

INTRODUCTION/MOTIVATION

Pregnancy is a unique developmental period in a woman's life, characterized by numerous psychological, behavioural, and biological changes. Maternal history of adverse childhood experiences (ACE) before 18 has been shown to exert distal effects on the mental health of women.

This study aims to explore the relationships between ACEs and pregnancy-related mental health symptoms and learn how they can impact the pregnancy journey and outcomes. The specific objectives of this study are to explore:

- How Adverse Childhood Experiences affect pregnancy related depression, anxiety, and quality of life.
- The nature of interrelationships between mental health related symptoms during and after pregnancy.

DATASET

Better Understanding of the Metamorphosis of Pregnancy (BUMP) Study Dataset:

- The BUMP study is a longitudinal feasibility study aimed to gain a deeper understanding of the pre-pregnancy and pregnancy experience using digital tools
- Participants are provided with an Oura smart ring, a Garmin smartwatch, and a Bodyport smart scale alongside study apps to capture various physiological and psychological symptoms.
- 4 surveys are used for the causal discovery analysis, as shown below:

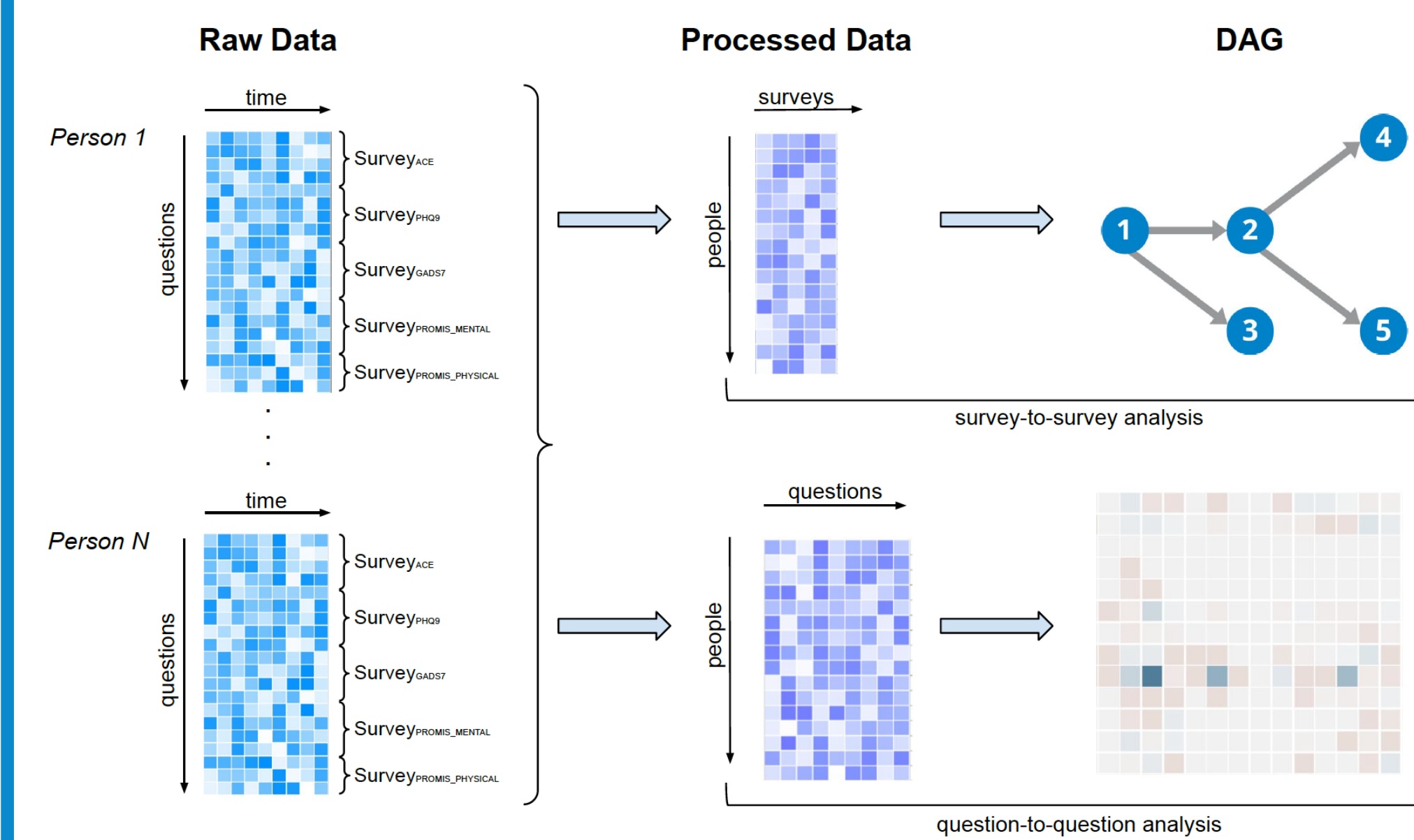
Survey	Frequency
PHQ-9	Every 2 week
GADS-7	Every 2 week
PROMIS Global-10	Every 4 week
ACE	First check-in

- Those surveys were established as the gold standard in literature in measuring depression and anxiety disorders, mental and physical well-being.

METHODS

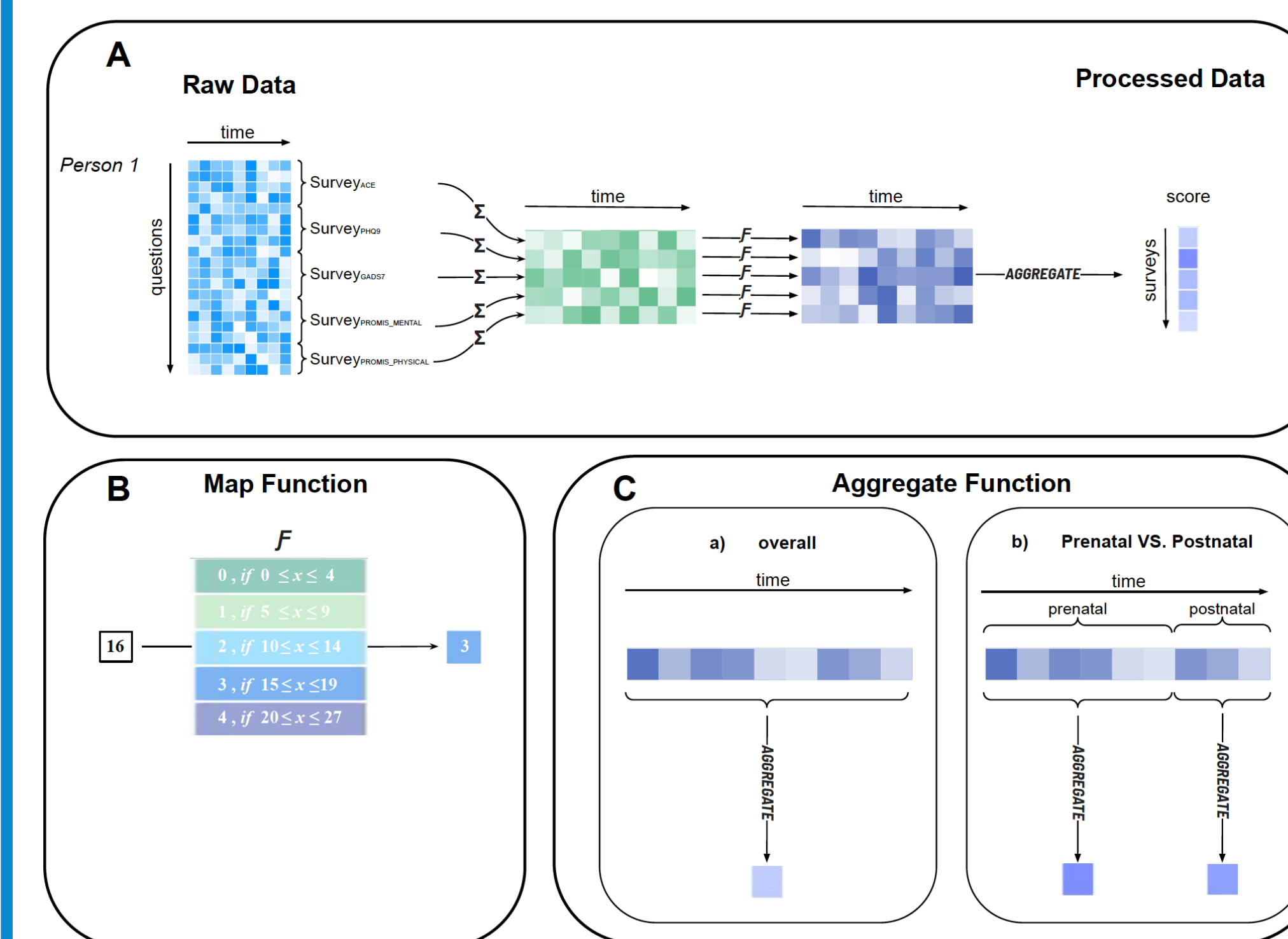
Algorithm Overview:

A conceptual schematic diagram below shows how DAGs are generated using raw survey data. (**Top left:** survey-to-survey analysis, which viewed each survey as a node. **Bottom left:** question-to-question analysis, where each question in each survey is a node.)



Survey-to-survey Analysis Preprocessing:

- For a patient, question scores were first summed up in each survey, then mapped to a survey score by \mathcal{F}_s . The survey scores were aggregated across time.
- An example map function \mathcal{F}_s taking 16 as input, outputting 3 under the conditions.
- Two ways of aggregating survey scores across time: a) is across all time; b) is separated by delivery into two time intervals.



RESULTS

The result of survey-to-survey analysis is shown in Figure 1. To better interpret results, we look at edges with strong connections with a weight greater than 0.5. Here, the result implies that adverse childhood event affects anxiety which can also affect depression. Results also reveal that depression can lead to bad quality of life from a mental health perspective. The DAG also illustrates that mental health can affect physical health during pregnancy.

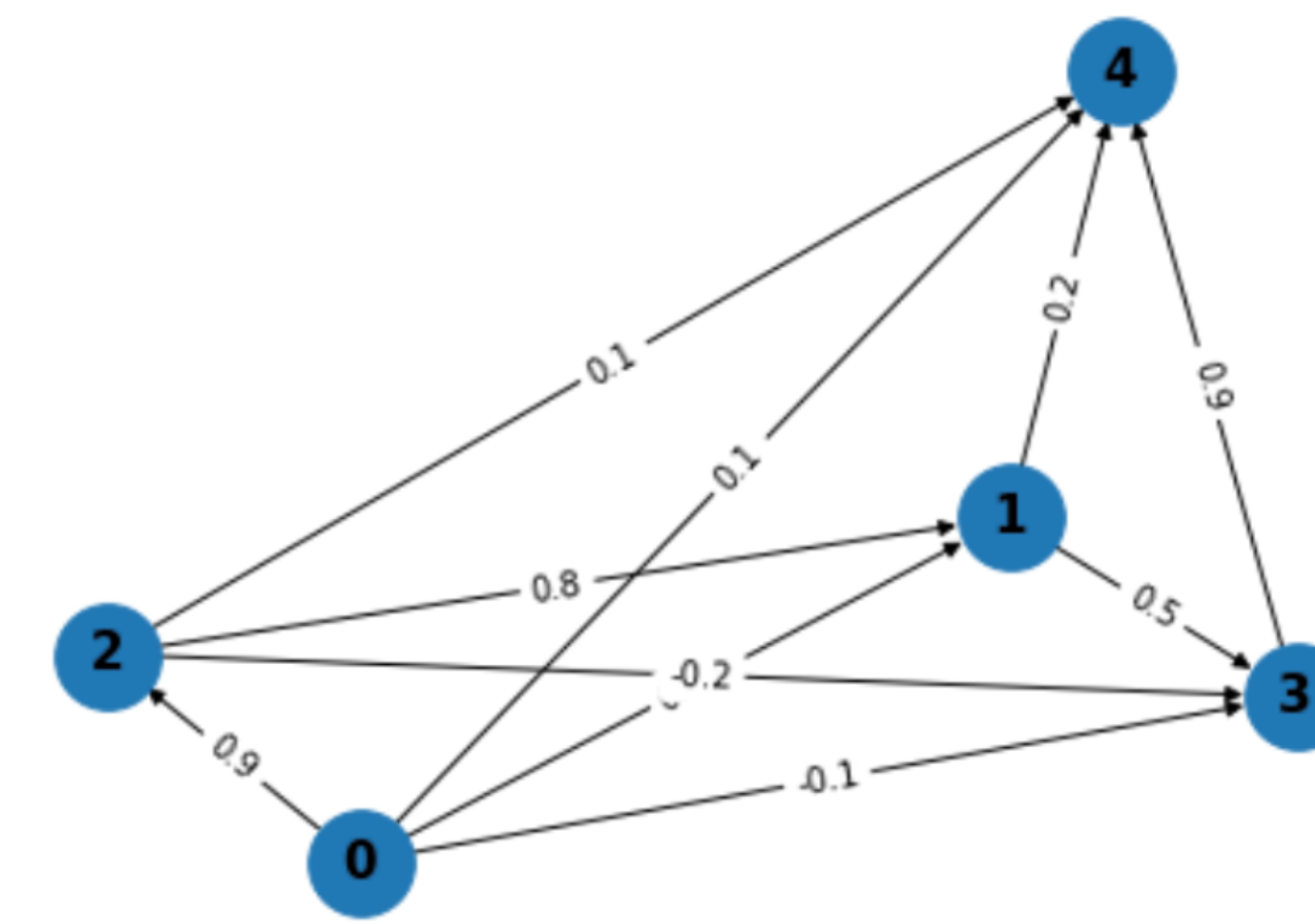


Figure 1: Survey-to-survey analysis: the DAG generated by the DAGs with NO TEARS algorithm. Note that node 0 is ACE; node 1 is PHQ-9; node 2 is GADS; node 3 is PROMIS Global 10 - Mental; node 4 is PROMIS Global 10 - Physical.

FUTURE RESEARCH

- There are inherent limitations in inferring causality from observational data. The presence of confounding variables, selection bias, and other sources of bias can make it difficult to establish causal relationships with certainty.
- An association framework would involve using correlational analyses, to quantify the strength and direction of the relationship between ACEs and mental health symptoms. It could also involve exploring potential moderators or mediators of the relationship to better understand the factors that may influence this association.

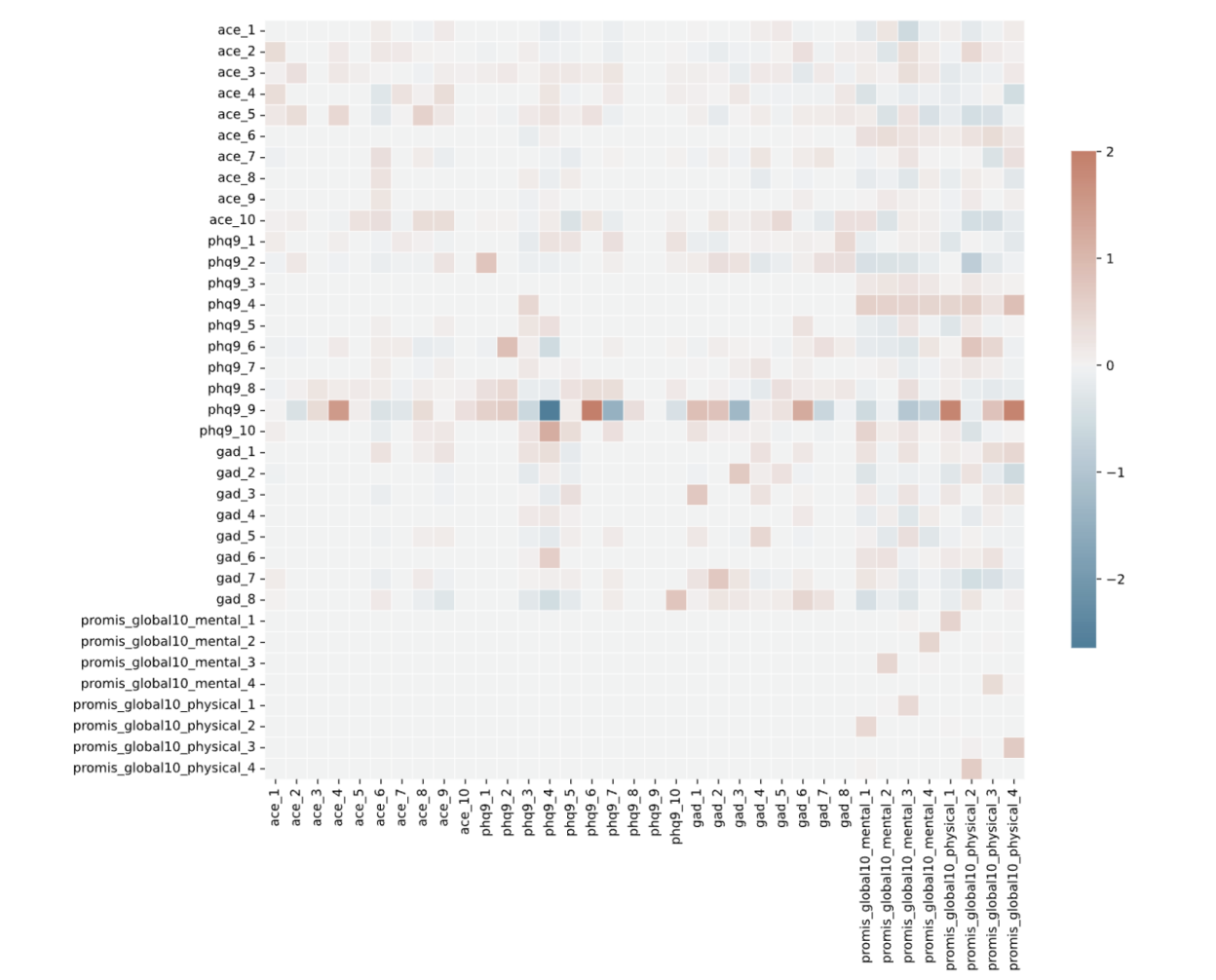


Figure 2: Question-to-question analysis: the DAG generated from the DAG with NO TEARS algorithm over all time. The direction of the edges are from variables on rows to columns. The variables are: questions in ACE, PHQ-9, GAD-7, PROMIS-mental, and PROMIS-physical.

The result of question-to-question analysis is shown in Figure 2. As shown in this figure, question 9 from the PHQ-9 survey has stronger edge weights leading to other questions. It asks participants the following: over the last 2 weeks, how often have you had Thoughts that you would be better off dead or of hurting yourself in some way. Compared with other questions in these surveys, which mostly asked about sleep and eat, this question would reflect an extremely severe symptom if answered "yes".

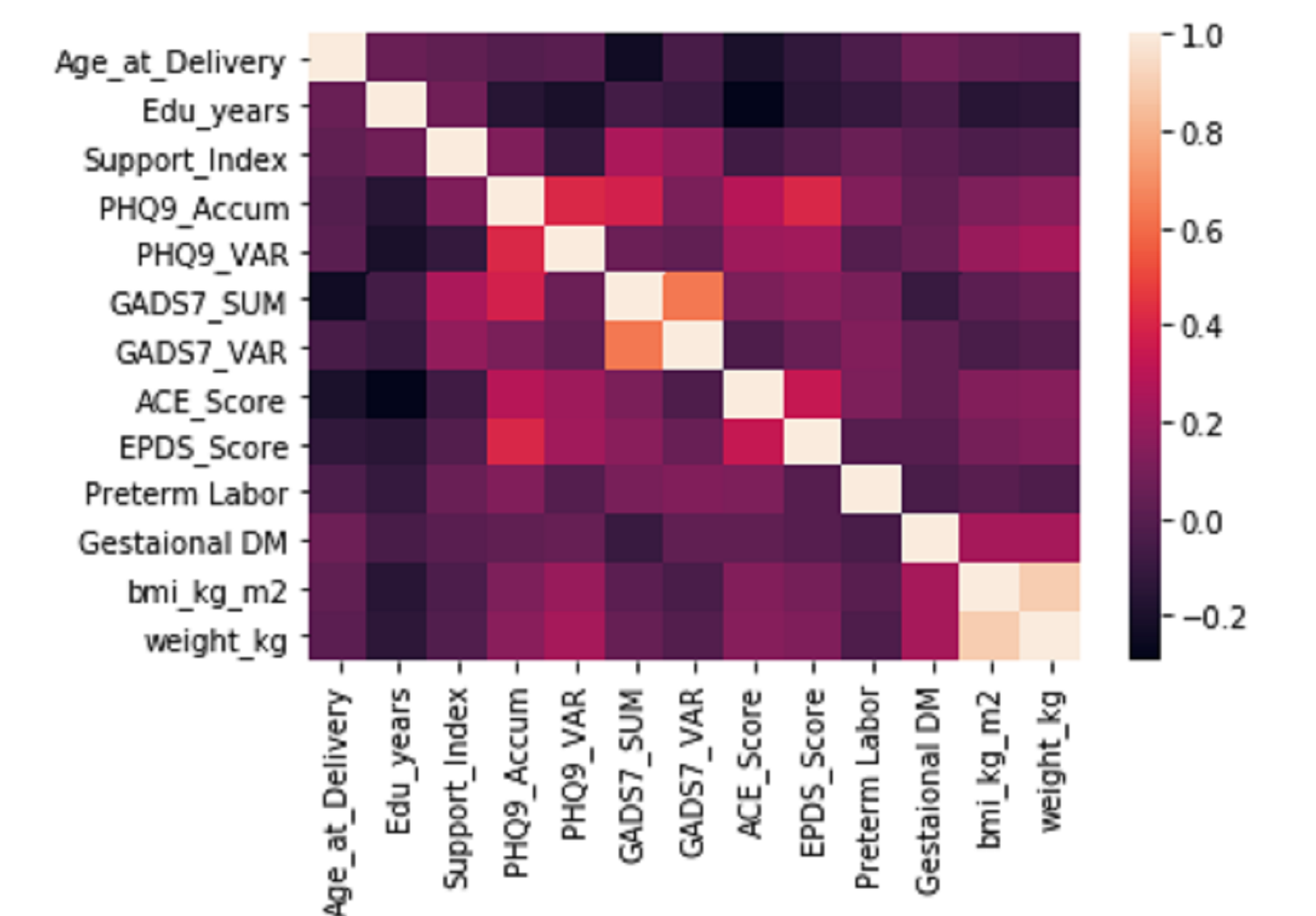


Figure 3: Correlation between ACE, Mental Health, Demographics, Physical Health, and Pregnancy Complications