Latent Variable Model Does Not Capture Actigraph-Assessed Sleep Quality Indices

George Bate, M.S.[1], Jesse Bahrke, M.S.[1], Joanna Buscemi, Ph.D.[2], Sara Lampert-Okin, M.S.[1], Rachel Neff Greenley, Ph.D.[1], Kristin Schneider, Ph.D.[1], Susan T. Tran, Ph.D.[2] & Steven A. Miller, Ph.D.[1]

1: Rosalind Franklin University of Medicine and Science

2: DePaul University

Introduction:

- Most sleep research uses a single, global index, such as total hours sleep, to reflect sleep quality (Tomfohr et al., 2011).
- Reliance on a single index lacks the nuanced information that is afforded when modeling multiple sleep quality indices.
- It is unclear if other sleep quality indices, such as efficiency or wakefulness, correlate so highly as to fall under a single factor.

The main purpose of this study was to uncover interrelations of various Actigraph-assessed sleep quality indices to determine whether future research should model sleep quality indices separately or together.

Methods:

- Sample
  - 260 undergraduate students
  - M_{age} = 19.60; Mostly female (69.1%); racially diverse (53.2% non-Hispanic White)
- Procedure
  - For 14 consecutive days, participants wore Actigraph monitors that provided daily values for….
    - Total Sleep Time (TST) - daily duration of sleep in minutes (ICC = .17)
    - Sleep Efficiency (EFFf) - % of time spent in bed that participant is asleep (ICC = .25)
    - Wakefulness After Sleep Onset (WASO) - number of awakenings after sleep begins (ICC = .26)
    - Movement Index (MI) - number of limb motions divided by participant's time in bed in minutes (ICC = .34)
    - Sleep Fragmentation Index (SFI) - sum of minutes of sleep during which movement occurred (ICC = .11)

ROSALIND FRANKLIN UNIVERSITY of MEDICINE AND SCIENCE

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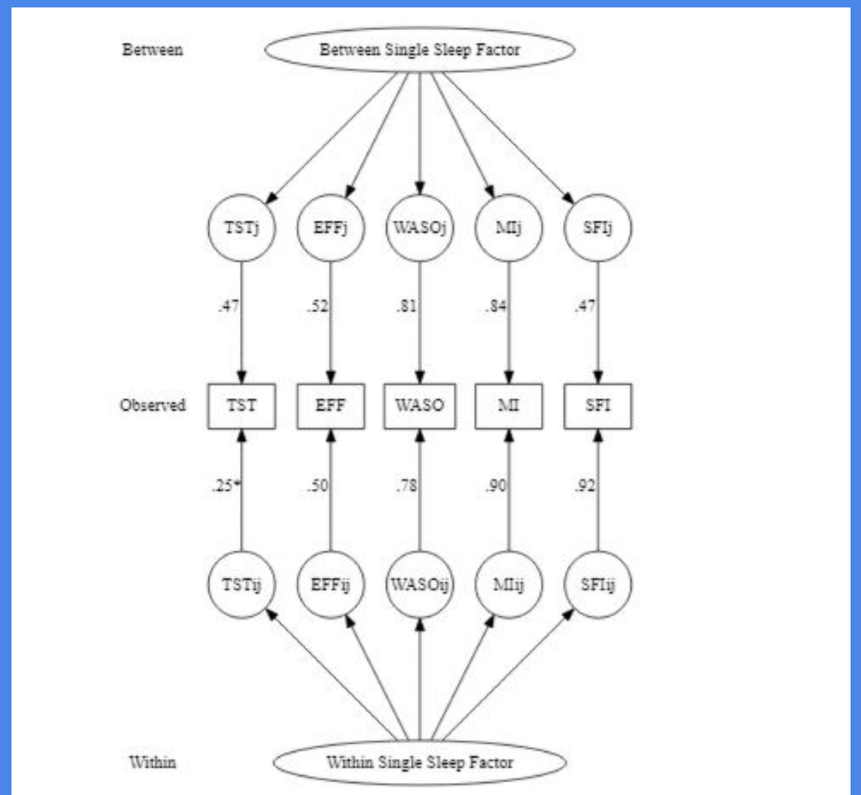
A Multilevel Confirmatory Factor Analysis of five sleep quality indices loading onto a single latent variable fit data poorly.

Poor fit suggests that future studies should model multiple sleep quality indices individually, rather than a single latent variable reflecting multiple indices in one factor.



*only loading not significant, p > .05.

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Direct correspondence to: george.bate@my.rfums.org

- Analyses
  - ICCs above .10 indicated multilevel analyses were warranted
  - A multilevel confirmatory factor analysis (CFA) was conducted to determine if a model in which the five sleep indices load onto a single latent variable fit the data well.
  - The between- and within-persons parts of the CFA were estimated separately before an overall CFA incorporating between- and within-persons parts was estimated.

Results:

- The overall CFA model of the five sleep quality indices loading onto a single latent variable fit the data poorly, CFI = .23, SRMR = .13, RMSEA = .32, TLI < .01.
- Within-persons CFA:
  - All five sleep quality indices had significant loadings onto a within-person general factor of sleep, $p < .0001$.
  - The within model fit better than the overall model, but fit poorly, CFI = .59, SRMR = .13, RMSEA = .42, TLI = .18.
- Between-persons CFA:
  - Four of the five sleep quality indices had significant loadings onto a between-person general factor of sleep, $p < .01$.
  - Total sleep time (TST) did not significantly load onto a between-person general factor of sleep, $p = .16$.
  - The between model fit better than the overall and within models, but still fit poorly, CFI = .70, SRMR = .15, RMSEA = .44, TLI = .41.

Discussion:

- Poor fit of a model in which five sleep quality indices loaded onto a latent variable suggests that the sleep quality indices examined in this study operate uniquely and, therefore, warrant investigation independent of one another.
- Superior fit of a between model compared to an overall model and a within model and superior fit of a within model compared to an overall model suggest that disentangling between- and within-subjects components of latent variable models of sleep quality indices yields more accurate results.
- Future research will benefit from exploring the nuances of factors contributing to sleep quality.