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Use of Causal Diagrams to Inform the Design and Interpretation of Observational Studies: An Example from the Study of Heart and Renal Protection (SHARP)

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Abstract

Observational studies often seek to estimate the causal relevance of an exposure to an outcome of interest. However, many possible biases can arise when estimating such relationships, in particular bias because of confounding. To control for confounding properly, careful consideration of the nature of the assumed relationships between the exposure, the outcome, and other characteristics is required. Causal diagrams provide a simple graphic means of displaying such relationships, describing the assumptions made, and allowing for the identification of a set of characteristics that should be taken into account (*i.e.*, adjusted for) in any analysis. Furthermore, causal diagrams can be used to identify other possible sources of bias (such as selection bias), which if understood from the outset, can inform the planning of appropriate analyses. In this article, we review the basic theory of causal diagrams and describe some of the methods available to identify which characteristics need to be taken into account when estimating the total effect of an exposure on an outcome. In doing so, we review the concept of collider bias and show how it is inappropriate to adjust for characteristics that may be influenced, directly or indirectly, by both the exposure and the outcome of interest. A motivating example is taken from the Study of Heart and Renal Protection, in which the relevance of smoking to progression to ESRD is considered.

Epidemiology and outcomes **observational studies** **causal diagrams**
Bias (Epidemiology) **kidney** **Kidney Failure** **Chronic** **Motivation**
Renal Insufficiency **Chronic** **Selection Bias** **Smoking**

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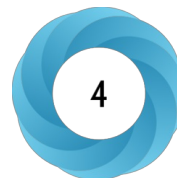
Published online before
print August 2016; doi:
10.2215/CJN.02430316
CJASN March 07, 2017
vol. 12 no. 3 546–552

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