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PhD Dissertation Defense

Entitled

INTELLIGENT AND EXPLAINABLE SYSTEM TO PREDICT INFANT BIRTHWEIGHT AND PRETERM BIRTH IN THE UNITED ARAB EMIRATES

by

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Abstract

Adverse pregnancy outcomes such as Low Birth Weight (LBW) and Preterm birth (PTB) are complex pregnancy challenges that can lead to high perinatal mortality and long-term morbidity for infants. Early prediction of such adverse outcomes can be useful for averting catastrophic outcomes for the mother and her baby. With advances in machine learning (ML)-based algorithms, several models have been proposed for both PTB and LBW prediction. However, the risk factors associated with these outcomes are still unknown, particularly in the United Arab Emirates (UAE). Furthermore, existing ML-based prediction models work in a black-box manner and lack proper interpretations for clinicians, which limits their use in clinical settings. Also, the current ML models are unable to capture the structural inter-relationship among the patients in a tabular dataset. Therefore, to address these challenges, we proposed an intelligent system to identify important risk factors and predict adverse pregnancy outcomes using explainable ML models. In addition, to improve the classification performance and explainability, we transformed the tabular data into a knowledge graph structure and extracted graph embedding features. A dataset of 3,509 pregnant women (2708 parous and 801 nulliparous) from the Emirati population in the UAE was analyzed. Important risk factors were selected based on literature and medical justification. Extensive experimental results show that our proposed method achieved promising performance, with an AUC of 0.834 which is 6% higher compared to traditional ML methods. We identified main risk factors such as previous preterm birth, previous caesarian section, pre-eclampsia, maternal age, BMI, and infection of amniotic sac (during pregnancy). The proposed solution has significant potential for clinical use as a screening tool for LBW and PTB prediction in the UAE, particularly for the Emirati population. Our system offers personalized patient analysis that can assist clinicians in understanding the impact of each risk factor on each patient, allowing for personalized care to reduce morbidity and mortality. By identifying important risk factors and providing a more explainable approach, our system has the potential to improve maternal and neonatal health outcomes in the UAE.

Keywords: Adverse pregnancy outcomes, Low birth weight, preterm birth, Explainable Machine learning, Knowledge graph.