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Distributed Big Data Analytics Method for the Early Prediction of the Neonatal 5-Minute Apgar Score before or during Birth and Ranking the Risk Factors from a National Dataset

Toktam Khatibi [1,*], Ali Farahani [2], Mohammad Mehdi Sepehri [1] and Mohammad Heidarzadeh [3]

[1] School of Industrial and Systems Engineering, Tarbiat Modares University (TMU), Tehran 1411713114, Iran; mehdi.sepehri@modares.ac.ir
[2] Computational Analysis and Modeling, Louisiana Tech University, Ruston, LA 71272, USA; afa011@email.latech.edu
[3] Neonatology, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz 5166614766, Iran; heidarzadeh_2013@yahoo.com
* Correspondence: toktam.khatibi@modares.ac.ir; Tel.: +98-2182883913

Abstract: One-minute and five-minute Apgar scores are good measures to assess the health status of newborns. A five-minute Apgar score can predict the risk of some disorders such as asphyxia, encephalopathy, cerebral palsy and ADHD. The early prediction of Apgar score before or during birth and ranking the risk factors can be helpful to manage and reduce the probability of birth producing low Apgar scores. Therefore, the main aim of this study is the early prediction of the neonate 5-min Apgar score before or during birth and ranking the risk factors for a big national dataset using big data analytics methods. In this study, a big dataset including 60 features describing birth cases registered in Iranian maternal and neonatal (IMAN) registry from 1 April 2016 to 1 January 2017 is collected. A distributed big data analytics method for the early prediction of neonate Apgar score and a distributed big data feature ranking method for ranking the predictors of neonate Apgar score are proposed in this study. The main aim of this study is to provide the ability to predict birth cases with low Apgar scores by analyzing the features that describe prenatal properties before or during birth. The top 14 features were identified in this study and used for training the classifiers. Our proposed stack ensemble outperforms the compared classifiers with an accuracy of 99.37 $\pm$ 1.06, precision of 99.37 $\pm$ 1.06, recall of 99.50 $\pm$ 0.61 and F-score of 99.41 $\pm$ 0.70 (for confidence interval of 95%) to predict low, moderate and high 5-min Apgar scores. Among the top predictors, fetal height around the baby's head and fetal weight denote fetal growth status. Fetal growth restrictions can lead to low or moderate 5-min Apgar score. Moreover, hospital type and medical science university are healthcare system-related factors that can be managed via improving the quality of healthcare services all over the country.

Keywords: Apgar score prediction; big data; distributed feature selection; distributed classification; stack ensemble

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1. Background

The Apgar score has been measured at 1 and 5 min after birth for neonates, and they are good predictors of birth outcome [1,2]. Apgar score ranges from 0 to 10 points, and its higher values are more desired. The Apgar scores have been considered as standardized, effective and convenient assessments for newborn infants, with widespread application by obstetricians.

An Apgar score of 7 or higher shows that the newborn has good to excellent health situations. Low Apgar scores at 5 min after birth have been diagnosed as an important risk factor poor survival for neonates [3], birth asphyxia [4] and ADHD [5].

Moreover, previous studies have shown that neonates having low 1-min or 5-min Apgar scores have been more likely to have a low IQ score [6]. Other previous studies have