

Organ-Divergent Biological Aging with Within-Person Change in Sleep Duration: The Taiwan MJ Cohort

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Objective: Between-person associations of sleep with metabolic health may reflect confounding. We examined whether within-person changes in sleep duration were associated with organ-specific biological aging and whether associations differed in direction across organ systems.

Methods: In the Taiwan MJ health check-up cohort, sex-specific Biological Age Gaps (BioBAGs) for hepatic, renal, metabolic, immune and cardiometabolic systems were derived from routine biochemistry using the Klemura–Doubal Method. Self-reported sleep duration comprised six ordinal categories analysed at their midpoints. Generalized additive models assessed nonlinear associations, and Cox models examined incident metabolic disease. Within-person models related annualised BioBAG slopes to sleep-duration slopes, adjusting for baseline age, sex, adiposity and number of visits.

Results: Hepatic BioBAG showed a nonlinear association with sleep duration, with the lowest fitted values at 7–8 hours in both sexes; metabolic BioBAG increased above approximately 6 hours. Short sleep was associated with incident metabolic syndrome, diabetes and hypertension after Bonferroni correction. The inverse association between long sleep and hypertension did not persist after adjustment for baseline adiposity. Within individuals, a one-standard-deviation steeper increase in sleep duration was associated with slower hepatic aging by 0.08 BioBAG-years per year and faster immune aging by 0.12 BioBAG-years per year. Renal, metabolic and cardiometabolic slopes were not significant. The hepatic estimate was directionally consistent with an independent Chinese cohort, but hepatic and immune coefficients were not formally compared.

Conclusion: Within-person sleep-duration changes accompanied biological aging estimates of opposite sign across organs. The hepatic clock met prespecified quality criteria; the immune clock did not, making its result exploratory. Ordinal sleep measurement limits precision, and slopes measured over the same period preclude temporal ordering. These findings support assessing organ-specific patterns rather than relying solely on a single whole-body aging index.

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