How Fitness Heart Rate Belts And Mobile Phones May Be Used To Screen For Sleep Disorders

Baharav A.[1,2], Eyal S.[2]
[1]Sleep Laboratory, Wingate Institute, Netanya
[2]HypnoCore LTD, Petach Tiqva, Israel

Background

Autonomic function fluctuates during day and night according to the physical activity level, cognitive tasks and emotions, sleep-wake states. Heart Rate Variability (HRV) Analysis has been widely used as a reliable non invasive measure of autonomic function. Previous studies indicate that the balance between the sympathetic and the parasympathetic activity (Autonomic Balance or AB) is lowest during Slow Wave Sleep. We suggest that when no complete PSG is available, the minimal AB (min AB) during the first part of the night may serve to define normative population values, and possibly serve as a simple screening tool for sleep disorders.

Methods

People interested in getting insight into their sleep may use an iPhone application and a fitness Heart Rate Monitor (polar H7) to record their Heart Rate (HR) during the night. The recorded data is uploaded to the cloud for further analysis and users get information regarding their sleep quality, efficiency, structure and continuity.

The HR signal can be separately analyzed to calculate the AB during different time intervals at night. Autonomic arousals can be calculated by analyzing the HR signal in the time domain. Autonomic Arousal Index (AI) has been previously shown to correlate well with the sleep fragmentation due to OSAHS. An AI higher than 15 is suggestive of a sleep related breathing disorder.

Results

Based on 3103 night recorded by 90 subjects, who used the system to track or evaluate their sleep for at least 10 nights each, between January 23rd and May 20th 2014

1. Age: 45 years (range 18-72, some not disclosed)

2. Sex: 75% Male

Arousal Index

Mean autonomic Arousal Index (AI) indicates that 25% of users have a mean AI of 16 or higher (see Figure 1).

AI varies from night to night, however if higher than 15, it is consistently so (see Figure 2)

AI correlates with mean Autonomic Balance after falling asleep (Spearman, r 0.28, p (two tailed) 0.0075, n 90)

Figure 1: Arousal Index distribution in 90 users/3103 nights. Red line indicates threshold for significant sleep fragmentation

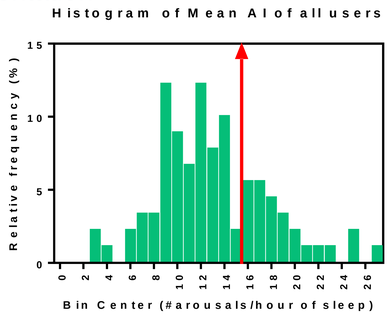


Figure 2: Arousal Index distribution of user 424 after 77 nights

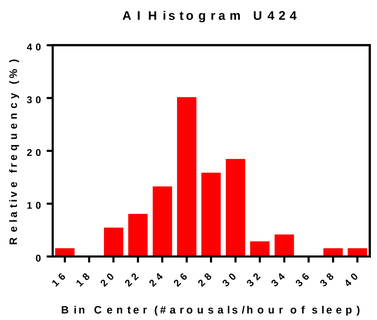
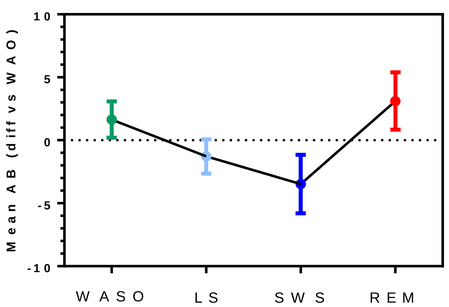


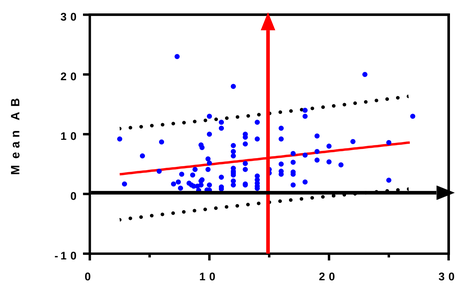
Figure 3: Mean AB per user with more than 10 tracked nights (n=90)



Autonomic Balance

Mean AB changes significantly with sleep wake states (RM one-way ANOVA, p<0.0001, see Figure 3). AB is lowest in SWS. Figure 4 shows the correlation of minimal mean AB during the first 2 hours of sleep versus AI at night.

Figure 4: min Mean Autonomic Balance (10 min during first 2h sleep) versus AI total



Conclusion

The Autonomic Balance correlates with the AI, yet there are additional factors that influence this very sensitive variable (previous day stressors and physical activity, emotions, movement, coffee and other stimulants consumption).

More data is required to define normal values and behavior of this variable during the night

The Autonomic Arousal Index remains the best candidate as a predictor of a sleep related breathing disorder. Simple validation studies are needed to define threshold values for OSAHS.