

SLEEP/WAKE CLASSIFICATION WITH HEAD ACTIGRAPHY

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Introduction: Wrist actigraphy is often used in conjunction with unattended cardio-respiratory monitoring to provide an estimate of the total sleep time. Head movements have rarely been used for this purpose; however, head-worn sleep recorders (e.g. NightCap, ARES, ZEO) have been introduced with some success, and further advances in the miniaturization of sensors and circuits may lead to a more widespread use of such devices. We therefore investigated the utility of head actigraphy in differentiation between wakefulness and sleep.

Methods: The algorithm was developed on 22 subjects ($RDI=27\pm 29$; range: 3-98), and cross-validated on 50 subjects ($RDI=30\pm 25$; range: 2-103). Subjects underwent concurrent overnight recording with standard laboratory polysomnography (PSG) and the head-worn ARES recorder with integrated 3-axis digital accelerometer (ACT). The algorithm classified 30-second epochs as Wake or Sleep based on the intensity and duration of head movements in the current epoch and three epochs before and after it. PSG recordings were manually scored according to the AASM criteria. Epoch-by-epoch comparisons ($n=36,991$) were performed, and sensitivity (Se), specificity (Sp), agreement (Ag), and Cohen's kappa were calculated. Significance of PSG-ACT differences in sleep latency (SL), total sleep time (TST) and sleep efficiency (SE) were tested with paired t-test, and impact of RDI on the classification accuracy with Pearson correlation coefficient and ANOVA.

Results: The algorithm's performance was similar in the development (Se: 67%; Sp: 91%; Ag: 86%; $\kappa=0.57$) and validation group (Se: 67%; Sp: 88%; Ag: 84%; $\kappa=0.54$). Differences in TST (PSG-ACT: -0.7 ± 34 min; range: -84 to +86min) and SE (PSG-ACT: $-1\pm 10\%$; range: -26 to +21%) were not significant, but the head actigraphy slightly underestimated sleep latencies (PSG-ACT: 2 ± 6 min; range: -15 to 30min; $p=0.003$). Classification accuracy was not significantly affected by RDI in patients with mild to moderate OSA ($RDI<40/h$), but deteriorated on average by -4% in those with $RDI>40/h$.

Conclusion: Accuracy of sleep-wake classification with head actigraphy is similar to that reported for wrist actigraphs.

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