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ACTIGRAPHY IN WORKER POPULATIONS: A SHORT REVIEW OF ITS APPLICATIONS AND FINDINGS

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Abstract
Background: Actigraphy is a method for monitoring sleep patterns through movement tracking, offering advantages like low cost and continuous data collection. It's useful in large-scale research and assessing sleep disturbances in real-world occupational settings. **Objective:** This study aims to evaluate the application of actigraphy in monitoring sleep quality among workers and its potential to enhance occupational health through sleep assessment. **Materials and Methods:** A literature review was conducted on studies published between 2019 and January 2025, focusing on actigraphy's use in occupational settings. Data was collected from multiple databases, adhering to PRISMA guidelines for selection and analysis. **Results and Discussion:** Workplace stress and shift work harm sleep quality, with actigraphy guiding future actions. Technological advancements like ACTman and WORK-A improved the accuracy and efficiency of sleep monitoring in these settings**. Conclusions:** Actigraphy is an effective tool for assessing workers' sleep disturbances and can potentially improve sleep quality through better work scheduling and stress management. Technological improvements enhance its reliability and application in occupational health research. **Application:** Actigraphy can be implemented in occupational health practices to monitor sleep disturbances, leading to better sleep outcomes. Its use can guide improvements in work schedules and reduce health-related costs in the workforce.

Keywords: Worker`s health, Occupational Health, Sleep, Occupational risk, Actigraphy.

Introduction

Actigraphy is a method used to infer sleep and wake patterns based on movement data collected through actigraphy. Its properties make it useful for collecting objective sleep data in large-scale research studies (Fekedulegn *et al*., 2020). Actigraphy is more convenient, less invasive, and lower in cost compared to polysomnography, and it can be used continuously, 24 hours a day. It has been shown that the estimated agreement between polysomnography and actigraphy in sleep and circadian rhythm studies in the adult population ranges from 91% to 93% (Ancoli-Israel *et al*., 2003; Fekedulegn *et al*., 2020). The main motor activity parameter evaluated by actigraphy is the mean activity; the actigraph provides information about a patient's activity in an experimental environment or a natural setting over a prolonged and continuous period (De Crescenzo *et al*., 2016).

The role of actigraphy may vary depending on the specific sleep disorder. In the case of insomnia disorder, actigraphy is more useful as a complement to sleep recordings or as an independent procedure in special cases where reliable self-reporting is not possible (Smith *et al*., 2018). It can also be useful for documenting sleep deprivation, improving the interpretation of the Multiple Sleep Latency Test in adult and pediatric patients suspected of having central hypersomnolence disorders, and evaluating insufficient sleep syndrome(Smith *et al*., 2018). Actigraphy can be useful for assessing total sleep time and sleep latency in patients with suspected and diagnosed insomnia disorder and provides a consistent measure of sleep latency compared to polysomnography (Smith *et al*., 2018).

According to the Sleep Research Society (Oxford Academic), studies utilizing actigraphy for assessing and managing sleep disorders have led to the development of evidence-based guidelines for its clinical application. However, further research is necessary to refine its methodologies and enhance its clinical utility, allowing for broader and more precise applications in sleep medicine(Morgenthaler *et al*., 2007). Studies using simulated shift work data from individuals with both daytime and nighttime sleep have assessed the accuracy of various software methods in detecting sleep and wake periods. These findings highlight the application of actigraphy in worker populations (Gao *et al*., 2022). In the field of occupational health, actinography can be of great importance for shift workers, who have been more frequently reported to experience poor sleep quality, insomnia, and daytime sleepiness; or for individuals in demanding jobs, which can have repercussions on their health, such as nurses, physicians, industrial and office workers (Güngördü *et al*., 2023; Sadeghniiat-Haghighi *et al*., 2020).

The aim of this review is to synthesize the available information on the use and importance of actinography in the field of occupational health.

Materials and Methods

Study design

A literature review was conducted, including cohort, case-control, and cross-sectional studies, while excluding systematic reviews and other literature reviews. The methodology followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure a rigorous and transparent selection process (Rethlefsen *et al*., 2021).

Search strategies

The information search was conducted in English to access the broadest available data. Several libraries, repositories, and databases were utilized, including PubMed, Scopus, and Web of Science. The search terms employed were "actigraphy" and "work* The study selection process comprised three exclusion stages. Initially, information published between 2019 and the January 2025 was sought, focusing on research articles from peer-reviewed journals and English papers to ensure scientific relevance. Duplicate records were eliminated. Subsequently, each article underwent analysis to exclude those not meeting the predefined inclusion criteria *(Bustos et al., 2019)*. Following this, a third exclusion phase was conducted to remove duplicate records. Finally, the full texts of the remaining articles were carefully reviewed.

Inclusion criteria

The primary inclusion criteria encompassed all workers assessed using actigraphy, with a specific focus on measurements conducted in real-world occupational settings.

Data Synthesis

All manuscripts meeting the inclusion criteria were thoroughly reviewed. Full-text versions of the selected studies were obtained to extract relevant data, which were systematically organized using a customized data collection table (Bustos *et al*., 2021). Following this process, the extracted data were structured and integrated into comprehensive tables for analysis

Results

In accordance with the PRISMA Statement guidelines, a total of 2,781 records were identified through database searches. Search filters were then applied to refine the results based on criteria such as publication date, article type, source type, and language. The search strategy and filters were iteratively adjusted to ensure the extraction of relevant data from each database.

After removing duplicates and reviewing abstracts and full texts, 10 studies were selected for inclusion in the analysis. The results from these studies were organized into tables to outline their specific outcomes and facilitate comparison across predefined categories for synthesis. A summary of the recompiled information is presented in Table 1.

Table 1. *Summary of the studies.*

Authors, year	Country/region	Population	Target sample	Main findings
(Kunkels *et al*., 2020)	Netherlands	athletes	-	ACTman* automates actigraphy workflows, improving transparency, reproducibility, and scalability, addressing research bottlenecks.
(Baek *et al*., 2020)	South Korea	shift work nurses	94	Strong agreement between sleep diary and actigraphy for total sleep time (ICC = 0.765-0.858) and sleep variability (ICC = 0.838), with diary overestimating total sleep time by 41-45 mins.
(Slavish *et al*., 2020)	United States	nurses	392	IIV in sleep linked to higher IL-6 and IL-1β but not other inflammation biomarkers; shift work did not moderate associations.
(Cheng *et al*., 2021)	United States	night shift workers	45	Model predictions for DLMO showed good concordance with in-lab measurements (Lin's coefficient = 0.70), with a mean error of 2.88 hours.
(Lee *et al*., 2021)	United States	full-time nurses.	61	Better sleep sufficiency led to increased mindful attention; mindful attention inversely related to sleepiness but not other sleep traits.
(Gerhardt *et al*., 2020)	Switzerland	railway employees	52	Social stressors from supervisors linked to poorer sleep quality; higher time control at work improved sleep. Work redesign to reduce stress and increase control recommended.
(Rodrigues *et al*., 2023)	Spain	-	55	Workplace bullying linked to poorer sleep outcomes, with anxiety mediating the relationship between bullying and sleep disturbances.
(Devine *et al*., 2020)	United States	United States Army Reserve Officers' Training Corps (ROTC) cadets	286	WORK-A** measures showed the best agreement with self-reported sleep times; larger discrepancies between Actiware and self-reports.
(Chabal *et al*., 2024)	United States	Navy submariners	58	Submariners' sleep duration comparable to other Navy personnel; circadian alignment improved over time.
(Wang *et al*., 2022)	Canada	naval personnel		Strong agreement between self-reports and actigraphy for sleep offset, but discrepancies for sleep onset latency and wake after sleep onset; better agreement for day workers.

*** ACTman:** *It is a tool that automatically preprocesses actinography input data into a uniform file format for further analysis (Kunkels et al., 2020).*
*** WORK-A**: Is a set of actigraphy-derived measures adapted from commercial industry standards for the analysis of sleep patterns that are specific to active-duty soldiers in operational domains (Devine et al., 2020)*

Discussion

Workplace Stress and Sleep Quality

Gerhardt *et al*. (2020) highlighted the impact of workplace stress on sleep quality, particularly stress from supervisors. Their findings suggest that higher control over work schedules improves sleep outcomes, reinforcing the importance of reducing work-related stress and increasing employee autonomy to promote better sleep. Rodríguez-Muñoz *et al*. (2024) further emphasize this connection, showing that workplace bullying is associated with sleep disturbances, with anxiety acting as a mediating factor. These findings suggest that creating healthier work environments and addressing stressors could significantly improve sleep and overall well-being.

Shift Work and Circadian Alignment

The impact of shift work on sleep quality is evident in studies such as those by Baek *et al*. (2020) and Wang *et al*. (2022), which report discrepancies between actigraphy and self-reported sleep data, particularly among night-shift workers. Workers on day shifts tend to have better sleep patterns and higher agreement between actigraphy and self-reports. Chabal *et al*. (2024) also found that submariners' sleep quality improved over time with better circadian alignment to their work schedule, highlighting the importance of adapting work shifts to the natural circadian rhythms of workers to minimize sleep disruption.

Technological Advances in Sleep Monitoring

Kunkels *et al*. (2020) and Devine *et al*. (2020) underscore the importance of technological innovations like ACTman and WORK-A in improving the accuracy and efficiency of sleep monitoring in work settings. ACTman's automation of actigraphy processes addresses common bottlenecks in research, while WORK-A's superior alignment with self-reported sleep times offers a more reliable approach compared to traditional methods. These advancements are crucial in refining sleep studies, particularly in occupational settings where accurate data is necessary for improving worker health and performance.

Conclusions

The findings from these studies underscore the critical role of workplace factors, such as stress and shift work, in influencing sleep quality. Technological tools for monitoring sleep have the potential to enhance accuracy and efficiency in research, providing valuable insights into how work-related conditions affect rest and overall health. Addressing work-related stressors and optimizing shift patterns in alignment with workers' natural rhythms could significantly improve sleep quality and employee well-being.

Limitations

While the studies reviewed provide valuable insights into the relationship between work factors and sleep quality, several limitations must be considered. Many studies rely on self-reported data, which can introduce biases and inaccuracies, particularly when comparing subjective sleep diaries with objective measures like actigraphy. Additionally, the generalizability of some findings may be limited by specific populations, such as submariners or shift workers, whose unique work conditions may not reflect the broader workforce. The variability in methodologies and measurement tools across studies also presents challenges in drawing definitive conclusions, especially regarding the precision of sleep monitoring technologies in real-world settings. Another limitation includes the limited diversity of keywords available to search for information. Future research would benefit from larger, more diverse samples and the use of more standardized and advanced measurement techniques to better capture the complexities of sleep-in occupational contexts.

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