Modelling the deep learning and hybrid machine learning for indoor air pollution's Effect on maternal on maternal and child health in South Asia

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Abstract:

Over the past ten years, the significance of indoor air quality as a determinant of health outcomes has gained considerable international attention, with women and young children being the most vulnerable. Moving beyond conventional analytical techniques, this research applies a novel Bayesian Neural Network (BNN) model to investigate the complex drivers of nutritional deficits in mother-child pairs across South Asia, with a specific focus on exposure to contaminants from domestic fuel use. The probabilistic framework of the BNN, implemented via the PC algorithm, identifies a robust link between the use of solid fuels for cooking and worsened nutritional status, confirming that such pollution is a major aggravating factor for malnourishment.

The model's architecture further elucidates critical conditional relationships. The nutritional health of both mothers and their offspring is shown to be directly influenced by household air pollution, an effect that is modulated by the type of residence (urban or rural). Other factors, including a mother's workforce participation, her educational attainment, and the household's water and sanitation facilities, also demonstrate a conditional effect on nutrition that is dependent on the economic status of the family. For maternal outcomes specifically, health is conditionally shaped by the frequency of prenatal healthcare visits and the household's wealth index, with the setting of residence acting as a key modifier. A child's nutritional status, meanwhile, is conditionally dependent on the mother's Body Mass Index and the child's birth order, with the magnitude of these effects being influenced by the mother's employment and education levels. These nuanced findings offer a new perspective distinct from earlier work. The study concludes by highlighting the urgent necessity for public health strategies that accelerate the transition to cleaner household energy sources throughout the region.

Keywords: Bayesian neural network, Deep learning, Undernutrition, Indoor air pollution, SHAP Analysis, Boruta Method, South Asia.