Blood Pressure and Restorative Sleep Intensity are Altered by Chronic Daytime Sleep Disruption in Rats.

Katherine A. Maki, Sara M. Mithani, Ulf G. Bronas, Anne M. Fink

Problem

When nurses’ schedules affect the timing and quality of their sleep, does this represent a risk factor for future cardiovascular (CV) disease?

Hypothesis

An inability to rest during typical sleep times will alter the quality of future sleep and change BP.

Theory

The Two-Process Model of Sleep Regulation measures oscillations in sleep- and circadian-related variables, such as blood pressure (BP).

Process S (Sleep) reflects the need to rest, which increases as individuals become fatigued by staying awake. Process S can be quantified by measuring fluctuations in the delta band of the electroencephalogram (EEG).

Process C (Circadian) reflects the activity of neurons responding to light and dark cues from the environment. Light-sensitive hypothalamic neurons produce predictable rhythms in core body temperature.

Methods

- Rats randomized to control (n = 5, no sleep disruption) or intervention (n = 5, 8-h of daily sleep disruption). Process S was measured by implanting cortical EEG electrodes.
- A catheter implanted in the abdominal aorta was used to measure BP. Process C was entrained to light (0800-2000) and dark (2000-0800) periods.
- Rats were undisturbed for 7 days (baseline). On Day 8, a mechanical arm disrupted the ability to rest for 8 h during the light phase (0900-1700).

Results

At baseline, the deepest sleep occurred during the light phase—typical of nocturnal WKY rats. When sleep was disrupted during the light-phase, however, rats demonstrated a significant reduction in deep sleep for the entire 24-hr period (Figure 2). These changes were not seen in control animals.

- When rats could not rest during their preferred sleep period (light phase), they failed to compensate for the lost sleep during the dark phase.

Relevance to Nurses

- The Two-Process Model illustrates two factors driving optimal sleep. Misalignment of Processes S and C may contribute to CV disease development.
- When nurses work at night, their daytime sleep may be less restful, leading to a chronic increase in SBP.
- The rat model represents a powerful tool for determining the mechanisms underlying elevated SBP and for testing interventions to protect nurses from the CV consequences of poor sleep.

Acknowledgements

Sigma Small Grant; Sigma Theta Tau, Alpha Lambda Chapter Student Research Grant; College of Nursing Dean's Fund, UIC Award for Graduate Research and International Society of Nurses in Genetics Grant (to KAM); MNRS Seed Grant and Janet Deatrick Research Award (to AMF).