

Strengthening sleep–autonomic interaction via acoustic enhancement of slow oscillations

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Abstract

Slow-wave sleep (SWS) is important for overall health since it affects many physiological processes including cardio-metabolic function. Sleep and autonomic nervous system (ANS) activity are closely coupled at anatomical and physiological levels. Sleep-related changes in autonomic function are likely the main pathway through which SWS affects many systems within the body. There are characteristic changes in ANS activity across sleep stages. Notably, in non-rapid eye-movement sleep, the progression into SWS is characterized by increased parasympathetic activity, an important measure of cardiovascular health.

Experimental manipulations that enhance slow-wave activity (SWA, 0.5–4 Hz) can improve sleep-mediated memory and immune function. However, effects of SWA enhancement on autonomic regulation have not been investigated. Here, we employed an adaptive algorithm to deliver 50 ms sounds phase-locked to slow-waves, with regular pauses in stimulation (~5 s ON/~5 s OFF), in healthy young adults. We sought to determine whether acoustic enhancement of SWA altered parasympathetic activity during SWS assessed with heart rate variability (HRV), and evening-to-morning changes in HRV, plasma cortisol, and blood pressure.

Stimulation, compared with a sham condition, increased SWA during ON versus OFF intervals. This ON/OFF SWA enhancement was associated with a reduction in evening-to-morning change of cortisol levels and indices of sympathetic activity. Furthermore, the enhancement of SWA in ON intervals during sleep cycles 2–3 was accompanied by an increase in parasympathetic activity (high-frequency, HRV). Together these findings suggest that acoustic enhancement of SWA has a positive effect on autonomic function in sleep. Approaches to strengthen brain–heart interaction during sleep could have important implications for cardiovascular health.

[slow wave activity](#), [parasympathetic activity](#), [acoustic stimulation](#), [sleep](#), [autonomic nervous system](#)

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