Analyzing Relationships Among Features of Diabetes-Induced Cerebral Microvascular Disease Using Causal Inference Methods

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Type 2 diabetes mellitus (T2DM) is a debilitating condition affecting 462 million people worldwide and puts those affected at risk of developing more severe diseases, including Alzheimer's and stroke. T2DM is strongly linked to cerebral microvascular disease (CVD), which drastically decreases the brain's blood flow and oxygen supply, increasing the risk of the aforementioned diseases. However, while features of CVD have been previously investigated, the exact relationships among these features are unknown, and how one feature may cause another is uncertain. Defining more precise connections among these features would allow physicians to better detect CVD-induced diseases and enable earlier treatment for patients. In this work, causal inference methods of machine learning were applied to better understand relationships between diabetes severity, gender, inflammation, and cerebral hypoperfusion. Specifically, a Bayesian network algorithm and a new method utilizing logic from Granger causality were implemented on data from subsets of a Physionet data set. Diabetes severity and specific inflammation biomarkers were found to be significant, and differences in cerebral vasoreactivity correlations were shown in males and females. While causal inference methods have not been extensively applied to this particular issue previously, this work shows that these methods have extreme potential for uncovering relationships in features of CVD, aiding medical practitioners in their treatments for those suffering from a T2DM- or CVD-induced disease.

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