Comparison of Video Observation and Actigraphy Recording to Measure Sleep Behavior

KARISHA BRISTOW, Craig Strohmeier, Sean Smith, & Tracy L. Kettering

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INTRODUCTION

Sleep problems occur at higher rates in individuals with Autism Spectrum Disorder, with a prevalence as high as 73%-86% (Rzepecka et al., 2011). Rzepecka et al. (2011) found that for children with intellectual and developmental disabilities, sleep problems predicted 38.8% of variance in reported problem behavior.

Further, several studies have identified sleep deprivation as an important setting event that may increase the probability of problematic behavior (O'Reilly, 1995; Kennedy & Meyer, 1996).

Despite the clear relationship between sleep and problem behavior, behavior analysts often must rely on caregiver reports of an individual's sleep patterns, which may be inaccurate.

Thoroughly validated alternatives of measuring sleep, such as polysomnography and accelerometers like Actiwatch®, are expensive or not likely to be tolerated by individuals diagnosed with autism. Few studies have assessed the validity of commercially available and relatively inexpensive accelerometers like the Fitbit®.

The purpose of this study is to determine if the sleep data provided by the Fitbit® is comparable to sleep data recorded by an observer reviewing video recording.

METHOD

Participants and Setting

Richard: 19 year-old male diagnosed with autism, intellectual disability NOS, impulse control disorder, and pica
Jason: 17 year-old male diagnosed with autism and intellectual disability NOS

Both participants resided in a facility for the assessment and treatment of severe problem behaviors. Video cameras are positioned throughout the facility and provided the video recordings that were analyzed in this study.

Variables

Sleep Duration: The total amount of time the participant is recorded as asleep.
Sensitivity: Video observation data and electronic data report sleep simultaneously.
Specificity: Video observation data and electronic data report wake simultaneously.

Data Collection and Procedures

Fitbit® Data: A Fitbit® was worn on the participants' non-dominant wrist 24-hours per day with the exception of activities during which the Fitbit® may be exposed to water. Richard wore the Fitbit® for 10 days. Jason wore the Fitbit® for 14 days. The Fitbit®'s sleep tracking sensitivity was set to "Normal" for both participants. The Fitbit® reports sleep onset using an algorithm that assumes sleep after 1 hour of inactivity. The wearer is assumed to be awake during periods of high activity in which sleep is unlikely.

Video Observation Data: The video recording was triggered by movement in each participant's bedroom so that video was only recorded for approximately 15 seconds following movement. Observers collected paper and pencil data on duration of sleep by watching the video recordings. The times of sleep onset and wake were recorded. Sleep onset was recorded when the observer noted the participant engaging in "sleep behavior" such as visible heavy breathing or laying down without movement. The participant was recorded as awake when engaging in behaviors such as sitting up, vocalizations, or movements in excess of brief position adjustments. During periods of no movement, and subsequent no video recording, it was assumed that the participant was in the state observed in the video before recording stopped.

It was ensured that the time on the Fitbit® corresponded to the timestamp on the video recording prior to data collection.

Data Analysis

- Sleep duration data recorded through video observation and by the Fitbit® was compared by dividing the smaller measurement by the larger measurement and multiplying by 100.
- Sensitivity and specificity were determined by calculating sleep duration agreement in 15 minute intervals for each night in the same manner as the total sleep duration agreement.
- The overall sensitivity was calculated by summing the sensitivity measurement from each night and dividing by the total number of nights.
- The overall specificity was calculated by summing the specificity measurement from each night and dividing by the total number of nights.

Interobserver Agreement (IOA)

IOA data were collected during 33% of observation periods for both participants. Agreement for sleep duration was 99.28%, agreement for sensitivity was 99.26%, and agreement for specificity was 97.97% for Richard. Mean agreement for sleep duration was 88.84% (range, 84.05% to 97.90%), the mean agreement for sensitivity was 84.50% (range, 77.37% to 94.84%), and the mean agreement for specificity was 89.36% (range, 83.47% to 97.42%) for Jason.

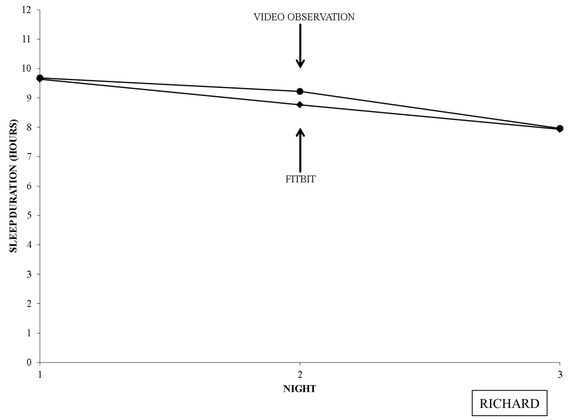

Figure 1 displays the total duration of sleep per night as measured by the Fitbit ® and video observation..

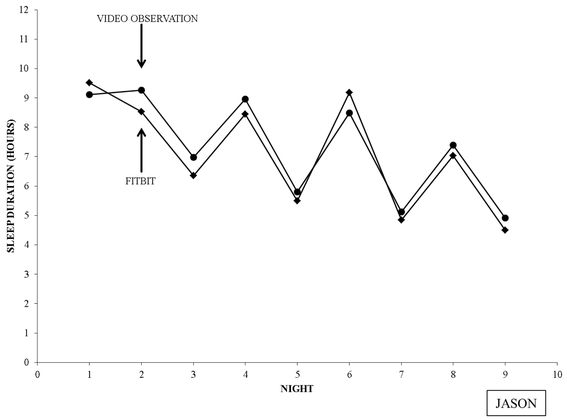

Figure 2 displays the total duration of sleep per night as measured by the Fitbit ® and video observation.

	Richard		Jason	
	Mean	Range	Mean	Range
Sensitivity	97.29%	94.08% - 99.02%	84.64%	71.67% - 95.69%
Specificity	97.75%	95.29% - 99.49%	84.41%	74.67% - 91.41%
Sleep Duration Agreement	98.06%	95.12% - 99.58%	93.71%	90.93% - 95.80%
Duration Difference (Mins)	10.67	2.0 - 27.0	24.6	16.0 - 44.0

Table 1 displays the agreement between video observation data and Fitbit ® reported data

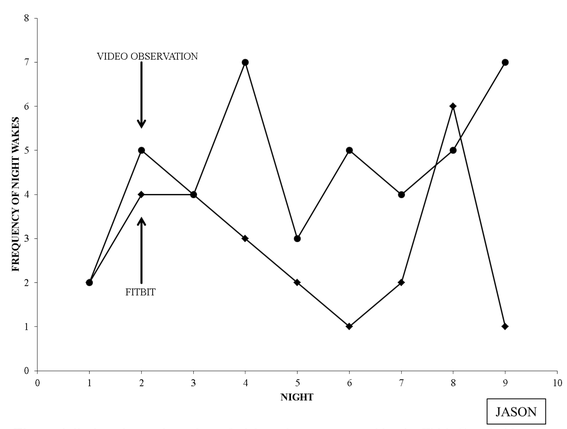

Figure 4 displays the total number of night wakes as measured by the Fitbit ® and video observation.

DISCUSSION

- The Fitbit® showed high specificity and sensitivity when compared to video observation and showed high overall agreement on sleep duration.
- Video observation typically reported more wakes after sleep onset than the Fitbit®, but it is unclear whether the video recording data or the Fitbit® data were more accurate.
- Agreement measures were more variable with Jason who engaged in more movement while asleep than Richard.
- This study is limited by the use of video monitoring. Future research on the validity of the Fitbit® in similar settings should attempt to have an observer present throughout the night.
- Overall, the Fitbit® is a suitable tool for caregivers and behavior analysts to obtain sleep data. Data on sleep reported by the Fitbit® was consistent with sleep data reported via video monitoring.
- Although it was not formally assessed, the Fitbit® may not be tolerated by all individuals with intellectual and developmental disabilities. Neither participant kept the Fitbit® on for every night of the study.

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