Researchers develop groundbreaking approach to evaluate sleep disorders

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Ben-Gurion University of the Negev (BGU) researchers have developed a groundbreaking approach to determine sleep quality using their new breath sound analysis (BSA). This is less expensive and invasive than current polysomnography (PSG) technology, according to a new study published on *PLOS* Online.

"One of the main goals of sleep medicine today is to improve early diagnosis and treatment ofthe 'flood" of subjects presenting with sleep disorders," says Prof. Yaniv Zigel Ph.D., head of the Biomedical Signal Processing Research Lab in BGU's Department of Biomedical Engineering.

"We've developed a non-contact 'breathing sound analysis' algorithm that provides a reliable estimation of whole-night sleep evaluation for detection of sleep quality, snoring severity and Obstructive Sleep Apnea (OSA). It has the potential to reduce the cost and management of sleep disorders compared to PSG, the current standard of treatment, and could be used at home."

PSG requires a full night sleep center stay and subjects are connected to numerous electrodesand sensors that are attached to the patient to acquire signals and data from electroencephalography (EEG), electrooculography (EOG), electromyography (EMG), and electrocardiography (ECG) tests. The data is processed and visually examined or mathematically transformed manually in order to reveal insights about sleep/wake states and many aspects of physiology. "This

procedure is time-consuming, tedious and costly due to complexity and the need for technical expertise; the market is begging for a better solution," says Eliran Dafna who conducted this study as part of his Ph.D. research.

In the study, the researchers measured whole-night breathing sounds from 150 patients using both ambient microphones and PSG simultaneously at a sleep laboratory. The system was trained on 80 subjects and a validation study was blindly performed on the additional 70 subjects. A set of acoustic features quantifying breathing patterns was developed to distinguish between sleep and wake segments. Sleep quality parameters were calculated based on the sleep/wake classifications and compared with PSG for validity.

When comparing sleep quality parameters, there were only minor average differences in the measurements between PSG and BSA. Measuring 150,000 individual time segments (epochs), the BSA epoch-by-epoch accuracy rate for the validation study was 83.3 percent with 92.2 percent sensitivity measuring sleep as sleep.

"The results showed that sleep/wake activity and sleep quality parameters can be reliably estimated solely using breathing sound analysis," says Prof. Ariel Tarasiuk of BGU's Department of Physiology and head of the Sleep-Wake Disorders Unit, at Soroka University Medical Center. "This study highlights the potential of this innovative approach to measure sleep in research and clinical circumstances. Clearly, the transition of this technology to at-home sleep evaluation depends on third party reimbursements for the use of home study equipment."

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