Automatic Detection Of Pathological Signs In Newborns Through AI And Cry Analysis For Assessing Infant Health Status

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Background

Early identification of pathological conditions in newborns is essential for timely and effective medical intervention. High-pitched, weak or hoarse cry is often considered a relevant variable used in assessments for neurological conditions and for pain, discomfort, or irritability. Nevertheless, these observations remain subjective and qualitative, often requiring a high level of expertise.

Aims

The purpose of this research is to develop an Artificial Intelligence (AI) algorithm capable of differentiating between the cries of healthy newborns (HC) and those with pathological conditions (PC) supporting neonate's health assessment.

Methods

Participants

38 Healthy Full-term newborns (HC) - mean GA 38.5 weeks ± 1.23

20 newborns with Pathological Conditions (PC) - mean GA 30.5 weeks ± 5.58

Pathologies:

- respiratory diseases (RDS, BPD, tachypnea, apnea)
- brain injuries (IVH, cerebral infarctions)
- infection
- metabolic disorders (hypoglycemia, multifactorial anemia, hypothyroidism)
- congenital malformations
- gastrointestinal complications

Dataset

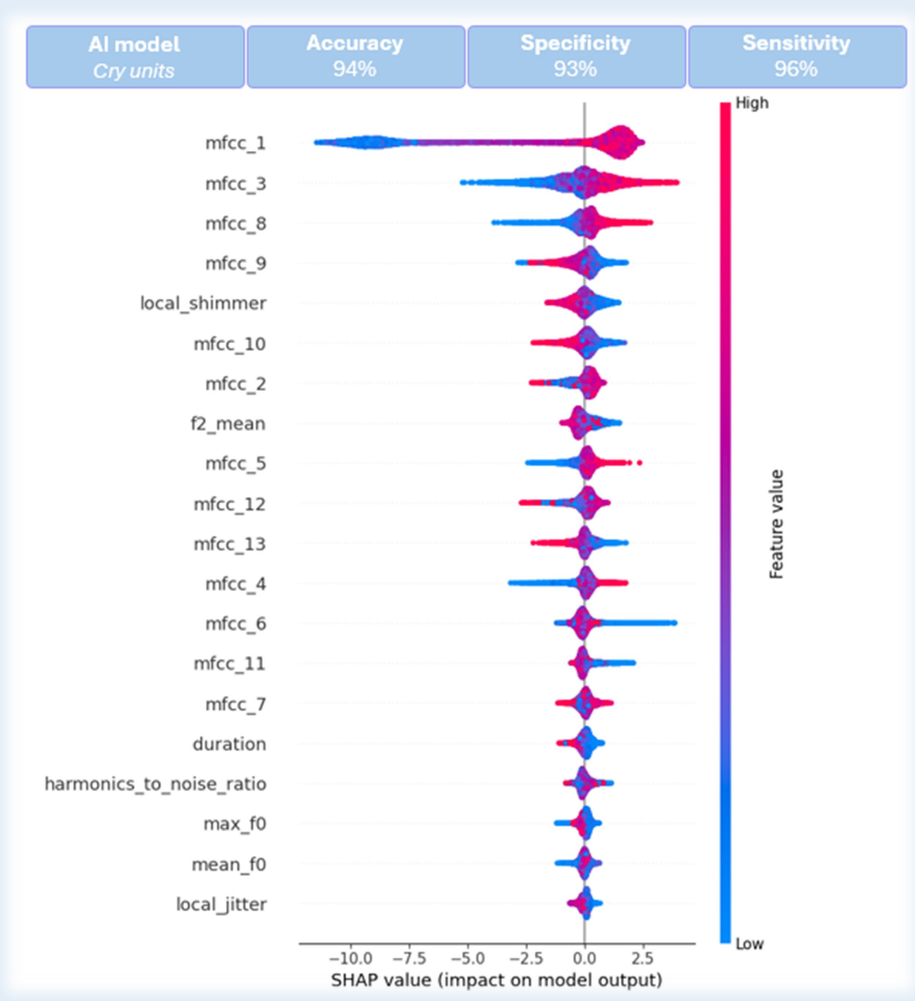
Cry Audio Recordings (12k cry units)

Methodology

- Audio features:
  - Fundamental Frequency (F0) and descriptives metrics
  - % Hyperphonation % High pitch, Harmonic Noise Ratio (HNR), Jitter, Shimmer, Formants, Cry Unit Duration
  - Mel-Frequency Cepstral Coefficients (MFCCs)
- Machine Learning (ML)

Findings

The gradient-boosted decision tree was employed to categorize the cry units into HC and PC. The ML algorithm demonstrated a high level of accuracy, achieving 94% in distinguishing between healthy and pathological cries. The analysis revealed that the most important features are related to the voice quality, energy and physiological aspects of the vocal tract.



Conclusions

This study highlights the potential of cry analysis as a quantitative, objective, accessible and non-invasive tool supporting the early identification of health issues in newborns, applicable in clinical settings.

Future research should focus on expanding to include a broader range of pathological conditions and integrating cry analysis with other clinical markers to move forward into precision medicine.

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