odds ratio bias necessitated the specification of two additional parameters. First, we set \( E(Y=1|u=1,a=1,x) = 0.5 \). Second, as defined by our dichotomization of the exposure, we set the prevalence of exposure to one-third. This was used to calculate \( \Pr(u|x) \).

\[ P(u|x) = P(u|a = 1, x)P(a = 1|x) + P(u|a = 0, x)P(a = 0|x) \]
Similar to Figure 1, Figure 2, below, plots the corrected lower 95% confidence bound against the value of $\gamma$. The different colored curves in each subplot show the relationship for different values of delta. Each of the four subplots corresponds to different input values for the prevalence of the unobserved confounder in the exposed population (e.g., 0.1, 0.3, 0.5, and 0.8).

Figure 2: Estimates of the corrected lower 95% confidence bound by values of delta, gamma, and $P(u|a=1,x)$ using the exact equation.

As seen in both figures, our results are more sensitive to a prevalent unobserved confounder. In the exact analysis, when $P(u|a=1,x)=.8$, a U with a 2-fold association with A and a 1.4-fold association with Y would change our inference. When $P(u|a=1,x)=.3$, a U with a 2-fold association with A and a 2.5-fold association with Y would change our inference.