

### **Modelling Interactions between Multiple Causes of Death Using Causal Pies**

Most people die from at least two causes of death. However, the interplay between individual diseases within cause of death sets remains largely unexplored, leading to a limited understanding of the importance of individual conditions recorded on the death certificates. This contribution focuses on application of sufficient component cause models (also known as causal pie models) to (i) identify the diseases that contribute most significantly to death, and (ii) model the causal pathways to death. We work with individual cause-of-death data from the US and Czechia, along with Czech morbidity data from health registries. Our results highlight the critical role of diabetes and other respiratory diseases in COVID-19 deaths, as well as their interactions with dementia and ischemic heart disease, with 10% of COVID-19 deaths resulting from mechanisms involving these diseases. Next, the interplay among leading triads of cardiovascular causes—underlying, contributory, and immediate—differs depending on (i) whether the relationship between the underlying and immediate cause is influenced by the contributory cause, (ii) whether the immediate cause results from the underlying cause, and (iii) whether there is an interaction between contributory and underlying causes in their influence on the immediate cause.

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