

A Multi-Method Causal Discovery Study

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1. Background

- MHL is multidimensional and context-dependent.
- Existing studies largely rely on theory-driven causal assumptions.
- Interactions among MHL components remain unclear across populations (Soria-Martinez et al., 2023).

2. Research Objective

To infer potential causal relationships among mental health literacy dimensions using data-driven causal discovery methods.

3. Data and Measures

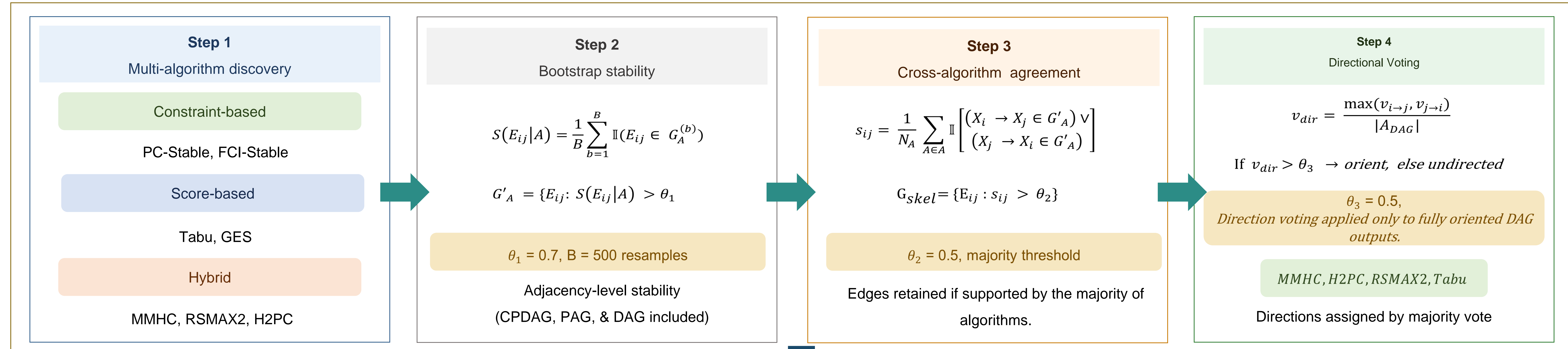
Study Design: Cross-sectional survey at an institute level

Variables: 6 MHL indicators

Sample: 385 participants (academic institution)

Instrument	MHL Dimensions
MAKS Mental Health Knowledge Schedule	Awareness of recovery, social inclusion, and mental health conditions
BMI Beliefs Toward Mental Illness	Negative beliefs toward mental illness
MHSAS Mental Help-Seeking Attitudes Scale	Attitude towards seeking professional help

4. Methodology: Multi-algorithm ensemble framework for robust structure learning



Final Consensus Causal Graph

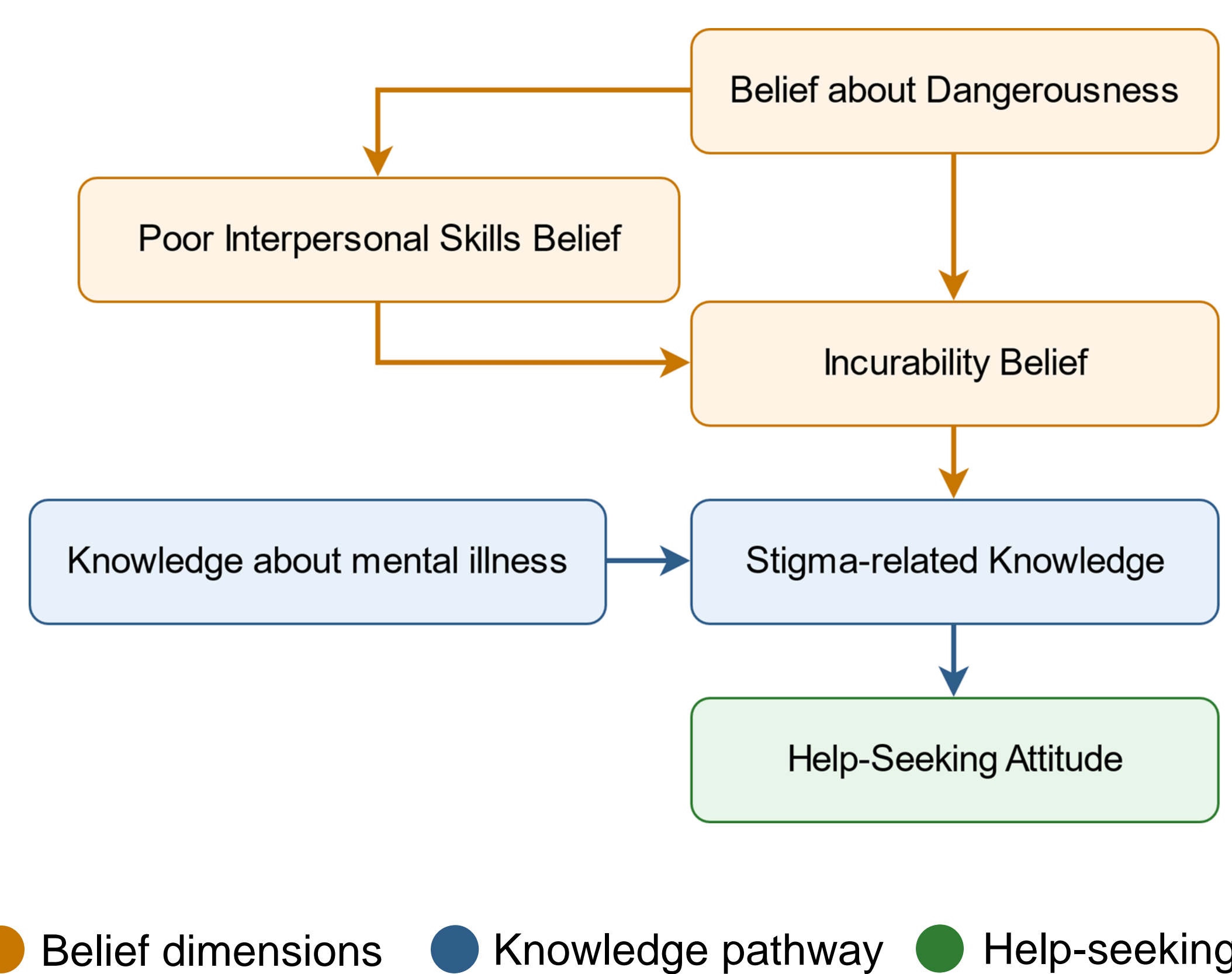
Stable under resampling

Robust across algorithmic assumptions

Directions by majority votes

Notes: PC-Stable: Peter-Clark algorithm, stable model, FCI: Fast Causal Inference, GES: Greedy Equivalence Search, MMHC: Max Min Hill Climbing, H2PC: Hybrid Parents and Children algorithm, RSMAX2: General 2-Phase Restricted Maximization
CPDAG: Completed Partially Directed Acyclic Graph, PAG: Partial Ancestral Graph, DAG: Directed Acyclic Graph

5. Results



Consensus causal graph inferred from observational data

6. Key Insights

- Ensemble discovery reduced dependence on single-model assumptions under theoretical uncertainty.
- Two independent upstream pathways (Belief and Knowledge).
- Stigma-related knowledge emerged upstream of help-seeking attitudes.
- Belief dimensions formed a distinct directed pathway
- Final graph retained only stable cross-method relationships.

References

- Constantinou, A., Kitson, N. K., Liu, Y., Chobtham, K., Amirkhizi, A. H., Nanavati, P. A., Mbuva, R., & Petrunaro, B. (2023). Open problems in causal structure learning: A case study of covid-19 in the uk. *Expert Systems with Applications*, 234, 121069. <https://doi.org/10.1016/j.eswa.2023.121069>
- Soria-Martinez, M., Navarro-Pérez, C. F., Pérez-Ardanaz, B., & Martí-García, C. (2023). Conceptual framework of mental health literacy: Results from a scoping review and a delphi survey. *International Journal of Mental Health Nursing*, 33(2), 281–296. <https://doi.org/10.1111/inm.13249>

7. Policy & Practical Implications

- Dual-pathway design: address beliefs AND knowledge as separate intervention targets.
- Supports resource prioritization in limited-budget MHL programs.
- Enables stepped-care intervention frameworks.

8. Conclusion

- Integrated stability assessment and ensemble agreement.
- Framework adaptable across diverse application domains.
- Findings remain context-specific and exploratory.
- Longitudinal and external validation are required.

