

Obstructive Sleep Apnea Detection Methods Based on Heart Rate Variability Analysis: Opportunities for a Future CinC Challenge

Daniele Padovano, Arturo Martinez-Rodrigo, José M Pastor, José J Rieta, Raúl Alcaraz

Research Group in Electronic, Biomedical and Telecommunication Engineering, University of Castilla-La Mancha, Spain

Background and Aim. Obstructive sleep apnea (OSA) is a sleep disorder with high prevalence in the general population, characterized by repetitive episodes of obstruction of the upper airways during sleep. OSA can cause from mild health disorders, such as grogginess or mental dullness, to more serious complications, like arrhythmias, hypoxemia or even depression. Nowadays, polysomnography (PSG) is still the gold standard for screening OSA, but it requires special facilities and patient's hospital monitoring overnight. To overcome these limitations of PSG, easier and cost-effective diagnosis methods have been explored in last years. This work reviews the latest advances in the evaluation of OSA from the heart rate variability (HRV) perspective to consider its potentialities for a future revisited CinC Challenge.

Methods. A literature research was conducted on several databases, including Web of Science, PubMed, Elsevier's ScienceDirect, IEEEExplorer, Springer, and Scopus. The selected search terms were *sleep apnea*, *detection*, and *heart rate variability*, which were combined with different connectors. Only papers from scientific journals and published after 2015 were reviewed.

Results. A total number of 18 works finally matched the search criteria. Their analysis drew two different research lines. On the one hand, some authors associated HRV features with OSA severity (i.e. the number of apnea episodes per hour). On the other hand, others used HRV features to detect OSA in a minute-by-minute basis. Although accuracy values between 80 and 95% have been reported in both cases, a high number of HRV features, along with other parameters derived from the ECG, have had to be combined with advanced classifiers. Because short databases have only been used for validation of these methods, more efforts are still required to obtain a realistic view of their generalization capability, and thus of their performance in wider contexts.

Conclusions. The proposed HRV-based OSA detectors have reported promising results and revealed insights about the role of sympathetic and parasympathetic systems in apnea events. However, additional research is still required to consider them as potential alternatives to PSG, thus turning this topic into an interesting opportunity for a future revisited CinC Challenge.