Wearable devices detect circadian disturbances that predict frailty risk in older adults

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Wearable devices can be used to measure a variety of signs and signals related to our health. A new study by researchers from Brigham and

Women's Hospital suggests that such devices may also be able to help predict older adults at risk of health complications related to frailty.

The team found an association between disturbances in daily patterns of rest and activity, or circadian rest-activity rhythms, and higher risk of occurrence and progression of frailty over time. The rhythms were recorded from wearable devices, and in some cases, could detect variations suggestive of future frailty more than six years before incidence. The results are published in *Nature Communications*.

"Our study demonstrates that wearable devices could represent an important tool for long-term health monitoring in older adults," said lead author Ruixue Cai, a doctoral candidate in the Division of Sleep and Circadian Disorders. "Frailty can reduce quality of life and detecting it early or predicting who is at risk could help us intervene to promote healthy aging."

Frailty, or age-related decline in physiological function, is a common condition in older populations that increases their vulnerability to adverse health outcomes. Disrupted circadian rest-activity rhythms have been previously linked to neurodegenerative diseases like Alzheimer's disease and Parkinson's disease. Research has also shown that aging changes these rest-activity patterns, with older people often preferring to keep earlier hours than younger adults.

The authors studied a cohort of 1,022 adults with a mean age of 81, recruited as part of the Rush Memory and Aging Project, who had been followed annually for up to 16 years. The researchers analyzed continuous rest and activity data from wearable devices, including measures such as the amplitude, stability and variability of rhythms.

Over a follow-up period of over six and a half years on average, the team found that 357 participants developed frailty. Blunted, less robust, or

inconsistent rest-activity patterns were associated with higher risk of incidence. These disturbances were also linked to faster worsening of frailty progression symptoms like decrease in grip strength, reduction of body mass index and increasing fatigue. The findings were independent of characteristics such as age, sex, sleep duration, sleep fragmentation and cardiovascular dysfunction.

The authors point out that circadian disruptions have been previously associated with sleep disorders, altered metabolism and neuronal loss, suggesting an overlap between mechanisms behind frailty and cognitive impairment.

The study was limited to an older population with a mean age of over 80. Rest-activity patterns can be affected by seasonal variations and environmental conditions, and wearable devices can sometimes misinterpret sleep and wake cycles. Future studies with better sleep assessment are required to better understand the causal link between circadian disturbances and frailty.

"Wearable technology provides a holistic approach for detecting common indicators of disease," said corresponding author Peng Li, Ph.D., of the Brigham's Division of Sleep and Circadian Disorders and the Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital. "Combining circadian rest-activity data with other clinical measures could help with early identification and intervention in susceptible populations."

  More information: Ruixue Cai et al, Circadian disturbances and frailty risk in older adults, *Nature Communications* (2023). DOI: 10.1038/s41467-023-42727-z