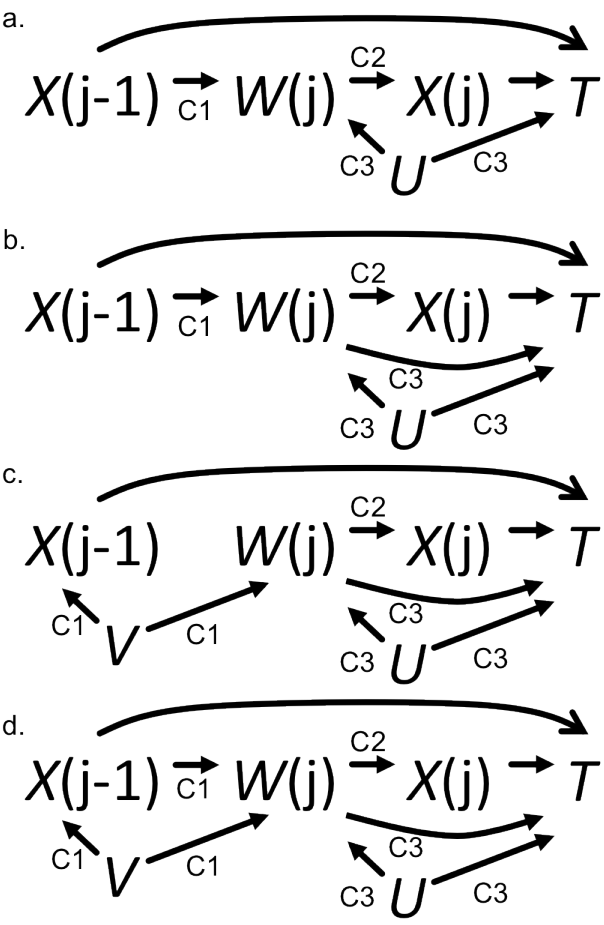
Online Web Supplement to Accompany the Manuscript: Assessing the component associations of the healthy worker survivor bias: occupational asbestos exposure and lung cancer mortality

We note that the causal diagram presented in Figure 1 is not the only causal structure that is consistent with the healthy worker survivor bias. Here we present four figures that represent a non-exhaustive set of observationally equivalent graphs of the healthy worker survivor bias. Formally, two causal diagrams are observationally equivalent if and only if they contain the same skeleton and colliders [1, p19, Theorem 1.2.8]. Figure A2a represents the same causal structure as in Figure 1 of the main text. In Figure A2b, an additional arrow is added from *W*(j) to *T*, suggesting a direct causal effect of leaving work on lung cancer mortality. In Figure A2c, component C1 is replaced by some unmeasured common cause *V*. And in Figure A2d, component C1 is represented by both a direct effect of exposure on work status, as well as an association due to some unmeasured common cause.

Figure A2



A key implication of these graphs is that the healthy worker survivor bias is consistent with a number of different possible mechanisms that may occur in the workplace. However, these diagrams all represent time-varying confounding affected by prior exposure [2]. Thus, as explained in the main text, for Figures A2a-A3d, not adjusting for employment status results in a confounded exposure effect estimate, while adjusting for employment status results in collider stratification bias. In all scenarios, the method proposed in the main text would apply. Moreover, for each scenario, if the proposed method indicates the presence of components C1-C3, then g-estimation of a structural nested model or the parametric g-formula could be used to resolve the bias.

1. Pearl J. Causality: Models, Reasoning and Inference. Cambridge: Cambridge University Press; 2000.
2. Hernán MA, Hernández-Diaz S, Robins JM. A structural approach to selection bias. Epidemiology. 2004;15(5):615-25.