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Research Article

Enhancing First-Night Fall in Hotels: A Preliminary Study Utilizing Withings to Measure Sleep Patterns at Home and in Hotel Settings

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ABSTRACT

Sleep is a critical physiological process important for overall well-being, influencing physical and mental health. Sleep disorders have become increasingly prevalent, impacting a significant portion of the population. The First Night Effect (FNE) often disrupts sleep patterns in a novel environment, affecting sleep architecture. This study aimed to prevent FNE by implementing sleep enhancement interventions and assessing their impact on sleep quality using the Withings Sleep Analyzer (WSA). The study involved 49 healthy participants, comparing sleep at home to sleep in a hotel. Various sleep enhancement measures were implemented in the hotel setting, including temperature regulation, relaxation practices, dietary adjustments, and auditory cues. The WSA quantified sleep quality based on factors like duration, depth, regularity, and interruptions. Results showed significantly higher sleep scores at the hotel compared to home, particularly in individuals with lower scores at home. Sleep duration and deep sleep were also significantly increased in the hotel setting. Heart rates showed no significant differences between hotel and home nights. The study suggests that optimizing the sleep environment through behavioral interventions and environmental adjustments can enhance sleep duration and quality, mitigating the FNE. However, limitations, such as the lack of randomization and varying sleep conditions at home, should be considered in interpreting the results.

Keywords: First night effect; Polysomnographic; Rapid eye movement; Withings sleep analyzer; Total sleep time; Sleep efficiency; Standard error of the mean

INTRODUCTION

Sleep is a fundamental physiological process that remains essential for the overall well-being of living organisms [1]. It plays a pivotal role in various aspects of human physical and mental health, as well as overall well-being. Beyond its physical advantages, sleep promotes emotional well-being, stress alleviation, and heightened concentration and memory [2]. The interplay of different sleep stages, along with their dynamic evolution throughout the night, contributes to the sleep architecture and sleep continuity. Deviations from these normal sleep stages often manifest as sleep disorders [3,4]. Sleep disorders have become increasingly prevalent in recent decades, affecting a significant portion of the population. In France, for example, one in three individuals' reports experiencing sleep disturbances, with the French population now sleeping 1.5 hours less on average than they did 50 years ago [5].

Encountering difficulty sleeping in a novel environment is frequent, often termed the FNE. Polysomnographic (PSG) recordings consistently reveal compromised sleep architecture and sleep continuity during FNE, characterized by a reduction in total sleep time, increased wakefulness, diminished sleep efficiencies, a decrease in Rapid Eye Movement (REM) sleep, and prolonged REM sleep latencies on the first night fall [6-8]. Despite suggestions that FNE might extend beyond the initial night [9], increasing evidence demonstrates that FNE is often limited to the first night fall, and that sleep improves significantly during the second night fall, particularly in young and healthy participants [6,10-12].

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During sleep, several physiological changes affect different body systems. These changes include modifications in cardiovascular parameters, respiratory patterns, cerebral blood flow and metabolism, shifts in renal function, and on endocrine functions [13-15]. These changes are well-tolerated in healthy individuals, while they may pose challenges to those with underlying health conditions. Also, sleep deprivation is recognized to have detrimental effects on both physiological and psychological well-being [16], which encompasses altered mood states, compromised decision-making skills, and cognitive impairment [17].

Our approach aims to prevent the FNE, encompassing a spectrum of sleep enhancement interventions, incorporating carefully designed practices to create an ideal sleep setting. We hypothesized that participants following this procedure would not have FNE in the hotel compared to home. To evaluate the duration of sleep and appraise its quality, we used wearable innovative tools that do not require any attachments to the body such as the Withings Sleep Analyzer (WSA) [18,19].

This study compared home sleep compared to sleep at hotel in 49 healthy medication-free participants using WSA to assess whether FNE may be prevented by sleep enhancement interventions.

MATERIALS AND METHODS

Participants

Among the 60 screened participants, sleep data at both home and the hotel were successfully obtained for 49 individuals. Participants for whom sleep data were not recorded or correctly collected, either at home and/or at the hotel were excluded from the analysis. The average age of participants was 37 years (± 9.97), with 66% women, 32% men, and 2% other, undefined. The study focused on healthy volunteers without specific medical conditions or the intake of sleep drugs. All participants provided signed informed consent before participating in the study (Dream'night Hôtel Sofitel Arc-de-Triomphe study).

Study design

The study included two consecutive nights of sleep assessment, in which participants spent the initial night at home and the subsequent night in a hotel, with a few exceptions. The study utilized the Withings Sleep Analyzer (WSA), a device designed to assess sleep quantity [18], to compare nights in both settings, at home and in the hotel. WSA was positioned beneath the participants' mattresses. The Sleep Analyzer is classified as a medical device of level 2, designed to detect moderate to severe sleep apnea syndrome but also to evaluate sleep quality. Briefly, WSA consists of an air-filled thermoplastic polyurethane cushion linked to a pressure sensor. The device is encased in a protective sleeve and is powered by a 5V 1A power adapter, supplied with the device. Within the sleeve lies the air pocket, connected to a housing safeguarding the electronic components of the device. Automatic sleep period detection occurs in two stages. Initially, an algorithm detects the user's presence or absence on the bed, followed by a second algorithm that categorizes each minute as awake or asleep. Both algorithms employ a classifier that takes input from body movement, respiration, and heart rate activity channels, subsequently outputting the user's state (in bed/out of bed and awake/asleep). Total Sleep Time (TST) is defined as the total number of minutes during which a user is detected in bed and simultaneously labeled as asleep. Sleep Efficiency (SE) is calculated as TST divided by the total number of minutes during which a user is detected in bed.

WSA quantifies sleep quality and derives a 100-point score based on four key factors: Duration (total time spent sleeping), Depth (proportion of the night spent in restorative phases), Regularity (consistency in bedtime and wake-up times), and Interruptions (awake time). Duration and depth are the most important factors in computing the sleep score.

Sleep enhancement measurements

The study was conducted at the Sofitel Arc de Triomphe hotel in Paris, France. In the pursuit of optimizing sleep quality during hotel stays, various aspects have been established to promote restful sleep, from changing temperature, light, noise, food to relaxation. Temperature regulation is a pivotal factor in optimizing sleep, and this study maintained an ambient room temperature of 18°C to create the ideal sleep environment [20-24]. We also encouraged the use of warm socks, ensuring that individuals maintain physical warmth throughout the night for added comfort [25]. The Sofitel bed "MyBed" is designed exclusively for Sofitel and provides targeted pressure relief, ensuring comfort to the participants.

The food menu further emphasizes the interplay between dietary choices and sleep quality avoiding excesses in fat, salt, sugar, or spice, a selection chosen by a committee of scientific experts to guarantee a restorative night's sleep [26,27]. The study also focuses on auditory environments. It highlights the benefits of white and pink noise generators, which have a calming effect on the nervous system. Silicone earplugs that provide silence, have also been proposed, enabling restorative sleep undisturbed by external noise [28-30]. These auditory cues can mask unwanted external noises, establish a regular ambient background, and assist in focusing the mind during the process of falling asleep [31,32].

The study promotes the implementation of a structured pre-sleep routine, featuring a session with the "Morphée" meditation box. This practice aims at reducing anxiety, combating bad sleep at night, and fostering relaxation, ultimately leading to improved sleep quality [33-35]. Accompanying this with a herbal tea to promote a restful sleep [36-38].

The "Baume du Dodo", a lip balm that ensures soft lips during the night, together with a silk sleep mask, naturally hypoallergenic and gentle on the skin, were proposed to block out light for an uninterrupted sleep experience. Finally, a pillow spray enriched with essential oils, including lavender, chamomile, and marjoram, contributes to quicker sleep onset and improved sleep quality [39-42].

Statistical analysis

The statistical software GraphPad PRISM was used for conducting statistical tests. Statistical significance was assessed using Paired t-test. Data are presented as mean ± SEM (Standard Error of the Mean). In the figures the following scheme is used to express p-values: *denotes P ≤ 0.05; **P ≤ 0.01; ***P ≤ 0.001; ****P ≤ 0.0001.

RESULTS

Global sleep score and sleep quality variations

Among 60 participants enrolled in the study, sleep measurements were successfully obtained for 49 individuals. The average sleep scores were significantly higher at the hotel compared to home setting (Figure 1A).

All participants were healthy with no sleep abnormalities. A subgroup analysis was conducted, focusing on individuals classified as poor-quality sleep participants, having sleep scores below 60 at home (n=20). For this subgroup, the sleep score at the hotel was significantly higher than that at home (Figure 1B), indicating that these poor-quality sleep participants experienced improved sleep quality at the hotel.

In participants with a high global sleep score (score >80), 52.8% (n=28) achieved this score at the hotel, compared to only 30% (n=16) at home (Figure 1C).

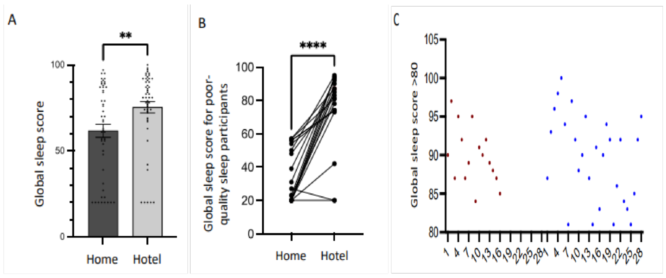

Figure 1: Variations in global sleep scores quality. Measurement of overall sleep score for all participants (A) and for poor-quality sleep participants (B). Each point represents the score of a participant measured at home and at the hotel. Data is represented as mean ± SEM. Paired t-test was used to determine the statistical significance between the two groups. (C) Number of participants with a high overall sleep score (>80). **Note:** ( ) ( ) home; ( ) ( ) hotel.

Sleep duration and deep sleep quality

The duration and quality of sleep are two important factors that profoundly impact the computation of the sleep score. An analysis showed that participants experienced a significantly longer average sleep duration at the hotel (~453 min) compared to their sleep at home (~388 min). On average, this translates to an additional 65 minutes of sleep enjoyed by participants at the hotel (Figure 2A).

The duration of deep sleep, characterized by a profound relaxation of the body and a further slowdown of respiratory and heart rates, was significantly greater at the hotel compared to the home environment (Figure 2B). This observation highlights a superior sleep quality experienced at the hotel, marked by more extended and restorative phases of deep sleep.

Heart rates did not differ between nights spent at the hotel and at home (Figure 2C). This suggests that the sleep environment, whether at the hotel or home, did not significantly influence participants' heart rates during sleep.

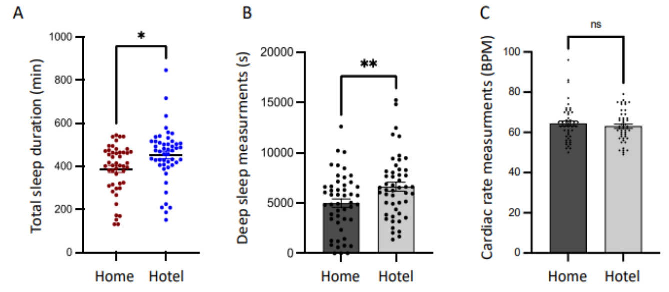

Figure 2: Measurement of sleep duration and heart rate. (A) Measurement of total sleep duration. Each red or blue point represents a participant's sleep duration in minutes at home or at the hotel, respectively; (B) Measurement of deep sleep at home and at the hotel; (C) Heart rate measurement. Each point represents an individual participant's measurement during sleep. Data is presented as mean ± SEM. BPM: Beat Per Minute. **Note:** ( ) ( ) home; ( ) ( ) hotel.

DISCUSSION

This study examined the relationship between sleep duration and the surrounding sleep environment using the Withings Sleep Analyzer in healthy volunteers, with the aim of enhancing the overall sleep experience for individuals away from their familiar sleeping environment and thus avoid the FNE. This study provided a broad spectrum of factors that have the potential to enhance sleep duration and quality. For instance, the dietary habits such as avoiding excessive caffeine or heavy, spicy meals close to bedtime can improve sleep patterns. Practices such as meditation, progressive muscle relaxation, or controlled breathing can help individuals alleviate stress, a common disruptor of sleep. Offering an optimal ambient temperature, a silent environment, and without light certainly also helped improve sleep in a hotel setting [43,44]. These techniques were an integral component of a sleep-conducive environment by creating a state of mental promoting sleep initiation and maintenance. Notably, individuals classified as healthy but with sleep scores below 60 at home, demonstrated enhanced sleep quality when exposed to the optimized sleep environment at hotel. The prolonged duration of deep sleep observed in the participants also pointed to the potential of environmental adjustments to promote this essential phase of sleep.

During sleep, the heart rate usually drops, indicating the body's restful state [45,46]. Individual variations exist in both awake and sleeping heart rates, but no changes were found between nights spent in hotels and at home. This suggests that the sleep environment, whether in a hotel or at home, had no significant impact on participants' heart rates during sleep.

Study limitations

Our study has several key limitations that merit consideration. Firstly, the lack of randomization in the selection the nights spent at home and in a hotel can introduce bias into the study, as individual preferences, habits, or environmental factors may influence the results. Furthermore, the night spent in a hotel may not be optimized if the enhancement program is not fully implemented. The lack of data specifying which enhancement measures were tracked and which are important to the overall experience further hampers the study's ability to draw definitive conclusions. Indeed, it remains unclear how rigorously participants adhere to the proposed measures and to what extent they consider them as effective, raising questions about the reliability and consistency of the findings. Addressing these limitations is essential for ensuring the robustness and validity of any comparative sleep study between home and hotel environments. Sleep recordings in hotel and home settings were carried out during the weekdays and weekends, reflecting the variability of bedtimes, rising times and time in bed durations between days. Additionally, participants were recommended to participate in regular work activities the day after the hotel night, simulating the demands of everyday life. Bed arrangements exhibited variability, as participants were either alone in the hotel bed (with one exception), or, at home, the presence or absence of a bed partner was not explicitly specified. Unlike the hotel, factors such as ambient temperature, lighting and noise were not standardized at home, reflecting the variability of sleep environment under home conditions.

CONCLUSION

In conclusion, this study highlighted the importance of considering sleep solutions for conditions like the first-night effect, combining behavioral interventions, and optimizing sleep environments to improve sleep duration and quality. The preliminary study conducted on enhancing first-night fall in hotels through the utilization of Withings to measure sleep patterns at home and in hotel settings has provided valuable insights into the potential impact of the hotel environment on guests' sleep quality. This study underscores the importance of customized sleep solutions for conditions like FNE, emphasizing the need for a holistic approach that combines behavioral interventions and optimized sleep environments to improve overall sleep experience.

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CONFLICT OF INTEREST

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