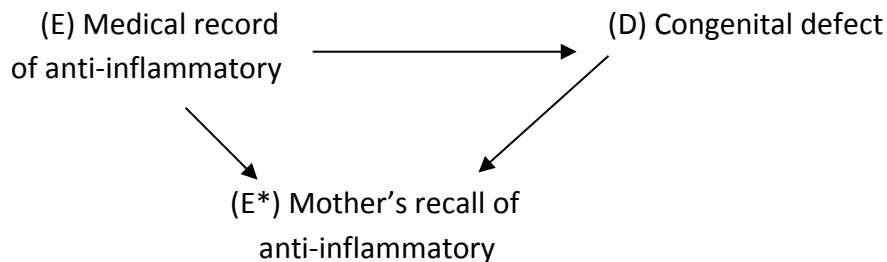


## Causal diagrams - Practical Solutions

### Scenario I

#### Proposed causal diagram



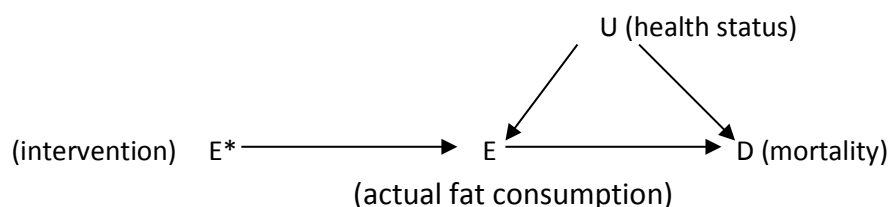
This DAG shows the causal effect of interest (from E to D) and also shows that E\*, the exposure reported by the mother, may be affected by the true exposure E (we would certainly expect this to be the case!). The diagram we have drawn also shows that there could be an effect of D on E\*. This is possible, since E\* was measured 1 month postpartum. If present, this arrow (from D to E\*) represents recall bias. You may have drawn two diagrams, with another possibility being this diagram with the arrow from D to E\* removed, representing the case in which there is no recall bias.

However note that conditional on E there is an association between E\* and D. This suggests that recall bias IS present. In the absence of an arrow from D to E\*, conditioning on E would remove any association between E\* and D, leading to a conditional odds ratio of 1; but this is not the case. Thus, if you drew your causal diagram without an arrow from D to E\*, you should add this now. If you considered both diagrams (with and without the arrow from D to E\*), you would now rule out the second diagram. Conditioning on E\* changes the estimate of the association between E and D as we would expect from the causal diagram since E\* is a child of both E and D.

The appropriate analysis is the crude analysis of the association between E and D (OR: 1.73). Adjusting for E\* distorts this.

### Scenario II

#### Proposed causal diagram



To answer the questions we should first ask what is the aetiologic question? There are two possibilities:

- 1) Does the intervention reduce the risk of mortality?
- 2) Does a low fat diet reduce the risk of mortality?

$E^*$  is randomly assigned so no parents. Given treatment allocation, compliance may depend on the treatment assigned and underlying health status ( $U$ ).

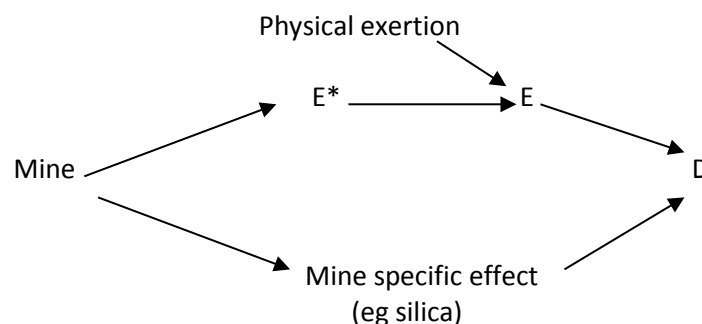
If the first question is the one of interest then a crude analysis of the association between  $E^*$  and  $D$  will give an unconfounded estimate of the causal effect (of the intervention).

If  $U$  is unmeasured we cannot obtain an unconfounded estimate of the causal effect of  $E$  on  $D$  using “standard” methods. However, these are precisely the circumstances in which the instrumental variables approach might be applied.

However please note that, since the crude OR between  $E$  and  $D$  differs from that adjusted for  $E^*$ , there should be also an effect from  $E^*$  to  $D$ , as it could be in an unblinded RCT. Or there might be some risk factor for  $D$  affecting randomization: for example, poor randomization concealment.

## Scenario III

### Proposed causal diagram



Note that  $E^*$  is associated with  $D$  conditional on  $E$ . Since  $E^*$  can only be a cause of  $D$  via  $E$ , there must be some other mine-specific factor which is an independent cause of  $D$ . Robins proposes silica as a possibility. Given this causal diagram an analysis adjusted for  $E^*$  would be the appropriate analysis.