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Proposing a machine-learning based method to predict stillbirth before and during delivery and ranking the features: nationwide retrospective cross-sectional study

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Abstract

Background: Stillbirth is defined as fetal loss in pregnancy beyond 28 weeks by WHO. In this study, a machine-learning based method is proposed to predict stillbirth from livebirth and discriminate stillbirth before and during delivery and rank the features.

Method: A two-step stack ensemble classifier is proposed for classifying the instances into stillbirth and livebirth at the first step and then, classifying stillbirth before delivery from stillbirth during the labor at the second step. The proposed SE has two consecutive layers including the same classifiers. The base classifiers in each layer are decision tree, Gradient boosting classifier, logistics regression, random forest and support vector machines which are trained independently and aggregated based on Vote boosting method. Moreover, a new feature ranking method is proposed in this study based on mean decrease accuracy, Gini Index and model coefficients to find high-ranked features.

Results: IMAN registry dataset is used in this study considering all births at or beyond 28th gestational week from 2016/04/01 to 2017/01/01 including 1,415,623 live birth and 5502 stillbirth cases. A combination of maternal demographic features, clinical history, fetal properties, delivery descriptors, environmental features, healthcare service provider descriptors and socio-demographic features are considered. The experimental results show that our proposed SE outperforms the compared classifiers with the average accuracy of 90%, sensitivity of 91%, specificity of 88%. The discrimination of the proposed SE is assessed and the average AUC of ±95%, CI of 90.51% ±1.08 and 90% ±1.12 is obtained on training dataset for model development and test dataset for external validation, respectively. The proposed SE is calibrated using isotopic nonparametric calibration method with the score of 0.07. The process is repeated 10,000 times and AUC of SE classifiers using random different training datasets as null distribution. The obtained *p*-value to assess the specificity of the proposed SE is 0.0126 which shows the significance of the proposed SE.

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