

# Wake Up Call: How Alarm Clocks Influence Heart Rate, Core Body Temperature, and Vigilance Compared to Free Days

AbdulRafeh Usmani  
& Gemner Sandoval

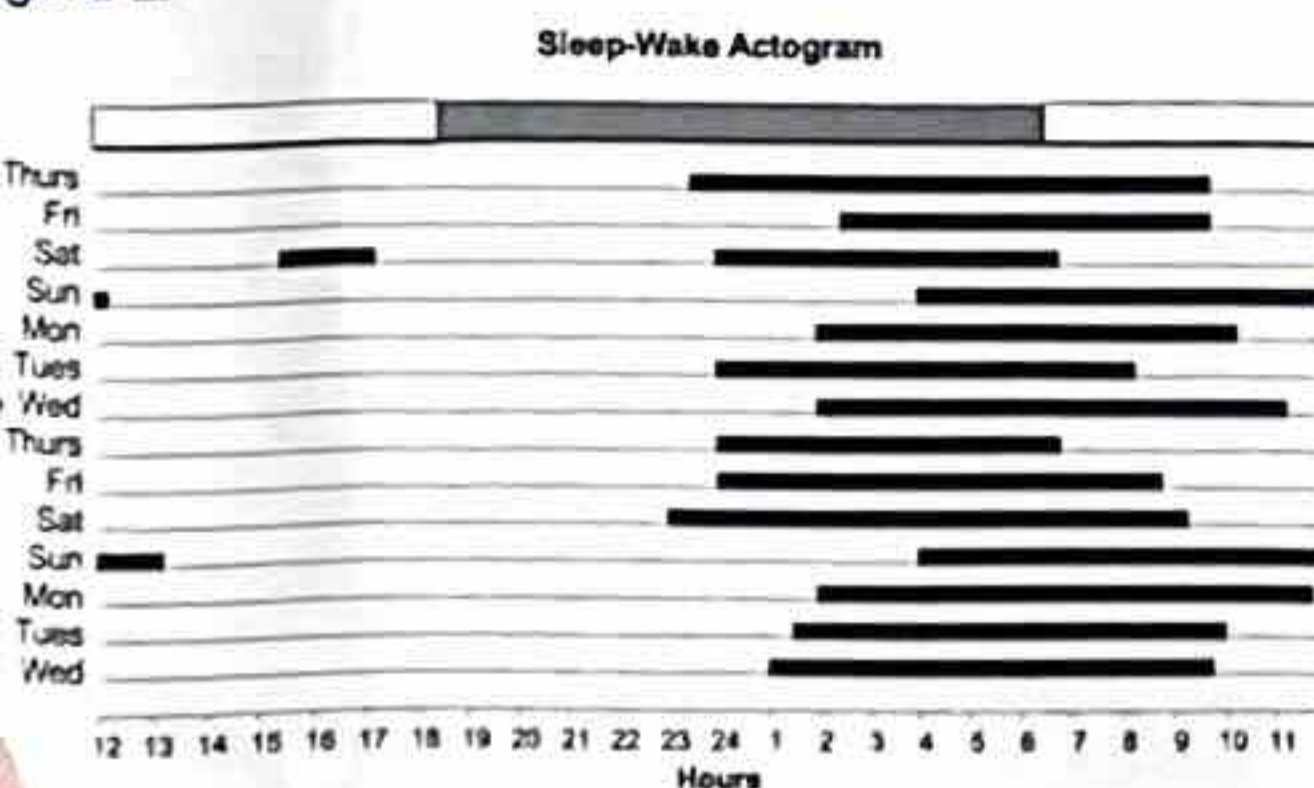
## Introduction:

The purpose of this study is to gather and analyze data regarding the effects of waking up with an alarm compared to waking up naturally, without an alarm, on a range of physiological factors, including heart rate, core body temperature, and vigilance.

## Methods:

Throughout the two-week study period, data was gathered via multiple methods. Core body temperature was measured through the use of an oral thermometer, while vigilance was evaluated using the "Lights Out" app. Participants held their finger on the screen and removed it when prompted, with the duration between the prompt and finger removal recorded in milliseconds. On average, three trials were performed each time vigilance was assessed. Heart rate was tracked with an Apple Watch, and all measurements were taken 7-8 times per day while disregarding any outliers.

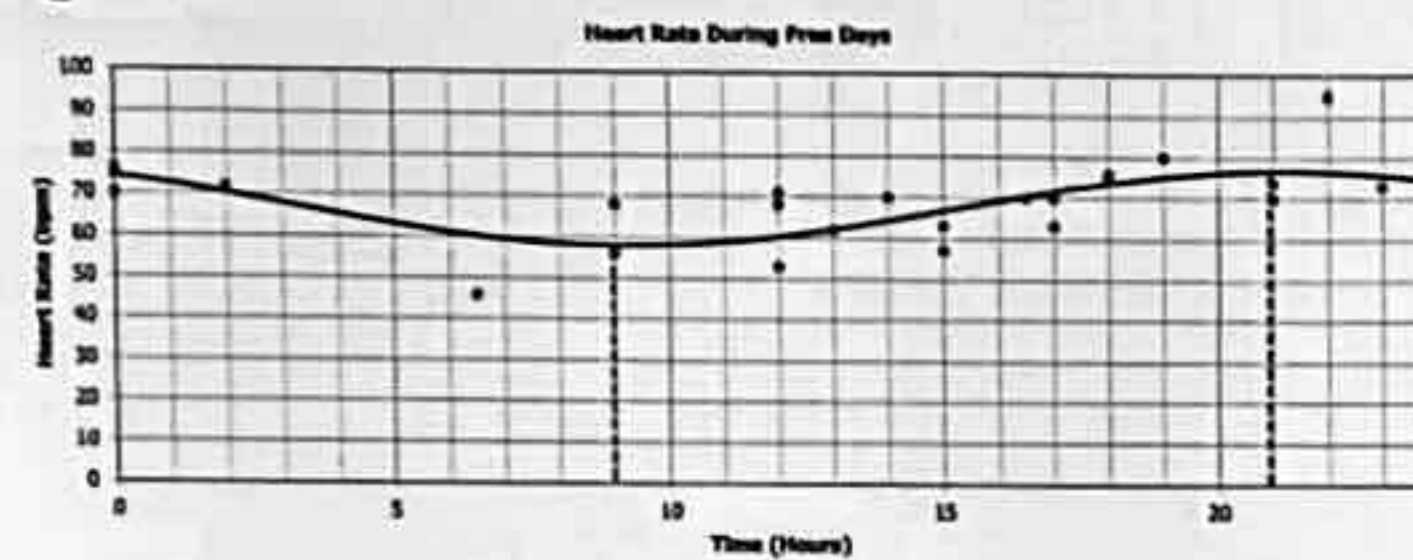
Figure 1:



Sleep-wake actogram displaying the sleep duration during the two weeks of the experiment. On a free day, the average sleep duration was 8.75 hours, with a mid-sleep time of 6:07 am. On an alarm day, the average sleep duration was 7.75 hours, with a mid-sleep time of 4:22 am. This yields a social jet lag of approximately 1 hour and 30 minutes.

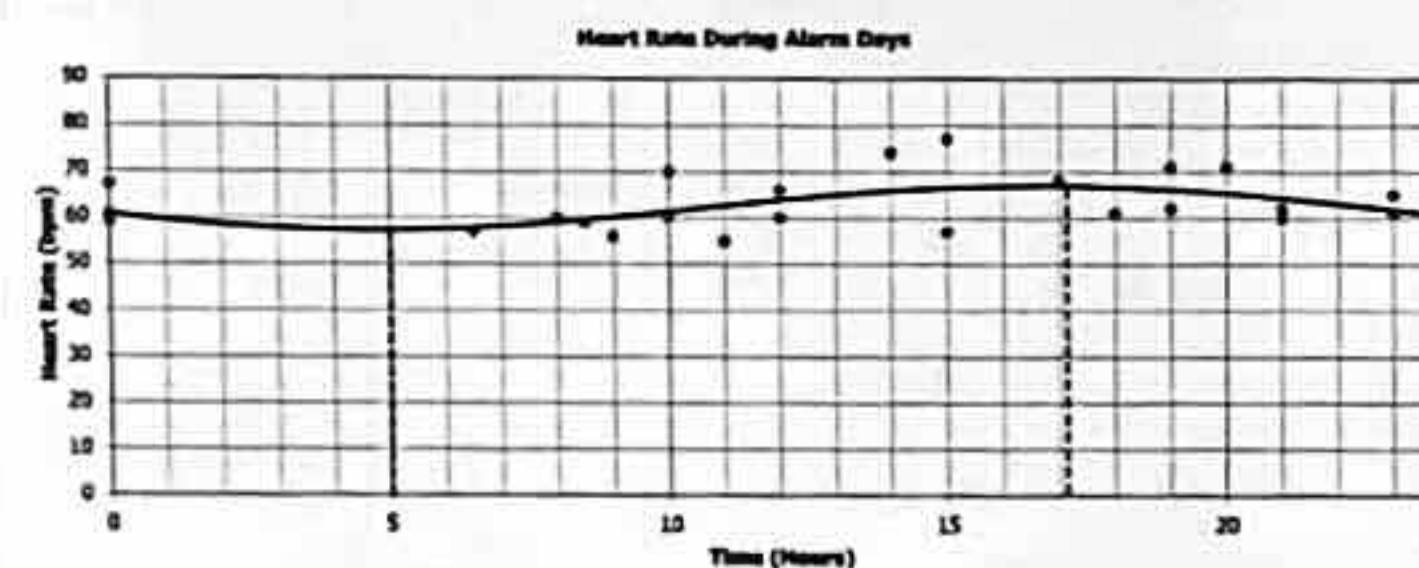
## Results:

Figure 2:



Heart Rate collected via an Apple watch throughout the free day. With the acrophase being 77.1 bpm and trough being 57.9 bpm. Average heart rate upon waking up was 58.75 bpm.

Figure 3:



Heart Rate collected via an Apple watch throughout the alarm day. With the acrophase being 67 bpm and trough being 57.4 bpm. Average heart rate upon waking up was determined to be 61.5 bpm.

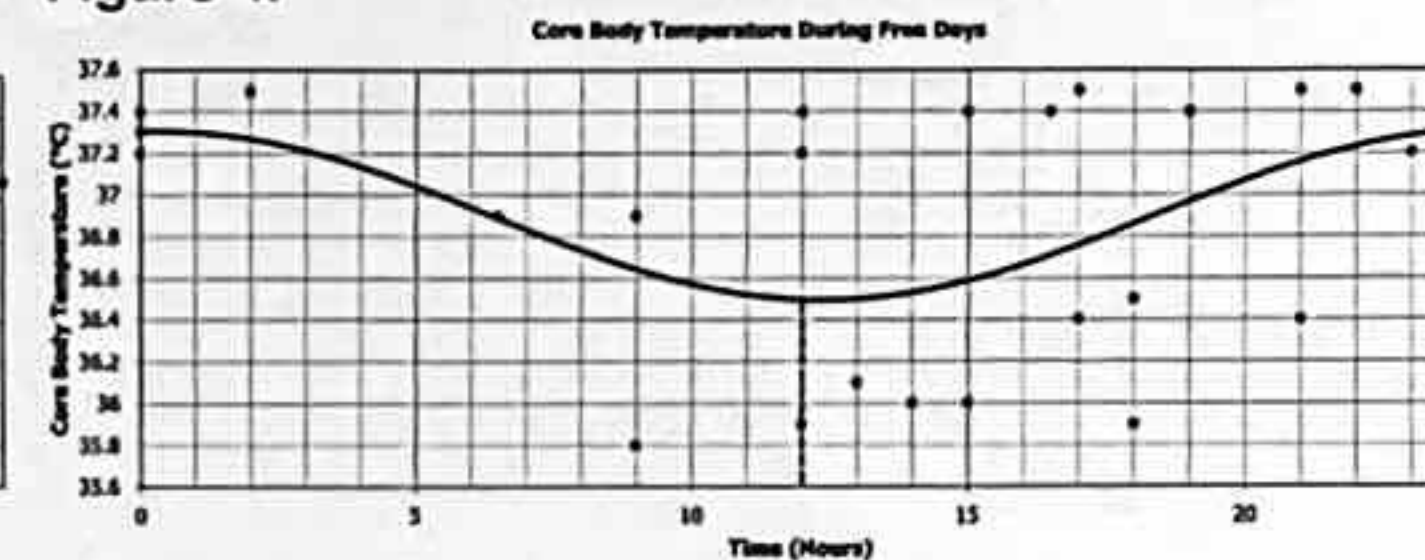
Trends noticed

It was observed that heart rate upon waking with an alarm was HIGHER compared to waking up without an alarm.

## Discussion:

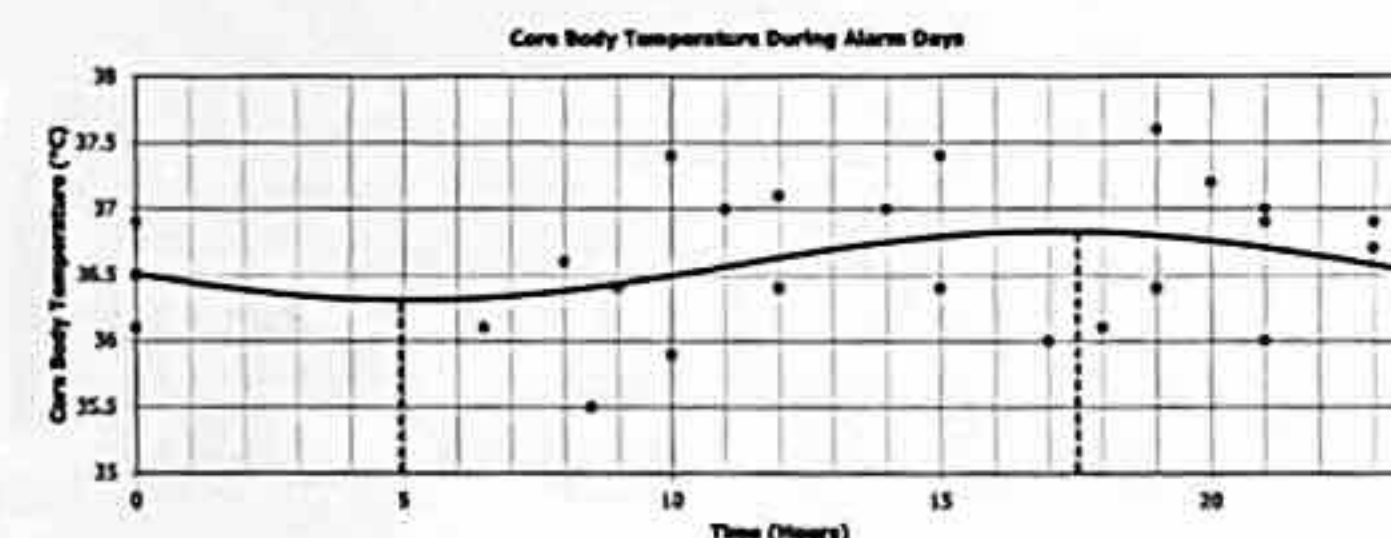
- A possible explanation for why heart rate is higher when waking up to an alarm could be due to the interruption of REM sleep. During REM sleep, the heart rate is similar to when one is awake. The alarm's interruption of REM sleep can lead to a higher heart rate compared to waking up naturally.
- Furthermore, "Snoozers had elevated resting HR and showed lighter sleep before waking" (Mattingly et al., 2022)

Figure 4:



Core body temperature collected via an oral thermometer throughout the free day. With the acrophase being 37.3 °C and trough being 36.49 °C. The average core body temp upon waking up was 36.55 °C.

Figure 5:



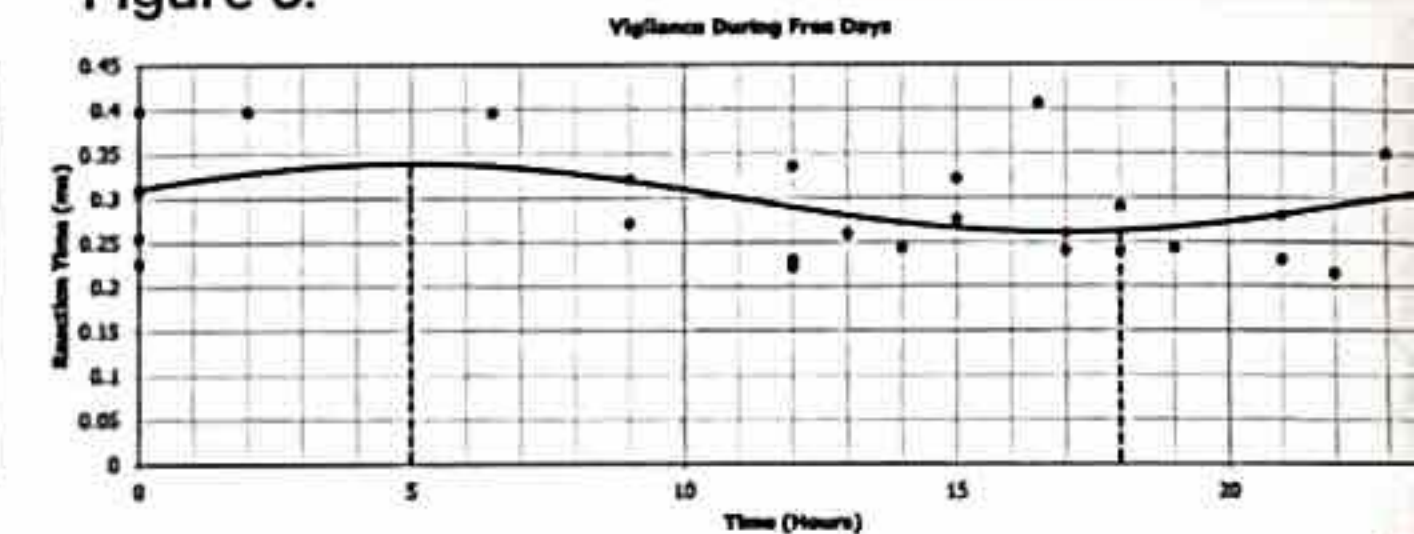
Core body temperature collected via an oral thermometer throughout the alarm day. With the acrophase being 36.8 °C and trough being 36.3 °C. The average core body temp upon waking up was 36.4 °C.

Trends noticed

It was observed that body temp upon waking with an alarm was LOWER compared to waking up without an alarm.

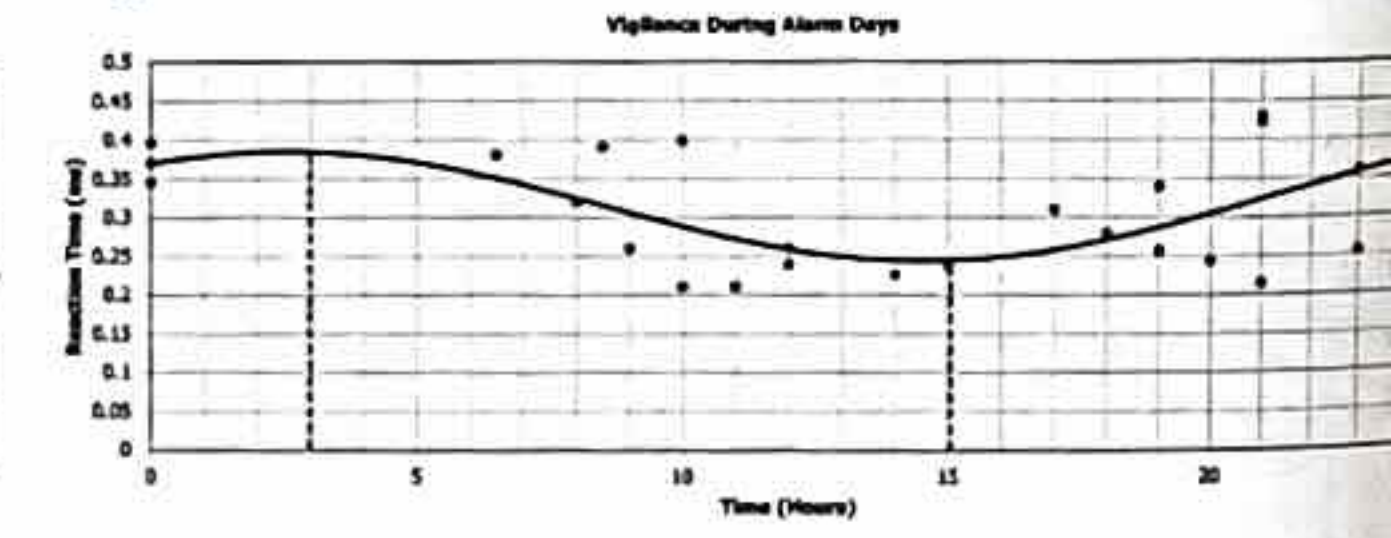
- The reason why core body temperature may be lower when waking up to an alarm clock can be explained by the natural drop in temperature that occurs during sleep. During sleep, the core body temperature can decrease by 1.5-2 degrees Celsius. When abruptly awoken by an alarm, the body's temperature is still low since it hasn't had the time to naturally warm up the body for awakening.
- NREM sleep transitions are often accompanied by a decrease in brain temperature (Harding et al., 2019). As the brain temperature decreases, it sends signals to the rest of the body to reduce metabolic activity, leading to a drop in body temperature. This process helps promote sleep and conserve energy during the night.

Figure 6:



Reaction time collected via the "lights out" app throughout the free day. With the acrophase being 0.33 ms and trough being 0.26 ms. The average reaction time upon waking up was 0.315 ms.

Figure 7:



Reaction time collected via the "lights out" app throughout the alarm day. With the acrophase being 0.385 ms and trough being 0.241 ms. The average reaction time upon waking up was 0.372 ms.

Trends noticed

It was observed that reaction time upon waking with an alarm was LOWER compared to waking up without an alarm.

explanation

- A possible explanation can be is when an alarm goes off, the body is jolted out of the sleep cycle, and it may take some time for the brain to fully adjust and transition into an alert state. This can lead to a temporary decrease in cognitive function and slower reaction times.
- Moreover, "the reaction times were better for all sleep stages in the no-snooze compared to the snooze condition" (Ogawa et al., 2022).