

## Abstract

# Within-Person Associations Among Physical Activity, Sleep, and Well-being in Situ: Opportunities for Whole-Person Well-being

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## Abstract

**Background:** Digital tools can help cultivate states of well-being through psychological interventions. Interventions and policies with the most promise of influencing individual and population health and well-being in real-world contexts require understanding the dynamic relationships between different domains of well-being in daily life.

**Objective:** This study aimed to consider multiple components of the health behavior–well-being system to identify potential targets for designing ecologically relevant interventions in everyday life.

**Methods:** We used self-reported affective states, purpose in life, and physical activity collected via smartphone-based experience sampling twice per day over 28 days as participants (N=226 young adults; mean age 20.2, SD 1.7 years; 76% women and 25% men) went about their daily lives. We used a multilevel vector autoregressive model to isolate within- and between-person relationships among daytime physical activity, nighttime sleep duration, nighttime sleep quality, happiness, sadness, anger, anxiousness, and purpose in life. This approach generates 3 networks describing the relationships among variables of interest: (1) a directed temporal network revealing within-person, time-lagged, previous-day relationships among variables; (2) a contemporaneous undirected network revealing within-person same-day relationships among variables; and (3) an undirected between-person network identifying between-person differences in how variables are associated with one another.

**Results:** Our complex-system approach to the health behavior–well-being system revealed significant interplay among physical activity, sleep, affect, and purpose in life. We found that when an individual had higher than their usual levels of physical activity on a particular day, they experienced an increase in happy affect the next day. Higher sleep quality on a particular day also predicted a decrease in negative affective states the next day. We found that purpose in life predicted decreased sad, anxious, and angry affect up to 2 days later. For contemporaneous relationships, higher than usual happiness predicted increased purpose in life and lower anger, anxiety, and sadness on the same day. We found that people who, on average, were happier tended to endorse a higher sense of purpose in life and experience increased sleep quality, whereas people who, on average, were sadder tended to have increased anxiety and anger.

**Conclusions:** Collectively, these findings suggest that behavioral interventions targeting sleep and physical activity may observe shorter-term (up to 1 day) effects on well-being, whereas interventions cultivating a sense of purpose in life can have slightly

longer effects on well-being, bleeding into the next few days. Our findings suggest that approaches simultaneously considering whole-person well-being rather than just one domain of well-being hold promise for informing the design of behavior interventions with the most promise of influencing health in real-world contexts. Moving forward, digital health tools should incorporate tracking multiple domains of well-being in daily life to increase opportunities for whole-person health approaches in virtual care settings.

**Conflicts of Interest:** None declared.

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## KEYWORDS

network analyses; health behavior; ecological momentary assessment; emotions; physical activity

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