



Explainable hybrid convolutional and transformer network for pediatric sleep apnea diagnosis using nocturnal oximetry



C. García-Vicente, G.C Gutiérrez-Tobal, J. Gómez-Pilar, F. Vaquerizo-Villar, A. Martín-Montero, M. Domínguez-Guerrero, D. Gozal, R. Hornero

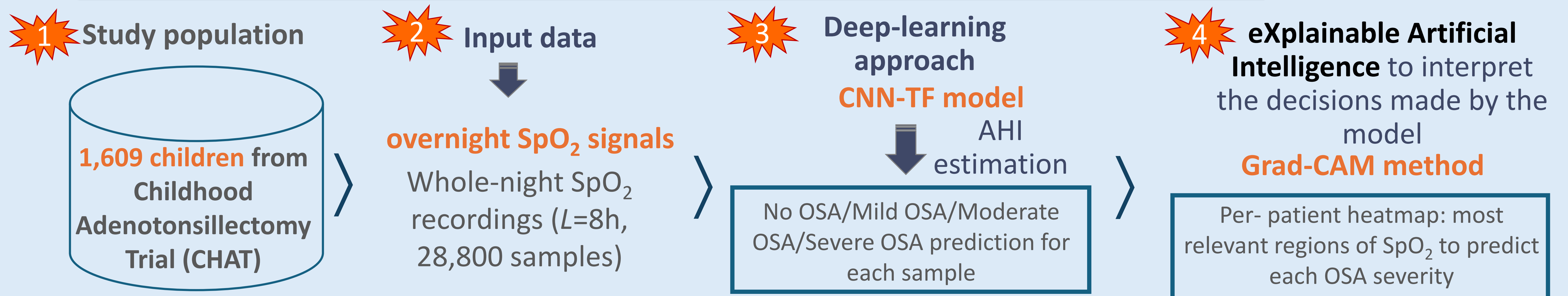
Background

- Pediatric obstructive sleep apnea (OSA) is a common respiratory disorder that leads to intermittent hypoxemia and desaturation-reoxygenation patterns in oxygen saturation (SpO_2).
- Polysomnography (PSG), the standard diagnostic method, is costly, complex, and inconvenient, particularly for children. Therefore, a timely and precise diagnosis is of utmost importance.

Objective

This study assesses the effectiveness of an **interpretable hybrid convolutional neural network and transformer (CNN-TF)** model, by **overnight SpO_2** to **estimate the 4 OSA severities** (no OSA, mild OSA, moderate OSA, and severe OSA) and **uncover relevant SpO_2 patterns** associated with the disease.

Materials and Methods



Key Results

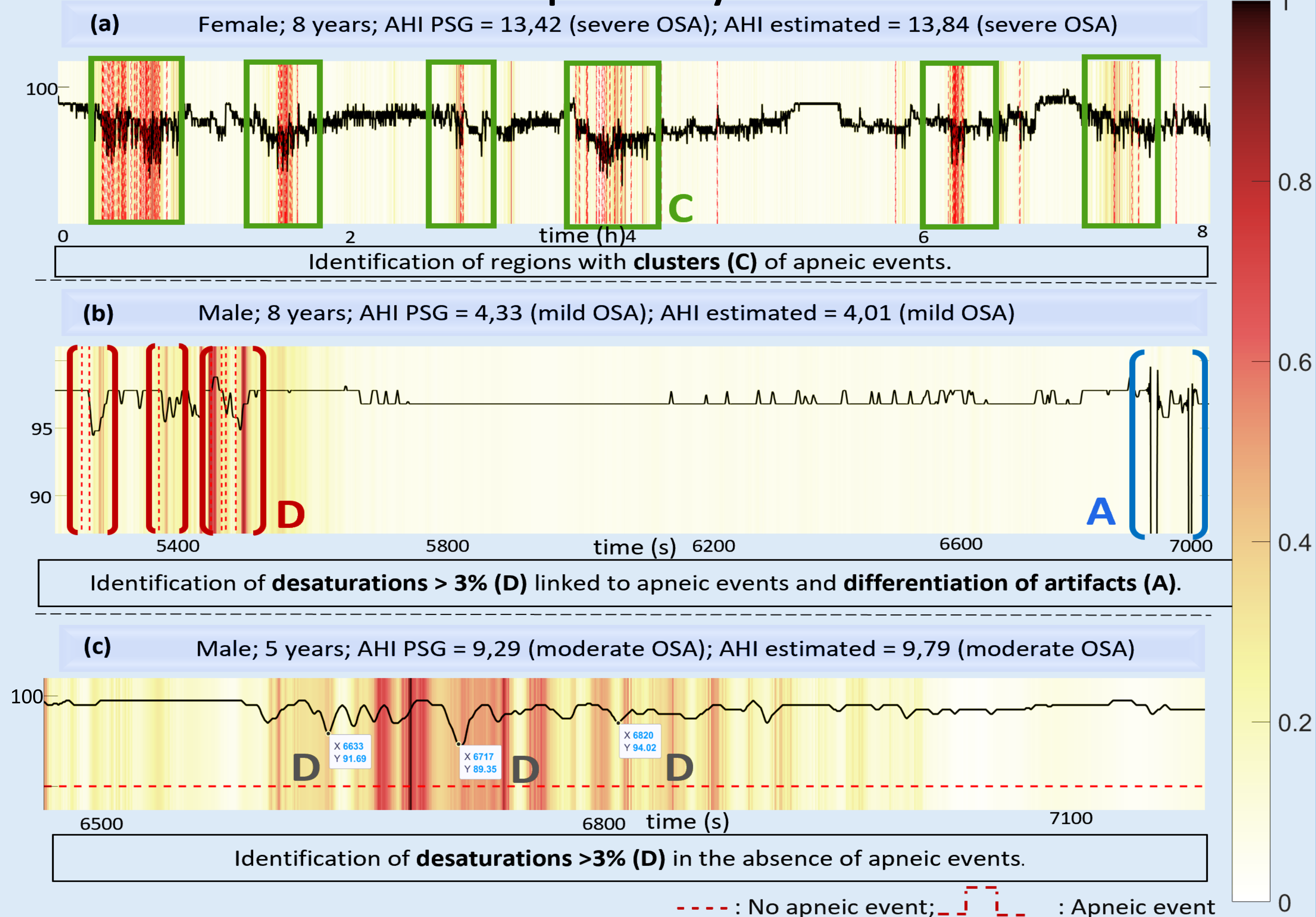
Diagnostic performance

Cohen's 4-class kappa
0.529

4-class accuracy
68.56%

| AHI cutoff | Se | Sp | LR ⁺ | Acc |
|------------|------|------|-----------------|------|
| 1e/h | 90.6 | 50.8 | 1.8 | 81.9 |
| 5e/h | 85.6 | 93.3 | 12.8 | 91.0 |
| 10e/h | 80.5 | 96.9 | 26.0 | 94.7 |

Model interpretability



Conclusions

Integrating an interpretable CNN-TF model in the analysis of nocturnal SpO_2 provides a reliable diagnosis of pediatric OSA. Grad-CAM was useful for interpreting the proposed model and enabled achieving a deeper understanding of the pathophysiological behavior of SpO_2 related to pediatric OSA.

Acknowledgement

This work is part of the projects PID2023-148895OB-I00, TED2021-131913B-I00, and CPP2022-009735, funded by MCIN/AEI/10.13039/501100011033 and the European Union "NextGenerationEU"/PRTR. This research was also co-funded by the European Union through the Interreg VI-A Spain-Portugal Program (POCTEP) 2021-2027 (0043.NET4SLEEP.2_E), and by "CIBER-Consortio Centro de Investigación Biomédica en Red" (CB19/01/00012) through "Instituto de Salud Carlos III.

