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Home Nursing Intervention Using NemuriScan for Sleep Issues in a Patient with Bipolar Disorder: A Case Report

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Abstract

Background: Sleep disturbances are a common challenge for individuals with bipolar disorder (BD), contributing to a reduced quality of life, cognitive impairment, and a heightened risk of relapse. Home-visit nursing plays a crucial role in promoting sleep hygiene and stabilizing daily rhythms in individuals with BD. This case report explores the integration of Nemuri Scan (NSCAN) into home-visit nursing care to enhance sleep management for a person with BD.

Methods: This case report employed a prospective observational design, monitoring the sleep patterns of a 50-year-old woman diagnosed with BD who received home nursing care. NSCAN was placed under her mattress to collect objective sleep data over 390 days. Key sleep parameters were recorded, including total sleep time, sleep efficiency, and nighttime awakenings. Data were shared biweekly with both the participant and the home-visit nurse, who incorporated the findings into the Wellness Recovery Action Plan (WRAP) framework to inform self-management strategies and nursing interventions.

Results: The participant's sleep patterns progressed through four distinct phases, reflecting variations in sleep duration, deep sleep percentage, and nocturnal awakenings. Objective sleep monitoring facilitated personalized nursing interventions, including goal-setting to increase daytime activity and improve sleep-wake rhythms. The integration of NSCAN data into WRAP-based dialogue enabled the participant to identify personal well-being indicators and adopt proactive self-management strategies.

Conclusion: This case report underscores the potential of non-wearable sleep monitoring devices in home-visit nursing care for individuals with BD. The combination of objective sleep data and self-management support contributed to improvements in sleep patterns and daily rhythms. These findings suggest that integrating sleep monitoring into nursing interventions may enhance recovery-oriented care for individuals with BD.

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Introduction

Sleep disturbances, including irregular sleep patterns and sleep deprivation, are prevalent in both depressive and manic states of bipolar disorder (BD) [1]. Previous studies indicate that over 60% of individuals with BD experience some form of sleep disorder, with approximately 50% suffering from insomnia and 30% from hypersomnia [1]. These disturbances, along with circadian rhythm disruptions, have been associated with reduced quality of life (QoL), cognitive impairment, and an elevated risk of relapse and suicide [1], making sleep regulation a central concern in BD management. Consequently, maintaining a stable daily rhythm and addressing sleep disturbances are critical components of care for individuals with BD.

Home-visit nursing plays a crucial role in promoting regular daily rhythms and supporting sleep hygiene in individuals with BD [2]. It has also been shown to be effective in symptom stabilization and relapse prevention [3,4]. Traditionally, subjective methods such as sleep diaries and questionnaires have been used to assess sleep-wake patterns in individuals with BD living in the community [5]. However, these assessments may not always provide an accurate representation of actual sleep patterns. Advances in objective sleep monitoring through wearable devices now allow for detailed 24-hour assessments of sleep and activity rhythms [6]. A systematic review analyzing activity patterns in BD found that, compared to healthy individuals, those with BD tend to have prolonged sleep duration, increased total sleep time, and reduced daytime activity levels [6]. Additionally, a study that monitored patients with BD using actigraphy over one year reported that changes in activity patterns were detected an average of two weeks before the onset of mood episodes [7]. These findings suggest that objective sleep and activity monitoring could serve as a valuable tool in home nursing by facilitating the early detection of warning signs and aiding in relapse prevention.

Several devices are available for objective sleep monitoring, including wearable actigraphy devices and non-wearable sensors such as the Nemuri Scan (NSCAN; Paramount Bed Co., Tokyo, Japan), which is placed under the mattress. Wearable devices offer the advantage of collecting multiple physiological parameters, but they also present challenges , such as discomfort associated with wearing the device and limited capability in assessing daytime sleep [8]. In contrast, NSCAN is a thin, non-contact sensor that detects body movements and vibrations to determine sleep and wake states, minimizing user burden while allowing for daytime sleep assessment. A validation study comparing NSCAN with polysomnography (PSG), the gold standard for sleep evaluation, reported an agreement rate of 92.4%, a sensitivity of 97.6%, and a specificity of 33.8% [9]. These sensitivity and specificity values are comparable to those observed in studies

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comparing NSCAN with actigraphy [9]. However, to the best of our knowledge, no studies have examined the use of objective sleep monitoring devices in individuals with BD.

In this case report, we describe the use of NSCAN to objectively monitor the sleep patterns of a client with BD experiencing sleep disturbances. The collected data were shared with both the client and the home-visit nursing team to help improve daily rhythms and support self-management. The nursing intervention was based on the principles of the Wellness Recovery Action Plan (WRAP) (10), a framework designed to empower individuals in managing their health. By integrating objective sleep monitoring with self-management support, the client showed improvements in both sleep patterns and daily routines. This report underscores the potential value of incorporating sleep monitoring devices into home-visit nursing care for individuals with BD.

Methods

Design and Participant

This study was a case report employing a prospective observational design. Sleep data were collected at home using the NSCAN in clients with mental disorders who were receiving home-visit nursing care in Osaka. Participants were selected by the manager of the nursing station based on the following criteria: [1] the ability to walk independently and a confirmed diagnosis of a mental disorder by a psychiatrist, [2] self-reported difficulties with sleep, and [3] an assessment by the home-visit nurse indicating issues related to sleep and daily rhythm. As the NSCAN requires electricity, participants were provided with 500 yen to cover the associated cost.

The participant was a woman in her 50s diagnosed with BD. Her parents, who reside in another prefecture, provide financial support. She had a history of one prior hospitalization but had remained out of the hospital since discharge. Previously employed as a healthcare worker, she currently receives disability pension support and has been unable to return to work due to mood instability and disrupted daily rhythms, leading to prolonged periods spent at home. Acknowledging that fluctuations in her mood were negatively affecting her sleep patterns and daily life, she expressed interest in participating in this study.

Clinical background

The participant was diagnosed with depression at the age of 35 and was hospitalized for approximately three months, six months after the initial diagnosis. She subsequently experienced mood fluctuations and was later diagnosed with BD, continuing outpatient psychiatric care. Although she had temporarily discontinued visits to her psychiatric clinic, she had resumed regular outpatient care by the time she participated in the study. Seeking to stabilize her daily life without being overwhelmed by emotional fluctuations, she received home nursing visits once a week.

The participant reported spending prolonged periods at home due to mood instability and irregular sleep patterns, which contributed to reduced activity levels. During the study period, her prescribed medications included lithium carbonate (800 mg), carbamazepine (200 mg), and flunitrazepam (2 mg). Home-visit nursing care was structured around the WRAP framework, supporting discussions between the participant and the nurse regarding her well-being, daily routines, and self-management strategies.

Intervention and monitoring procedure

Sleep data were collected using NSCAN, a non-wearable actigraphy system equipped with pressure sensors placed under the mattress to assess sleep status while minimizing user burden. The device is 1.5 cm thick and does not interfere with sleep. It was positioned under the futon, and the participant's sleep-wake patterns were continuously recorded. Sleep monitoring was conducted over 14 months (a total of 406 days). Since data analysis was performed on a monthly basis and the final month contained insufficient data, only 13 months of data (a total of 390 days) were included in the analysis. The collected data included total time in bed per day (minutes), total sleep time per day (minutes), total time in bed at night (minutes), total sleep time at night (minutes), total time in bed during the day (minutes), total sleep time during the day (minutes), sleep efficiency (%), sleep onset latency (minutes), number of nighttime awakenings, and deep sleep index (a proprietary measure reflecting sleep depth and quality).

Throughout the monitoring period, the participant received biweekly feedback on her sleep data from the researchers, who visited her alongside the home-visit nurse. Using this data, the home-visit nurse and the participant collaborated to assess her situation, identify challenges, and develop care strategies.

Additionally, the participant and home-visit nurse maintained a structured record-keeping system based on the WRAP framework. This system included documentation of the participant's perspectives, input from family and supporters, and descriptions of her "what I look like on my best day" during stable periods. At each home-visit, the nursing care plan was reviewed and adjusted accordingly. Since the participant was already familiar with WRAP, she actively engaged in discussions with the home-visit nurse to develop effective self-management strategies for addressing sleep disturbances and mood fluctuations.

Ethical Considerations

The researcher provided a comprehensive explanation of the study both verbally and in writing, and written informed consent was obtained from the participant. She was informed that participation was voluntary, that she could withdraw from the study at any time without consequences, and that all data would be anonymized. The study was approved by the ethics review committee of the affiliated institution (Approval No. 27-4) and conducted in accordance with the CARE guidelines for case reports [11].

Results

During the 390-day sleep monitoring period, the participant's sleep patterns and daily activities underwent four distinct phases of change. The monitoring period, spanning from October 2015 to October 2016, was divided into four phases: Phase 1 (October–December 2015), Phase 2 (January–March 2016), Phase 3 (April–June 2016), and Phase 4 (July–October 2016). The progression of sleep patterns throughout the study is illustrated in Figure 1, which presents the monthly average total sleep time and nighttime sleep duration. Additionally, periods during which the participant and the home-visit nurse established specific goals and implemented strategies to increase activity levels are indicated in the figure. Table 1 summarizes the mean values of sleep parameters across the four phases, with hypersomnia quantified as the proportion of deep sleep during each period. The details of each phase are described below.

	Phase 1	Phase 2	Phase 3	Phase 4
	min / % (SD)	min / % (SD)	min / % (SD)	min / % (SD)
Nighttime Sleep Duration (min)	720.2 (257.6)	566.2 (289.0)	391.8 (230.7)	424.3 (232.8)
Daytime Sleep Duration (min)	219.5 (193.5)	174.6 (151.8)	117.2 (106.7)	195.3 (153.2)
Total Sleep Duration per Day (min)	939.7 (200.2)	740.8 (291.9)	509.0 (253.2)	619.6 (268.7)
Sleep Efficiency (%)	79.5	77.6	86.3	82.9
Sleep Onset Latency (min)	13.4 (13.5)	18.4 (18.5)	13.0 (9.4)	20.0 (14.9)
Number of Nocturnal Awakenings	4.5 (3.5)	3.5 (3.01)	0.8 (1.3)	1.34 (1.8)
Hypersomnia (%)	85.7	54.0	19.7	35.3
Nighttime Time in Bed (min)	873.5 (304.0)	689.0 (325.0)	443.0 (265.6)	496.64 (275.8)
Daytime Time in Bed (min)	312.0 (257.7)	311.0 (218.6)	240.5 (163.8)	331.08 (197.5)
Total Time in Bed per Day (min)	1185.5 (201.2)	1000.0 (282.2)	683.5 (286.5)	827.72 (295.3)

Table 1: Characteristics of Sleep Data in Four Periods.

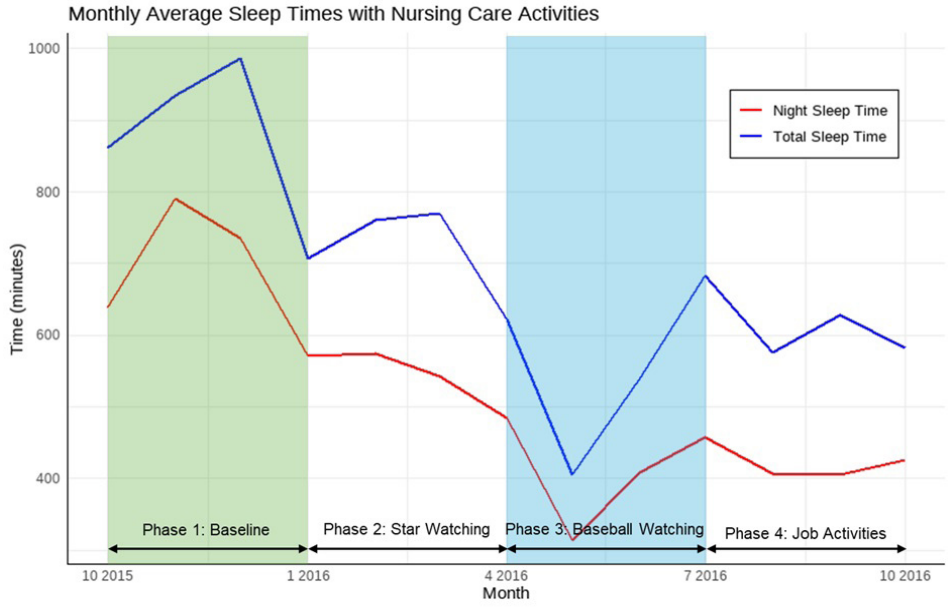

Figure 1: Monthly Trend of Average Sleep Duration.

Phase 1 (Months 1–3; Baseline)

During the first three months, the average total sleep time exceeded 900 minutes per day, with an average of 4.5 nighttime awakenings. The proportion of deep sleep remained high at 79.5%, and hypersomnia was present during 85.7% of this phase. The participant spent an average of 1,185 minutes per day in bed, indicating that she remained lying down for most of the day. Although she reported to the home-visit nurse that her sleep rhythm was improving despite occasional prolonged sleep, sleep monitoring data revealed extensive time spent in bed. Upon reviewing these results, she reflected on her sleep patterns and expressed a desire to address them. Using the recorded sleep data, the participant and the home-visit nurse retrospectively analyzed her activities and mood on days when she achieved optimal sleep and daytime activity, identifying personal indicators of well-being. Together, they recognized "being able to focus on the stars and the moon" as a personal indicator of "what I look like on my best day." Based on this insight, they collaboratively developed goals and strategies to increase outdoor activities.

Phase 2 (Months 4–6; Star Watching)

Based on the participant's sense of well-being and the shared goal of increasing the frequency of going outside to look at the stars, a specific objective was set (Phase 2: Star Watching). During this period of home nursing care, sleep data were presented, and both the participant and the home-visit nurse observed that her sleep conditions improved as a result of actively engaging in star watching.

During this phase, the average nighttime sleep duration was 566 minutes, and the number of nighttime awakenings was 3.5, both of which were lower than in Phase 1. However, the average daily time spent in bed remained at 1,000 minutes, and the deep sleep percentage was 77.6%, both of which were also lower than in Phase 1. In response to these monitoring results, the participant reflected that the increase in activity sometimes led to taking naps or lying in bed idly.

Phase 3 (Months 7–9; Baseball Watching)

During this period, the participant's interests expanded beyond watching the stars and the moon, leading to a new goal of attending her

nephew's baseball game, which she set and shared with the stabilize, and the frequency of activities, including going out, home-visit nurse (Phase 3: Baseball Watching). The participant also discussed details of the game during home-visits. It was observed that setting personal goals motivated her to go out more frequently. Additionally, while reviewing sleep data, the participant and the home-visit nurse explored the relationship between activity levels, sleep duration, and overall physical condition, as there were days during this period when her sleep duration was particularly short. During this phase, the number of nighttime awakenings decreased to 0.8, the lowest among all four phases, while the deep sleep percentage increased to 86%, the highest recorded. However, the average nighttime sleep duration was 391 minutes, the shortest among all phases. The average daily time spent in bed was 683 minutes, the average daytime sleep duration was 117 minutes, and the percentage of oversleeping was 19.7%, the lowest across all four phases.

Phase 4 (Months 10–13; Job Activities)

During this period, the participant's daily routine began to increased. However, the average daily time spent in bed increased by approximately 150 minutes compared to Phase 3, reaching 827 minutes. As part of home nursing care, the participant set a goal of engaging in activities related to employment and adjusted her priorities accordingly (phase 4: Job Activities). When the home-visit nurse and the participant reviewed the sleep data, which indicated an increase in daytime bed rest, the participant explained that she was managing her activities independently, choosing when to go out during the day in response to rising summer temperatures. During this phase, the nighttime sleep duration was 424 minutes, the deep sleep percentage was 82.9%, and the average number of nighttime awakenings was 1.3.

Discussion

This case study suggests that non-wearable objective sleep monitoring devices may be valuable for assessing sleep patterns in individuals with BD living in the community. Furthermore, in the context of home nursing care for individuals with BD experiencing sleep disturbances, sharing objective sleep data and incorporating it as a self-monitoring tool could facilitate improvements in daily rhythm and self-management.

Traditionally, sleep diaries and self-reported questionnaires have been commonly used to assess sleep conditions. Additionally, wristwatch-type actigraphy determines sleep and activity patterns based on wrist movements(6); however, this method may be insufficient for accurately evaluating sleep in individuals with hypersomnia who spend up to 20 hours per day in bed, such as the participant in this study. In such cases, a non-wearable sleep monitoring device offers a distinct advantage, as it enables continuous and unobtrusive monitoring once installed. In BD, where mood fluctuations can lead to depressive episodes, the effectiveness of wearable sleep devices may be limited by patient adherence, making long-term monitoring challenging(1). In this study, continuous monitoring for 390 days was feasible due to the non-contact nature of NSCAN. Additionally, biweekly feedback on sleep patterns was provided to both the participant and the home-visit nurse. This process not only helped the participant develop an objective understanding of her own sleep patterns but also served as a valuable information-gathering tool for the nurse, facilitating personalized interventions. The presentation of objective sleep data enabled both the participant and the nurse to identify sleep patterns, sleep-inhibiting factors, and factors influencing daily rhythm improvement-insights that may not have been apparent through subjective sleep reports alone.

In nursing interventions aimed at improving sleep and daily rhythms in individuals with BD, it is essential not only to present objective monitoring data but also to integrate it into collaborative discussions between the participant and the home-visit nurse, enabling the participant to use the data as a self-monitoring tool. Previous studies on WRAP interventions for individuals with BD have reported increased hope, improved recognition of early symptom signs, strengthened self-management skills, and enhanced QoL [12]. In this study, sharing sleep data between the participant and the home-visit nurse encouraged the participant to reflect on her daily life, a process closely aligned with WRAP concepts such as "what I look like on my best day," "early warning signs," and "stressors." Through this process, the participant actively utilized her own resources to manage challenges, demonstrating the practical application of WRAP's "Wellness Toolbox." A core principle of nursing interventions for individuals with BD living in the community is to leverage their strengths while enhancing educational support and coping strategies [13]. In this case, integrating objective sleep data with WRAP-based support enabled the participant to apply her own strengths in managing sleep and self-regulation. Additionally, the presentation of objective sleep data played acrucial role in sustaining self-management. Regular biweekly feedback on sleep patterns likely facilitated active behavioral engagement, particularly from Phase 3 onward, when the participant's subjective perception of sleep and daily rhythm improvements began to align with the objective data, reinforcing motivation for behavior change.

This case study has several limitations. First, the accuracy of NSCAN remains a concern. NSCAN has limitations in sensitivity, meaning that wakefulness without body movement may be mistakenly classified as sleep. This issue is particularly relevant in Phases 1 and 2, when the participant exhibited low activity levels, increasing the likelihood of false sleep detection. However, as the participant was aware of her limited range of activities and infrequent outings, she was able to accurately track changes in time spent in bed. Therefore, in this specific case, feedback on sleep data was likely effective in improving daily rhythm. Another limitation is that activity data were derived from subjective nursing records, which were based on the participant's self-reported descriptions. In the future, integrating applications capable of tracking mood and activity could enable more personalized and adaptive nursing support [14]. to further enhance the accuracy of sleep monitoring, future research should explore machine learning-based models that integrate diverse data sources to refine sleep pattern analysis and develop individualized intervention strategies.

Conclusion

This case report demonstrated that the use of a non-wearable sleep monitoring device provides a more accurate assessment of sleep patterns in individuals with BD living in the community. Furthermore, the findings suggest that incorporating objective sleep data as a self-management support tool can contribute to improvements in sleep and daily rhythms, ultimately facilitating nursing care that promotes recovery.

Competing Interests

The authors declare that they have no competing interests.

Author Contributions

Conceptualization: So Yayama; Methodology: So Yayama; Resources: So Yayama; Investigation: So Yayama, Kei Matoba; Data Curation: So Yayama, Kei Matoba; Formal Analysis: Kei Matoba; Writing – Original Draft: Kei Matoba; Writing – Review & Editing: So Yayama, Kei Matoba; Funding Acquisition: So Yayama; Project Administration: So Yayama.

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