

# Exploration of the Relationship Between Body Temperature and Sleep Among Adults With Multiple Sclerosis

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## Introduction

- Temperature input from the skin is important for sleep regulation
- When awake and sedentary, thermal comfort in healthy adults occurs at mean skin temperature (Tsk) of 33-34 °C
- When asleep, the mean Tsk under neutral conditions is approximately 34.6 °C, slightly higher than when awake
- In adults with MS, lesions within the hypothalamus may impair homeostatic control of body temperature; however, to our knowledge, no one has examined the relationship between Tsk and sleep in this population

## Methods

### Design

- Observational, prospective design

### Inclusion criteria

- Adults aged 20-70 years with physician-diagnosed MS
- Community-dwelling and English literate

### Exclusion criteria

- Conditions likely to interfere with outcome assessment (e.g. Parkinson's disease, menopause, currently taking interferon beta medications)

### Recruitment

- Institutional review board approval was obtained
- Recruitment was through physical referral and the Gateway Chapter of the National MS Society website

### Data collection

- Actimetry (GeneActiv Sleep) was used to measure Tsk and sleep for 7 consecutive days

## Statistical Analysis

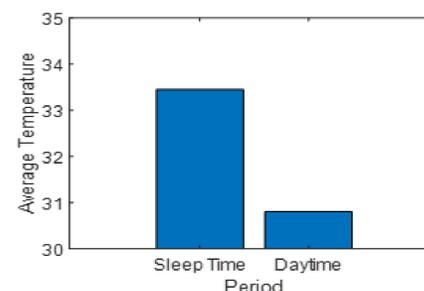
- Approximately 5000 hours of actigraphy and Tsk data was analyzed using MATLAB 2014a
- Linear polynomial regression analysis was used to examine the relationship between Tsk and sleep efficiency

## Results

**Table 1. Demographic characteristics of participants (N=30)**

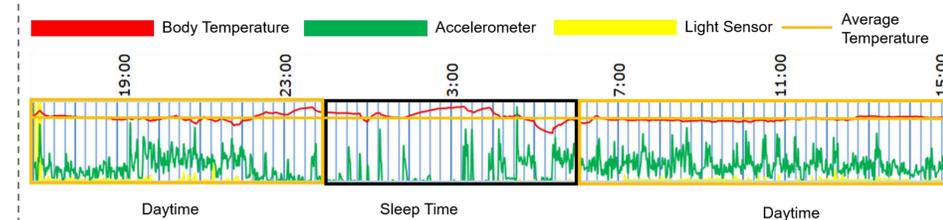
Age (years), M (SD)	45.5	(10.4)
Gender (Female), n (%)	28	(88)
Body Mass Index, M (SD)	27.0	(7.5)
Ethnicity (Caucasian), n (%)	23	(72)
Years since diagnosis, M (SD)	11	(8.0)
Years since symptom onset, M (SD)	15.8	(8.9)
Expanded Disability Status Scale, M (SD)	2.0	(2.3)
Sleep duration (minutes), M (SD)	290.1	(88.1)
Number of awake periods, M (SD)	55.8	(13.0)
Sleep efficiency, M (SD)	89.0	(4.8)

**Figure 1: Mean skin temperature during day and night**



- Mean Tsk increased 2.7 °C at lights-off and remained elevated throughout the night with a mean of 33.5 °C (Figure 1)
- During the night, we observed that increases in skin temperature of 1 degree or more preceded awakenings
- There was a linear relationship between overheating awakenings and sleep efficiency, with a SD of 4.1 in a 95% prediction interval
- We defined this new discovery as awakenings preceded by a 1-degree increase in peripheral skin temperature, which we called overheating provoked awakenings (see Figure 2)

**Figure 2: Actigram from 1 participant**



- **Of the total number of awakenings (mean=55.8; SD=13.0), 12.1% (mean=6.7; SD=4.8; range 0-12) were preceded by a 1 degree increase in Tsk.**

## Conclusions and Limitations

- Findings suggest that adults with MS have lower mean skin temperature during day and nighttime than previously described among healthy adults.
- The change in skin temperature at lights-off is much larger than observed in healthy adults.
- Interestingly, a 1-degree increase in Tsk provoked awakenings among MS patients. We defined this phenomenon as “overheating provoked awakenings” (OPA). The number of OPAs ranged widely but impaired sleep efficiency.
- Limitations include cross-sectional design, which eliminates the possibility of observing changes over time. Additionally, the sample was small and homogenous.

## Implications for Practice and Research

- Clinicians should provide information on factors known to lead to overheating prior and during nighttime.
- Future research efforts should investigate whole body thermal sensation and parameters of sleep quality among adults with MS, which would help identify interventions to improve sleep