

Temporal and Bidirectional Associations between Objectively Measured Physical Activity and Sleep in Preschoolers

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INTRODUCTION

- The 24-hour cycle consists of sedentary behavior (low energy expenditure activities in sitting, reclining, or lying position during wake), physical activity (light to vigorous energy expenditure activities during wake), and sleep.
- Despite relations reported in older individuals, more research is needed on the associations between these behaviors in early childhood (1,2).
- To explore the interactive relationships between these behaviors in older children and adults, previous studies have examined temporal between- and within-person associations through micro-longitudinal designs (3,4).
- However, such analyses have not been conducted in early childhood, when behaviors are more influenced by adult caregivers and sleep patterns differ from older children.

Purpose: To examine temporal and bidirectional associations between sedentary behavior, physical activity, and sleep in preschool children.

METHODS

- Design and Participants:** We conducted an analysis of repeated daily measures with data from 248 preschool-age participants from an ongoing trial (ClinicalTrials.gov ID: NCT03285880).
- Measures:** Wake and overnight sleep variables were assessed via wrist-based actigraphy (*M* days = 10.4, *M* nights = 9.8) with Actiwatch Spectrum Plus monitors and were recorded as repeated (daily) measures.
- Analysis:** Multilevel models with lagged effects and AR(1) error covariance structure were used to examine temporal associations and were adjusted for age, sex, socioeconomic status, and nap frequency. Significant associations were categorized as beneficial (e.g., less sedentary behavior = longer sleep) or unfavorable (e.g., less sedentary behavior = shorter sleep).

Variables	Mean (SD) or n (%)
Age (months)	50.9 (9.8)
Sex (female)	120 (48.4)
Nap Frequency	
Rarely (0-1 days/week)	46 (18.5)
Sometimes (2-4 days/week)	109 (44.0)
Frequently (5+ days/week)	93 (37.5)
Overnight Sleep Measures	
Sleep duration (minutes)	570.5 (40.4)
Sleep mid-point (decimalized time)	2.2 (0.7)
Sleep efficiency (%)	88.2 (3.5)
Wake Behavior Measures	
Activity counts (counts/min)	565.9 (106.5)
Sedentary behavior (%)	41.8 (7.6)
Light physical activity (%)	42.8 (4.7)
Moderate-to-vigorous physical activity (%)	15.4 (5.3)

RESULTS

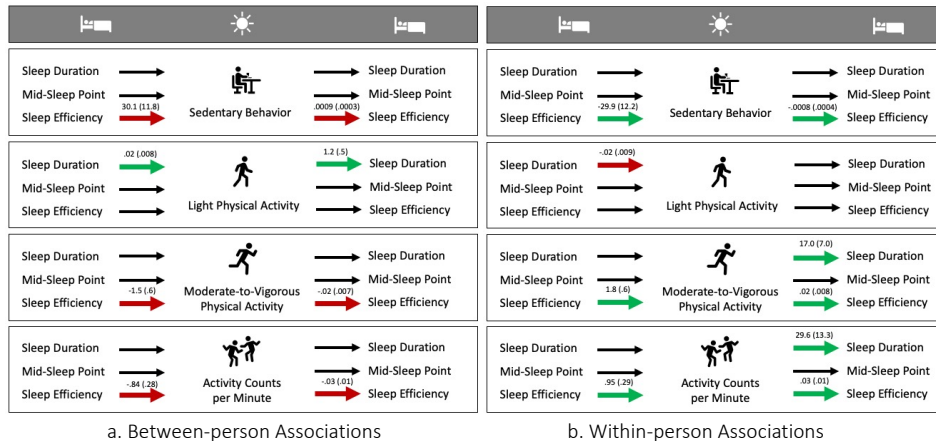


Figure 1. Summary of the temporal wake and nighttime sleep measures. **Black arrows** indicate a null association, **green arrows** indicate a beneficial (i.e., favorable) significant association ($p < .05$), and **red arrows** indicate an unfavorable significant association ($p < .05$) with coefficient estimates and standard errors noted above significant arrows. Variables with two red or two green arrows on the same row within the same panel represent a bidirectional relationship.

CONCLUSION

- Generally, activity levels or sleep were not beneficially associated with subsequent time spent in sleep or wake behaviors, respectively.
- When participants obtained greater activity or sleep compared to their individual average, some beneficial associations were evident.
- When designing interventions that target behaviors of the 24-hour cycle, individual tailoring may be an important component.
- Future analyses with young children should consider within-person associations and investigate lagged effects beyond one day in diverse samples, including children with developmental or sleep disorders.

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