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COMMENTARY

The faces of sleep apnea in the age of machine learning

Commentary on Eastwood P, Gilani SZ, McArdle N, et al. Predicting sleep apnea from three-dimensional face photography. *J Clin Sleep Med*. 2020;16(4):493–502. doi:10.5664/jcsm.8246

Ofer Jacobowitz, MD, PhD, FAASM[1]; Stuart MacKay, MD, FRACS[2]

[1]*ENT and Allergy Associates, New York, New York;* [2]*School of Medicine, University of Wollongong, Wollongong, Australia*

Obstructive sleep apnea (OSA) is underdiagnosed and untreated in a significant number of adult patients,[1,2] despite advocacy in the last decade for development and adoption of new methods for diagnosis.[3,4] In the same period, we have witnessed widespread implementation of machine-learning technologies for analysis of "big data" and prediction tools. Artificial intelligence is used for speech recognition on smart phones or home speakers, to detect financial fraud, image recognition in self-driving cars, social media preferences, and for medical and scientific diagnostics. Since OSA is a prevalent condition affecting millions of individuals, it is logical that screening for those at risk of OSA would be easier using machine-learning tools.

In this issue of the *Journal of Clinical Sleep Medicine*, Eastwood and colleagues[5] have accepted the challenge of OSA screening, and in so doing developed a three-dimensional (3D) facial photography algorithm that may have a role in future clinical assessment pathways. The concept of predicting OSA using algorithms has been explored for some time[6] and is warranted given the substantial burden of undiagnosed OSA. For their algorithm, the authors employed a unique mix of a non–clinically biased community sample of middle-aged adults and a cohort of sleep clinic patients to address the question of usefulness of geodesic and linear measurements in 3D facial photographs. A total of 400 participants were used to demonstrate accuracy with a variety of contours, angles, and distances taken from these 3D images. They used supervised machine learning, where the program learns the algorithm that matches the input to the desired output in a training dataset with known outcomes. By using linear discriminant analysis, Eastwood and colleagues were able to reduce the dimensionality of the data, consisting of numerous linear and geodesic measurements, projecting these features to a simpler analysis space that better separates patient groups. The derived algorithm was then tested on a patient group that comprised 10% of the dataset, not used for development of the predictive model. The outcomes showed superior prediction modeling when compared with various standardized questionnaires, with a sensitivity of 97% and specificity of 76% for an apnea-hypopnea index (AHI) ≥ 5 events/h versus an AHI < 5 events/h.

The study's limitations include the presence of a higher body mass index (32.2 vs 26.9 kg/m^2), age (54.5 vs 47.4 years), and neck circumference (39.7 vs 35.0 cm) in those with OSA versus those in the control group. These differences could account for some morphological differences between the groups. In addition, there was an unexpected small decrease in accuracy for the detection of an AHI ≥ 10 events/h and an AHI ≥ 15 events/h, particularly for women. These limitations were acknowledged by the authors and could be better assessed using a larger, better-matched testing set to validate this predictive model.

The challenge for the future is how to incorporate such research into clinical practice. While image-analysis technology appears to be easy to implement and inexpensive, it is based on a correlation with the AHI, an imperfect metric for OSA. Polysomnographic indices such as the AHI can be discordant with clinical features of OSA including sleepiness and quality of life.[7] On the other hand, some measures of hypoxia, such as the oxygen desaturation severity, may better correlate with excessive sleepiness than the AHI[8] and may better predict the sequalae of OSA. Future studies might focus on integrating facial photographic morphology with additional, readily available signals such as oximetry from wearable technologies or home sensors. Certain wearable devices are already capable of measuring pulse oximetry and some provide oximetry variability analysis. Similarly, the home of tomorrow will likely incorporate sensors in the bedroom, which may gather physiological sleep data using optical, acoustic, infrared, ultrasonographic, or other means.

The study by Eastwood and colleagues provides a modern, innovative addition to the diagnostic assessment of patients for OSA. It is hoped that photographic image analysis can be merged with other, easily obtained parameters from patient history, soft tissue examination, and physiological endo-typing to direct improved and individualized treatment for our patients.

CITATION

Jacobowitz O, MacKay S. The faces of sleep apnea in the age of machine learning. *J Clin Sleep Med*. 2020;16(4):469–470.

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Address correspondence to: Ofer Jacobowitz, MD, PhD, FAASM, ENT and Allergy Associates, 18 East 48th Street, 2nd floor, New York, NY 10017; Tel: (646) 868-4300; Email: ojacobowitz@entandallergy.com

DISCLOSURE STATEMENT

The authors report no conflicts of interest.