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Later circadian timing and increased sleep variability are associated with attenuated overnight blood pressure dipping among chronic shift workers

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Abstract

Introduction:

Nighttime shift work is associated with adverse cardiovascular outcomes, including hypertension. Increased sleep variability and circadian disruption may increase sympathetic activity and waking blood pressure (BP), potentially constraining typical BP reductions during overnight sleep. However, the relationships between circadian phase, sleep variability, and overnight BP reduction (dipping) among day vs. chronic nightshift workers is unknown.

Methods:

Ambulatory BP was monitored for 48-hours among 10 dayshift (mean± SD; age 33.1±7.0 y; BMI 26.3±5.4 kg/m^2) and 10 chronic (9.3±6.8 y of shiftwork) nightshift workers (age 32.7±9.1 y; BMI 27.9±7.6 kg/m^2). Overnight BP dipping was calculated from the sleeping/waking systolic BP ratio. Variability in sleep timing was defined as the SD of reported sleep onset across 1-week. Circadian phase was determined by salivary dim-light melatonin onset (DLMO; 3pg/ml threshold). Differences between groups were assessed using independent t-tests and linear mixed-effects models with group and time-from-sleep-onset or circadian phase as fixed-effects, and participant as a random effect. Relationships between overnight BP dipping and DLMO, sleep onset timing variability, and phase angle of entrainment (DLMO to sleep onset during ambulatory BP) were assessed using Pearson correlation analyses.

Results:

Chronic nightshift workers had reduced overnight BP dipping (-9.3±1.5 % vs -13.4±4.4 %; p=0.04), later DLMO timing (21:08±0:53 vs 19:21±1:02; p=0.001), smaller phase angle of entrainment (3.7±1.0 h vs 5.0±0.90 h; p=0.02), and greater variability in sleep onset timing (3.2±1.5 h vs 0.87±0.34 h; p<0.001). Significant group effects for higher systolic BP across circadian phase and time from sleep onset in the nightshift group were observed compared to dayshift (both p<0.05). DLMO (r=0.49; p=0.04) and phase angle of entrainment (r=0.53; p=0.02) were associated with overnight BP dip magnitude (later circadian phase correlated with less dipping). Sleep onset timing variability was negatively correlated with magnitude of overnight BP dipping in nightshift (r= -0.76; p=0.04) but not dayshift workers (r=0.26; p=0.61).

Discussion:

Attenuated overnight BP dipping among chronic nightshift workers may be indicative of increased cardiovascular risk. Chronic circadian disruptions (i.e., smaller phase angle of entrainment) as a function of higher sleep variability among nightshift workers may mechanistically contribute to poorer health outcomes compared to dayshift workers.

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