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Published in:
Digital Health and Informatics Innovations for Sustainable Health Care Systems

DOI (link to publication from Publisher):
10.3233/SHTI240770

Publication date:
2024

Document Version
Publisher's PDF, also known as Version of record

Digital Health and Informatics Innovations for Sustainable Health Care Systems
J. Mantas et al. (Eds.)

doi:10.3233/SHTI240770

Prediction of Poor Glycemic Control in Children with Type 1 Diabetes

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Abstract. This study developed and validated a machine learning model for predicting glycemic control in children with type 1 diabetes at the time of diagnosis, revealing age at diagnosis as the most informative predictor.

Keywords. Type 1 diabetes, children, glycemic control, decision support

1. Introduction

Prediction of poor glycemic control in children with type 1 diabetes (T1D) can facilitate early intervention to mitigate long-term complications [1]. Machine learning models are a powerful tool for such predictions [2,3]. This study aimed to develop and validate a machine learning model for the prediction of glycemic control in children with T1D using data collected at the time of diagnosis.

2. Methods

Data were extracted retrospectively from Danish pediatric subjects diagnosed with T1D between 2020-2022 at ages 1-19 years. Inclusion required at least one hemoglobin A1c (HbA_{1c}) measurement within two weeks of diagnosis and at least one additional HbA_{1c} measurement 2-10 months after diagnosis.

Extracted features were gender, age, municipality, affiliated hospital, and baseline HbA_{1c}. Poor glycemic control was defined as mean HbA_{1c} 2-10 months after diagnosis above 53 mmol/mol. The model was based on multiple logistic regression with forward feature selection, and performance was assessed using the area under the receiver operating characteristic curve (AUROC). Additionally, a correlation analysis between the most informative feature and the mean HbA_{1c} 2-10 months after diagnosis was conducted.

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3. Results

A total of 100 subjects were included (56% being male; age at diagnosis: 10.48±4.63 years), and 78% were in glycemic control 2-10 months after diagnosis. The best feature combination was age at diagnosis, municipality, and baseline HbA_{1c} (AUROC: 0.89, Figure 1). Age at diagnosis, the most informative feature, showed a statistically significant nonlinear correlation with mean HbA_{1c} 2-10 months after diagnosis ($p<0.0001$). Thus, both younger and older ages at diagnosis were associated with a higher risk of future poor glycemic control.

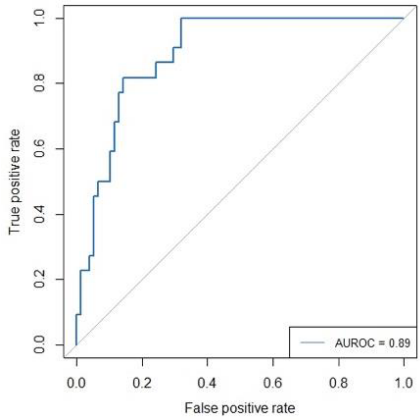

Figure 1. Receiver operating characteristic curve for the multiple logistic regression model.

4. Discussion and Conclusions

The model demonstrated acceptable performance in predicting poor glycemic control in children with T1D using data collected at diagnosis. While age at diagnosis was the most informative feature, its association with glycemic control may be influenced by additional unconsidered variables related to life phases and circumstances, highlighting the need for future research to enhance model performance. In conclusion, the model has the potential to improve glycemic control among children with T1D at risk of future poor glycemic control. However, caution is warranted, as the model's performance lacks validation on independent test data.

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