MENU

WRIST RHYTHMS

Validating Fitbits for
Community Wellness App

The goal of this
research was to
examine the
instrumental
validity of Fitbits for
capturing human
sleep and activity
rhythms in order to
promote well-being

This project helped drive the
decision to include Fitbit
activity data acquisition in the
launch of a major 5-year
cohort study under the
direction of the Whole
Communities Whole Health
UT Austin Bridging Barriers
Grand Challenge. This
challenge seeks to reimagine

and trust in a self-service mobile app for community members participating in UT research.

the way research is conducted in order to best serve communities.

This research is now published in **Smart Health, 29 (2023).**

Problem

We know that the coupling between human sleep behaviors and the natural environment is important for mental health, cognition, and physical well-being. Sleep-staging wearable activity trackers offer users the promise of personalized sleep and activity insights, but systematic validation of their capabilities in this area are sparse.

Solution

Many aspects of activity rhythms, but not nightly sleep, were captured accurately by the Fitbit relative to a research-grade activity tracking device. Further, these activity rhythm measures were associated with multiple measures of psychological well-being, including happiness, sadness, rumination, and stress. These effects were weak to moderate, depending on the measure examined.

Tools

- Activity tracking
- Sleep diary

Team

- 2 Principal Investigators
- 5 Research Assistants throughout
- 1 Engineer
- WCWH Team

My Role

- Co-Principal Investigator - led research design, study implementation, analyses, and reporting

Study Design

We enrolled over 50 healthy participants ages 18-74 who simultaneously wore a Fitbit and a lab-grade Actiwatch on opposite wrists, in addition to completing daily sleep surveys, for 10-14 days. Actiwatch arm assignment was
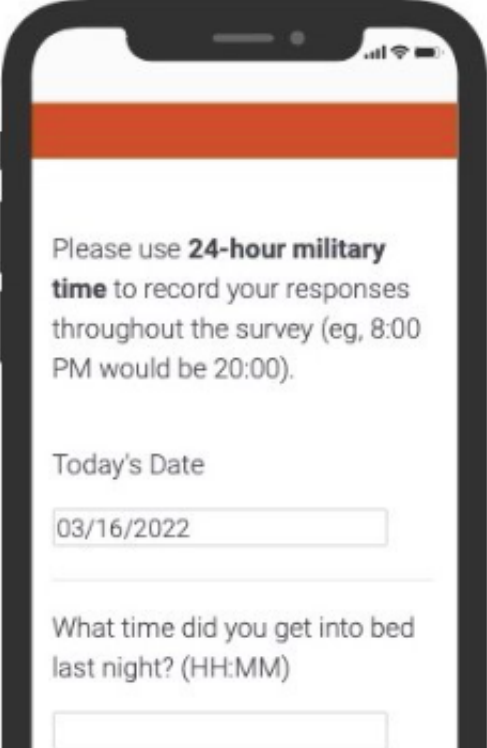
randomized across participants.

We examined how sleep and 24-hour activity rhythm measures related to other aspects of psychological well-being, such as self-reported mood and stress ratings collected through daily surveys.

Data collection

Activity Tracking

We collected summary sleep statistics (sleep duration, time in bed) from each device. We also used raw step-count and activity data to calculate novel measures that reflect aspects of the 24-hour activity rhythm (or circadian rhythm).
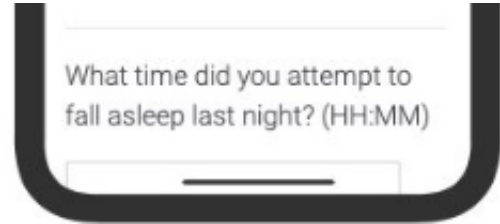
Surveys

Please use **24-hour military time** to record your responses throughout the survey (eg, 8:00 PM would be 20:00).

Today's Date

03/16/2022

What time did you get into bed last night? (HH:MM)

We used a combination of Qualtrics (above) and REDCap daily surveys to collect information about participants' sleep, activity, and social habits, as well as their daily moods.

What time did you attempt to fall asleep last night? (HH:MM)

Modeling activity rhythms

To quantitatively analyze 24-hour activity rhythms, we fit each participant's aggregated 24-hour activity data to a transformed cosinor model.

The model parameters were used to describe:
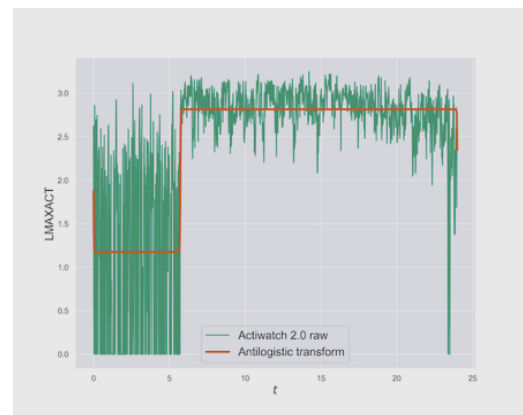
This is the same participant's modeled 24-hour activity rhythm. We can see that they tend to transition to higher activity around 6:00 AM, and

- the typical time of peak activity,
- transition from rest to active periods, and
- day-to-day stability of rest-activity patterns

that their activity during the rest period (12:00 AM - 6:00 AM) is relatively unstable.

Findings

From the Bland-Altman analysis, I created visuals that summarized the findings for each measure of interest to help understand the instrumental validity of Fitbits for sleep assessment at a higher level.

These data showed large discrepancies

Cosinor measures

across devices in sleep time, time in bed, and the circadian model's minimum, which reflects the amount of restlessness during sleep. However, there was excellent agreement across the other circadian rhythm measures.

Beyond knowing that Fitbit can accurately capture 24-hour activity rhythm measures, why are these measures potentially important for Fitbit users?

Associations with well-being

Using the daily
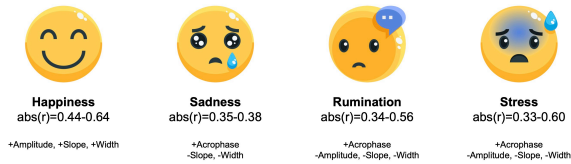
survey data, we found that 24-hour activity rhythm measures were associated with multiple measures of psychological well-being, including happiness, sadness, rumination, and stress. These effects were weak to moderate, depending on the measure examined.

Happiness
abs(r)=0.44-0.64

+Amplitude, +Slope, +Width

Sadness
abs(r)=0.35-0.38

+Acrophase
-Slope, -Width

Rumination
abs(r)=0.34-0.56

+Acrophase
-Amplitude, -Slope, -Width

Stress
abs(r)=0.33-0.60

+Acrophase
-Amplitude, -Slope, -Width

Impact

This project helped drive the decision to include Fitbit activity data acquisition in the launch of a

major 5-year cohort study under the direction of the Whole Communities Whole Health.

Personalized insights

Through this study, families can choose to have access to technology that will measure health factors like indoor air quality, sleep habits, mood, or physical activity. Their data is shared with them in real-time through a smartphone app so they can make informed decisions about their own health.

This validation work strengthened the decision to include Fitbit data collection as part of the study. Participants will be able to see their activity data (which showed high instrumental validity, as opposed to the sleep data) and how that relates to other environmental variables through the app.

Community advocacy

This data is also used in aggregated formats by community partners to advocate for changes at the city and county level to improve issues
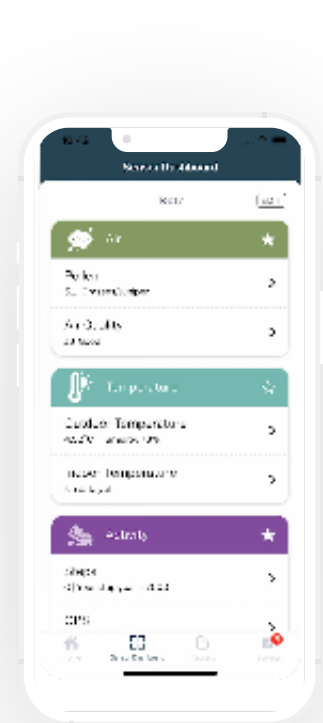
Hornsense App Sensor Dashboard

affecting the health of the entire
community.

This work helped to articulate the
value of including sleep and activity
data to inform community advocacy
efforts.