VALIDATING THE SLEEP/WAKE ESTIMATES OF A PHYSICAL ACTIVITY MONITOR WITH RURAL FIRE-FIGHTERS

Anastasi Kosmadopoulos[1,2], Gregory D Roach[1], Sally A Ferguson[1,2] and Charli Sargent[1]

[1] Centre for Sleep Research, Appleton Institute, Central Queensland University, South Australia
[2] Bushfire Co-Operative Research Centre, East Melbourne, Victoria

Background

Fire-fighters working night shifts need to prioritise daytime sleeps to reduce fatigue-related risks.

Monitoring sleep patterns between shifts could help determine the level of risk on shift commencement.

Polysomnography (PSG) is the gold standard for monitoring sleep but is not practical for day-to-day use.

The Actical is a device which records wrist activity and was developed to estimate energy expenditure during the day (Figure 1).
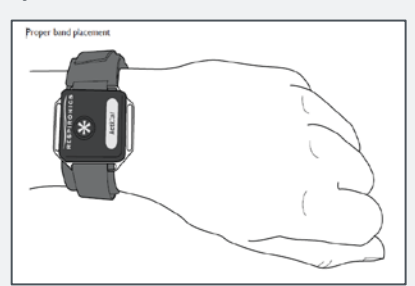

Figure 1. The Actical activity monitor

It has a potential dual function for estimating sleep/wake patterns, but has not been well-validated for this.

The aim of this pilot study was to evaluate the validity of the Actical for estimating sleep/wake patterns in fire-fighters.

Methods

Participants

Participants were three fire-fighters, mean age 44 years (range 22—60), recruited as part of a larger study.

Procedure

Participants went to bed between 22:00h and 07:00h for 3 nights in a shared sleeping area.

Each night, participants wore an Actical on their dominant wrist and had PSG electrodes placed on their heads in a standard montage.

Data Analysis

Actical data were downloaded and an algorithm was used to estimate sleep or wake for each 30-s epoch.

Electrical signals recorded using PSG were manually scored in 30-s epochs as wake or sleep according to standardised criteria.

Epoch-by-epoch comparisons were made to assess the ability of Acticals to identify sleep (**sensitivity**), wake (**specificity**), and agree with PSG overall (**accuracy**).

Sleep variables derived from Actical and PSG data were total sleep time (TST) and sleep efficiency (SE), the percentage of time asleep in bed.

Results

Epoch-by-epoch comparisons

Acticals were highly sensitive when estimating epochs as sleep (Table 1), but had poor specificity when estimating epochs as wake. Overall epoch agreement was good.

Table 1. *Epoch-by-epoch agreement of Actical with PSG*

	M ± SD
Sensitivity (%)	96.7 ± 1.7
Specificity (%)	45.1 ± 11.4
Accuracy (%)	85.7 ± 2.9

Sleep variables

A paired samples t-test showed that the TST estimated by the Actical (M ± SD; 7.1 ± 0.3 h) was significantly higher than the TST determined by PSG (6.4 ± 0.6 h), $t(6)=-4.5$, $p<.01$ (Figure 2).

A paired samples t-test showed that SE estimated by the Actical (87.1 ± 5.3%) was significantly higher than SE determined by PSG (78.1 ± 8.0%), $t(6)=-4.5$, $p<.01$ (Figure 2).
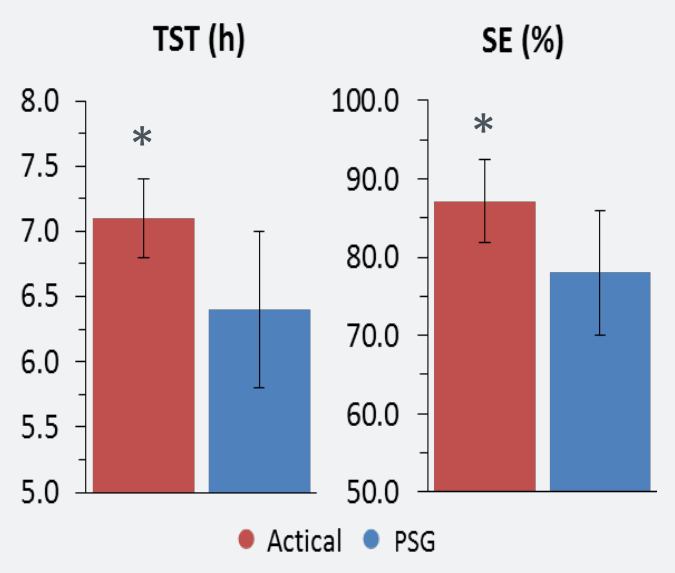

Figure 2. Total sleep time and sleep efficiency determined by Actical and PSG

Discussion

The theoretical advantage of using Acticals with fire-fighters is they estimate daytime energy expenditure and could thus serve a dual function.

The results indicate that, compared to PSG, Acticals overestimate sleep and underestimate wake. However, these results are similar to those found for related devices specifically designed to monitor sleep/wake patterns, and thus do not exclude Acticals as potentially useful for monitoring sleep in fire-fighters.