*Sleep Advances*, 2025, **6**, zpaf011
https://doi.org/10.1093/sleepadvances/zpaf011
Advance access publication 5 May 2025
**Review Article**

## Review Article

# Scoping review of the measurement of care environment factors that impact sleep in the rehabilitation, subacute, and aged care settings

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## Abstract

**Study Objectives:** Unfamiliar environments are often poorly conducive to quality sleep, especially for patients within health and aged care settings. This scoping review aims to map available evidence regarding the sleep environment in rehabilitation, subacute, and aged care settings. It examines how these factors are measured and seeks to identify any reported standard metrics, guidelines, or methodologies.

**Methods:** Searches were conducted within PubMed, EMBASE, Cochrane Library, Cumulated Index to Nursing and Allied Health Literature, PsycINFO, and Web of Science from database inception to May 2023. Eligibility criteria included original studies of any design reporting on the measurement properties of care environment factors affecting the sleep of adult patients admitted to rehabilitation, subacute wards, and aged care facilities.

**Results:** Seventy-four studies were reviewed that included 5055 participants, mostly (78.4%, 58/74) from aged care facilities. From 102 identified care environment factors, the spectral measurements of light were most reported (65.7%, 67/102), with methodologies varying from actigraphy and illuminance meters to pendant-style light monitors. Other environmental factors (sound, temperature, and air quality/humidity), room characteristics (mattress/bedding, room cohabitation), and hospital functioning (imposed schedules) were measured considerably less often and displayed similar variations in reported units and devices. Eighteen studies reported international, national, and methodological standards or guidelines.

**Conclusions:** This review provides a comprehensive overview of the care environment factors affecting sleep studied within rehabilitation, subacute, and aged care settings. Various units and devices were used in measuring these factors, and standard metrics and methodology were not consistently used. Future care environment studies incorporating interventions that employ standardized devices, units, and methodologies, will thereby enhance the reliability and comparability of findings within this field.

**Key words:** sleep; patient rooms; environment controlled; noise; environment design; nursing homes; long-term care; rehabilitation; aged care; reproducibility of results

### Statement of Significance

This scoping review addresses the increasing recognition of sleep environment interventions in acute care settings while exposing significant variability in measurement methods that complicate the standardization and practical application of findings. It identifies a critical research gap in long-term and rehabilitation settings, particularly regarding the influence of room characteristics and hospital functioning factors on sleep. The review highlights the urgent need for standardized measurement tools and methodologies to improve the reliability and comparability of future studies. By addressing these gaps, this work lays the foundation for evidence-based, standardized care protocols that could enhance patient outcomes across diverse healthcare environments.

**Submitted for publication:** August 12, 2024; **Revised:** January 13, 2025

## Introduction

Poor sleep within health and aged care environments is common and multifactorial, especially for older populations, with numerous studies highlighting its prevalence and emphasizing the need for targeted interventions [1–4]. Notably, studies have shown approximately 50% of adult medical inpatients [5] and up to 70% of older residents in a nursing home [6] experienced poor sleep quality during their care. There are many patient, care environment, and disease factors that influence sleep in care environments [5]. Contributors to poor sleep can be categorized into two groups: (a) individual level (e.g. undiagnosed sleep disordered breathing, medications, pain, medical, and psychological comorbidities); (b) care environment level (e.g. environmental factors such as light, sound, temperature, air quality/humidity, room characteristics such as mattress/bedding, room cohabitation, and hospital functioning such as imposed schedules) [7, 8] (Figure 1). Notably, while this study acknowledges the significant impact of individual factors on sleep in care facilities, these are beyond the scope of this paper, which focuses solely on care environment factors. Poor sleep quality and quantity during hospitalization have been linked to extended length of stay, increased risk of complications, and reduced patient satisfaction [9, 10]. Given that patients within rehabilitation wards and long-term care, such as subacute wards and aged care facilities, spend extended periods within the care setting, ensuring the environment is conducive to quality sleep remains an important aspect of patient-centered care. Despite this, compared to acute care, little research has been undertaken to understand the various care environment factors influencing sleep within these long-term or rehabilitation settings.

Emerging evidence suggests that nonpharmacological care environment interventions, such as light therapy, have the potential to improve sleep quality within acute care and community settings [11–14]. For instance, a recent systematic review of 53 studies found light therapy was effective in the treatment of general sleep problems, insomnia, and sleep problems related to Alzheimer's disease [15].

A challenge when conducting care environment intervention research studies or translating research into a standard of care across hospitals is the variation in what is measured across studies. There is considerable variety in the available measuring equipment to measure environmental factors, units of measurement, and methodologies. For example, light exposure has been measured using actigraphy [16, 17], illuminance meters [18], multipurpose data loggers [19], or simulations [20]. Another challenge is the uncertainty about which methodological standards and guidelines are reported and applied within

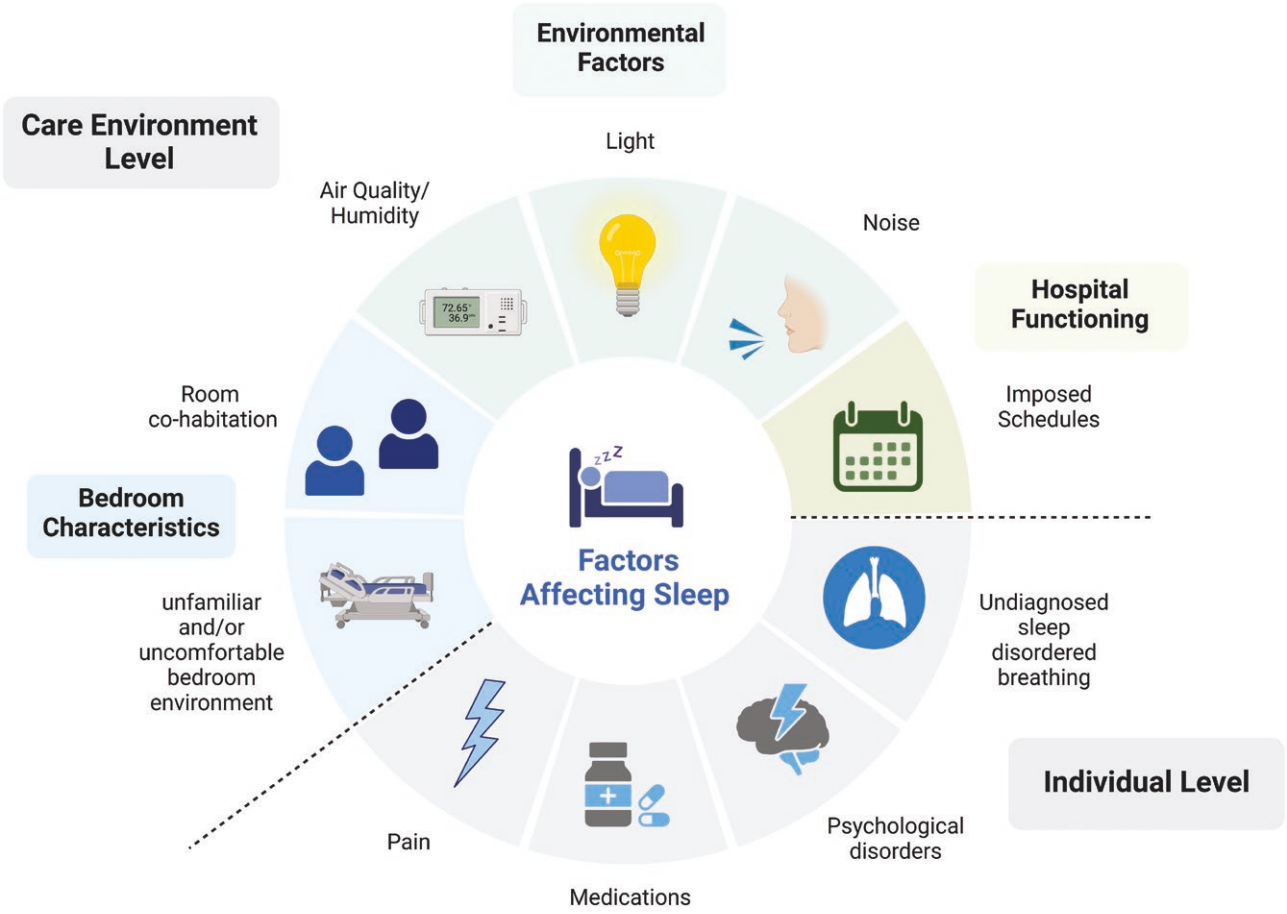


**Figure 1.** Individual and care environment factors affecting sleep within care settings. The diagram depicts examples of the various individual and care environment specific factors that affect the sleep outcomes of patients within treatment settings [5]. It categorizes the contributors to poor sleep into two groups: (a) individual level (e.g. undiagnosed sleep disordered breathing, medications, pain, medical, and psychological comorbidities); (b) care environment level (e.g. environmental factors such as light, sound, temperature, air quality/humidity, room characteristics such as mattress/bedding, room cohabitation, and hospital functioning such as imposed schedules) [7, 8]. Figure generated using BioRender. Ogilvy Dunstan, O (2025). https://BioRender.com/g43l498

these sleep environment research studies. Using various methods of measurement of the same factor across studies can lead to a lack of comparability, difficulty in replicating or synthesizing findings, and lack of validity. Therefore, consensus of standard units, devices, and methodology within the field is fundamental to establishing a robust foundation for future care environment interventions.

This study thus set out to undertake a scoping review with the aim of identifying and synthesizing the methods used within previous studies to measure care environment factors affecting sleep within subacute wards, aged care facilities, and rehabilitation settings. By mapping the existing evidence, this scoping review provides an overview of key themes and identifies gaps in the literature. However, while it offers valuable insights, it does not evaluate the quality of evidence or establish causal relationships, as such study objectives fall outside the purpose and scope of a scoping review. The goal of this study is to inform the design of future research and provide a framework to guide clinicians and environmental researchers in improving sleep quality through targeted research and interventions within these specific care settings.

## Materials and Methods

Scoping review methodology was used to systematically and comprehensively explore and map the available evidence surrounding the measurement of sleep care environment factors in aged care facilities, subacute wards, and rehabilitation wards. The review was conducted using Joanna Briggs Institute's (JBI) Manual for Evidence Synthesis Methodology [21] and reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) guidelines [22] and checklist. The protocol for this study was prospectively registered within the Open Science Framework database (osf.io/nws9j).

### Study eligibility criteria

This review aimed to find all available evidence from human studies reporting the measurement of care environment factors relevant to sleep in rehabilitation, subacute, and aged care settings. The eligibility criteria were guided by a clear definition of the Participants, Concept, and Context relevant to the review question (summarized in Supplementary Table S1 in the Supplementary Material).

"Participants" included adult patients aged 18+ years admitted to rehabilitation, subacute wards, and patients of aged care facilities. No other exclusion criteria were applied. The "concept" included reported unit, device, and "gold standard" measures of the care environment factors affecting the sleep outcomes of participants. Studies were included and classified as "manufacturer specifications" in cases where an environmental intervention with predefined measurements was implemented (such as a circadian lighting system) with no other external measurements taken. Certain cultural or sleep hygiene practices and interventions (e.g. foot bathing, acupuncture, aromatherapy, and music therapy) were not considered as care environment factors and therefore were excluded. "Gold standards" were defined as national and international guidelines or standards of measurement for devices, units, and/or methodologies reported within the studies. The "context" included hospital rehabilitation facilities, subacute wards, and aged care facilities (nursing homes/residential aged care facilities, and aged care wards). Excluded settings were community homes, acute hospital wards, intensive care units, hospice, and palliative care. Studies were still eligible for inclusion if they included multiple settings, but only data from the relevant and eligible settings were included.

### Search strategy

Database searches were conducted from database inception to May 2023 within PubMed, EMBASE, Cochrane Library, Cumulated Index to Nursing and Allied Health Literature (CINAHL), PsycINFO, and Web of Science. Backward and forward citation searching of highly cited articles was conducted to find additional studies not identified by the initial search strategy. The PubMed search strategy was drafted by the study authors in consultation with an experienced academic librarian and is outlined within Supplementary Table S2 with search strategies for additional databases outlined within Supplementary Table S3 in the Supplementary Material. Search terms relevant to the three main concepts of (a) sleep, (b) environment, and (c) subacute, rehabilitation, and aged care facilities were used.

### Study selection

Titles and abstracts of candidate articles, as well as full-text articles of relevant studies were screened independently against eligibility criteria by two authors (O.B.O.D. and L.S.H.) in Covidence. Disagreements were resolved by a third reviewer (A.Y.). Studies were included if they were full-length original studies of any design reporting on the measurement properties of care environment factors affecting the sleep of adult inpatients admitted to rehabilitation, and subacute wards, and residents of aged care facilities. Studies were excluded if they were: reviews, editorials, position statements, letters to the editor, conference abstracts, press releases, or PhD dissertations.

### Data extraction

Data was extracted by one reviewer (O.B.O.D.) using a Data Extraction Form within Excel, with any uncertainties reconciled by a second reviewer (A.Y.). Data were sought for the following variables: author, publication year, country, study aims, study design, setting, population characteristics (description, number of participants, and demographics), care environment factors studied, the unit of measurement, measures of each care environment factor, or any applicable gold standard comparators. The data extracted from each study was charted and organized into graphical and tabular means for analysis. In line with scoping review guidance [21], the quality and risk of bias of included studies were not assessed as this was not relevant to the aim of the study. However, it is important to note that the primary study objectives of a scoping review according to JBI standards are to map the key concepts, types of evidence, and gaps in research related to a defined field by systematically searching, selecting, and synthesizing existing knowledge, rather than to critically appraise the quality or validity of individual studies.

## Results

The search strategy identified a total of 3487 records; of which a total of 74 articles [14, 18, 23–91] met the inclusion criteria for data extraction and analysis. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)-style flow chart reporting the search and screening process is presented in Figure 2.

### Study characteristics

The study characteristics are presented in Supplementary Table S4 in the Supplementary Material. Around half of the studies

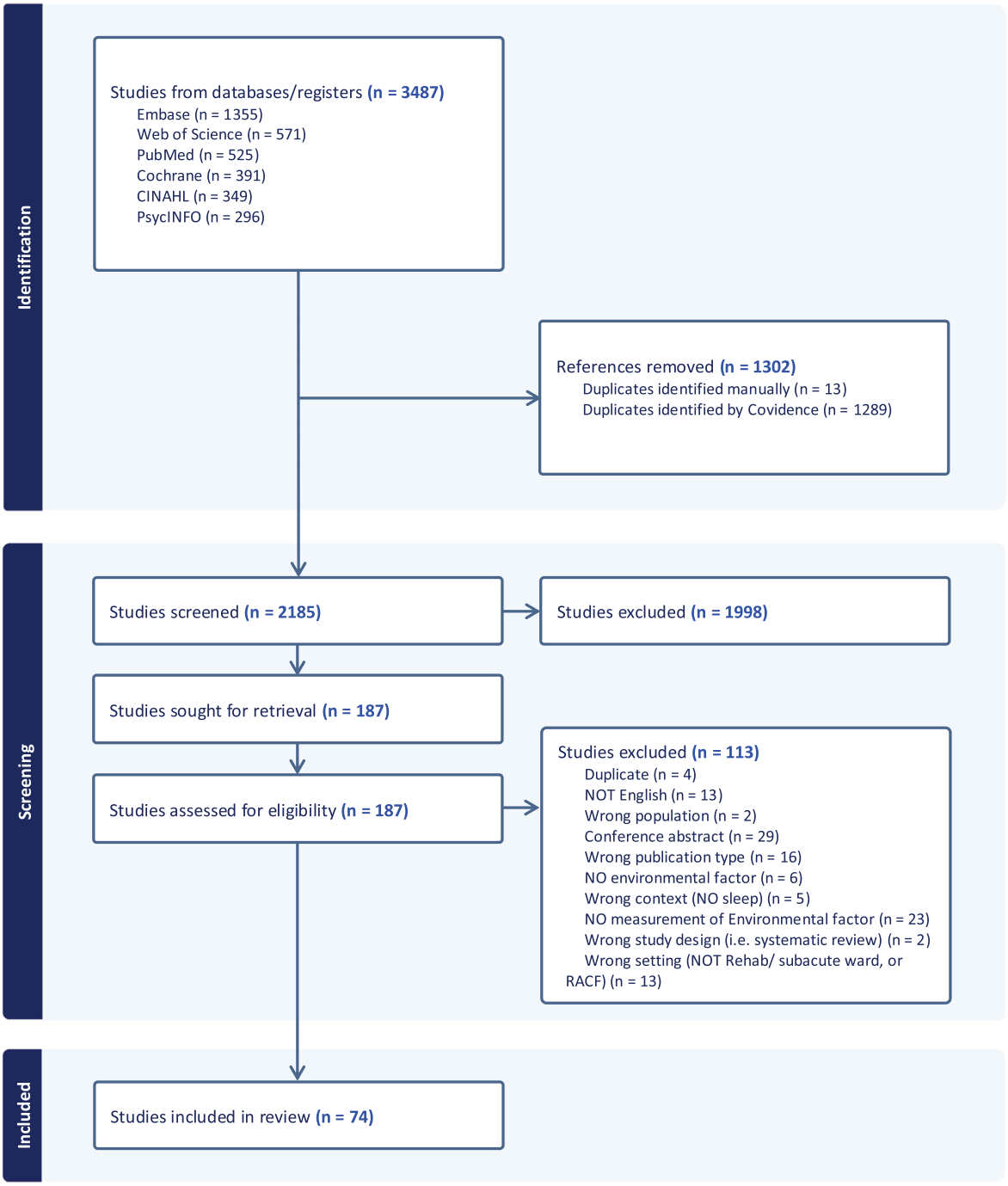


**Figure 2.** Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram.

originated from North America (40/74; 54%), with others from Europe (27/74; 37%), Asia (6/74; 8%), and Oceania (2/74; 3%). The included studies were published over a period spanning from 1993 to 2022. Half of the included studies (37/74; 50%) were published within the last 10 years. Most were conducted in the aged care setting (58/74 studies; a total of 262 aged care wards/facilities), with 10 in the rehabilitation setting (total of 11 rehabilitation wards/facilities) and seven in the subacute setting (total of 40 subacute wards/facilities). The included studies comprised 5055 participants, with study sample sizes ranging from 48 to 104 participants. Study participants' ages ranged from 24 to 102 years, with 89% of participants aged ≥65 years, and 67% aged ≥85 years.

## Measurements of care environment factors

The units and specific measures of the care environment factors are summarized in Figure 3A and B and Supplementary Table S5 (Supplementary Material), with most studies evaluating a combination of factors (total of 102 reported across 74 studies), rather than focusing on single care environment factors. Light was the most reported factor (67/102, 65.7%), with fewer studies measuring noise (18/102, 17.7%), imposed schedules (6/102, 5.9%),

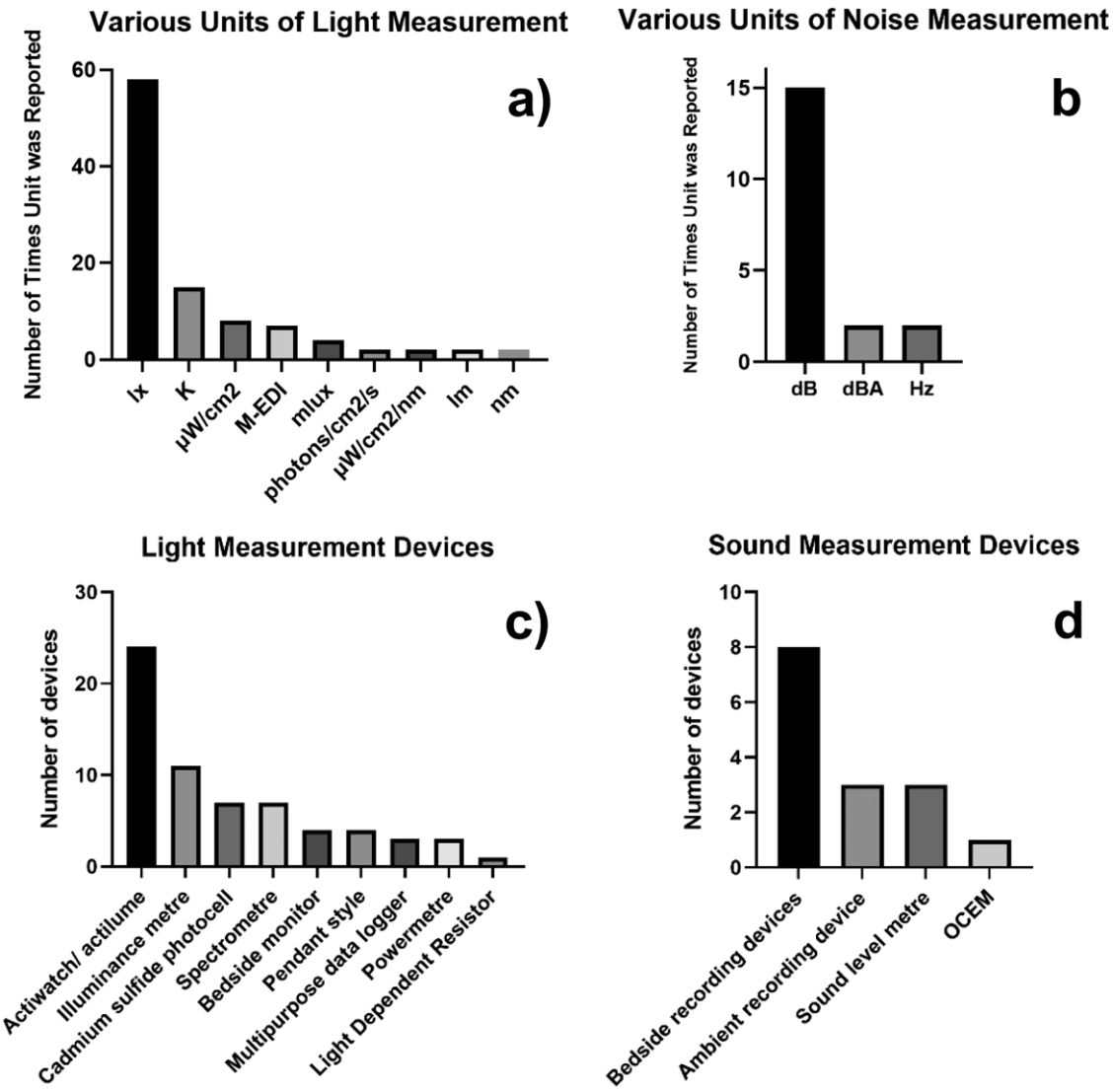


**Figure 3.** Measurement units and devices of various care environment factors reported in studies included in the scoping review. (A) Various units of light measurements. "lx" refers to illuminance measurements in Lux. "K" refers to correlated color temperature in Kelvins. "µW/cm$^2$" refers to light intensity. "M-EDI" refers to Melanopic Equivalent Daylight Illuminance. "mlux" refers to melanopic spectral efficiency in melanopic lux. "photons/cm$^2$/s" refers to photon density. "µW/cm$^2$/nm" refers to Irradiance. "lm" refers to lumens. "nm" refers to nanometers. (B) Various units of noise measurements. "dB" refers to decibels. "dBA" refers to A-weighted decibels. "Hz" refers to the frequency in hertz. (C) Various light measurement devices. (D) Various sound measurement devices. "OCEM" refers to Omnidirectional Condenser Electret Microphone.

temperature (4/102, 3.9%), air quality/humidity (3/102, 2.9%), bedding/mattress (3/102, 2.9%), and room cohabitation (1/102), 1.0%).

## Environmental factors

A wide variety of specific measures of light were employed across the studies. These included illuminance, correlated color temperature (CCT), light intensity, and melanopic spectral efficiency (Supplementary Table S5). Illuminance levels (lux) appeared to be the most frequently measured photometric characteristic (included in 58/74 studies, 78.4%). In 20 of these studies (20/58, 34.5%), illuminance measures were taken directly at eye level or the average eye level of patients. Notably, limited information regarding the position or height of the sensor was available for the remaining studies. This was followed by CCT measures using kelvins (K) (15/74, 20.3%), then Melanopic Equivalent Daylight Illuminance (M-EDI) (7/74, 9.5%), milliwatts per square centimeter (µW/cm$^2$) (5/74, 6.8%), and two studies measuring melanopic spectral efficiency (mlux) (2/74, 2.7%).

Most studies assessing noise levels measured standard decibels (dB) (15/74, 20.3%), representing the raw sound intensity without any frequency weighting [92]. Two studies utilized A-Weighted Decibels (dBA) (2/74, 2.7%), a measurement that employs a specific weighting scale to account for the varying sensitivity of the human ear to different frequencies [93]. Temperature and air quality/humidity were measured in standard degrees Celsius (4/74, 5.4%) and percent relative humidity (3/74, 4.1%) [94].

## Bedroom characteristics and hospital functioning

Within the room characteristics category, the bedding/mattress condition was mostly rated qualitatively by comfort on a 4-point Likert scale, with one study measuring the pressure of the patient's body across a field (bed) and relating certain movement and pressure with number of awakenings during sleep [24]. There was one study involving room cohabitation which measured comfort within various room layouts using focus groups and an observational framework designed to quantify disruptive

behaviors and the surrounding environmental condition [48]. Finally, within the hospital functioning category there were six studies evaluating the role of scheduling and sleep. These studies all focused on incontinence care, with the number of awakenings often being recorded by a nurse during interventions.

### Measurement methodology—device selection

Figure 3C and D display the reported frequency that different measurement devices and associated units were used to measure the environmental light and noise across studies. In studies that measured light, most studies utilized actigraphs, specifically the Actiwatch/Actilume devices ($n = 24$) for circadian rhythm, sleep, and light exposure monitoring. Illuminance meters ($n = 11$) and spectrometers ($n = 7$) were also commonly reported. Other devices, such as pendant-style light monitors with embedded spectrometers ($n = 4$), bedside monitors with embedded photometers ($n = 4$), multipurpose data loggers ($n = 3$), and cadmium sulfide photocells ($n = 7$) were commonly reported within studies measuring ambient environmental light. In studies that measured sound, bedside recording devices ($n = 8$) were most used to measure sound within studies, followed by ambient devices ($n = 3$), and sound level meters ($n = 3$). One study used an Omnidirectional Condenser Electret Microphone, and another study employed a 4-point Likert scale to measure the impact of noise qualitatively on the patients and staff. Two studies reported using the CEM DT-172 temperature and humidity data logger, whilst one other study reported using a thermometer and hydrometer. Typically, studies reported points-in-time measurements (e.g. measurements collected at noon) rather than continuous measurements.

### Gold standard measures

Supplementary Table S6 (Supplementary Material) displays the gold standard measures reported within each study (18/74, 24.3%). Notably, some studies described more than one gold standard or environmental factor. Overall, 18 studies reported 23 standards, guidelines, metrics, or methodologies. These "gold standards" were categorized into different levels, being international (10/23, 43.5%) and national (8/23, 34.8%) standards or guidelines, and standard methods and methodology (4/23, 17.4%). Specifically, the standards reported encompassed 13 measures for light, six for noise, five for air quality/humidity, and four for temperature. None of the identified gold standards were consistently utilized or referred to in more than four studies, including widely accepted standards such as the International Commission on Illumination (CIE) and the World Health Organisation (WHO). "Gold standard" methodology for light measurement reported works from Spitschan et al [58], Wewers & Lowe [86], Rea et al [18, 95, 96], as well as the irradiance toolbox and melanopic illuminance principles by Lucas et al [26, 63].

## Discussion

This scoping review identified that care environment factors related to sleep were measured in 74 studies in aged care, subacute, and rehabilitation settings, with light measured in lux through actigraphy being the most measured and reported standardized aspect. A range of units and devices were reported across studies for each care environment factor; however, few studies investigated factors other than light. Notably, the choice of measurement unit and device depended on the context and specific requirements of the study design, environmental intervention, and application. A range of international, national, and standard measurement frameworks were described for various care environment factors, however, few studies reported these "gold standards."

### Measurement units

Internationally recognized Standard Units (SI units) [97] such as illuminance (lx), kelvins (K), decibels (dB), and dBA were most widely used across the light and noise studies; this follows international standards such as from the CIE [98] and WHO [99].

Standard illuminance is a translatable and convertible metric provided by various devices which quantifies the amount of light that reaches a surface [100]. This information thereby measures the spatial lighting conditions that individuals encounter but differs from the spectral composition of light, which is important for sleep clinicians considering the nuanced impact of the light spectrum on patient circadian rhythms [101]. Lux values can be used in conjunction with other metrics, like melanopic spectral efficiency (mlux) [101], to assess the biological potential of light exposure in various settings. However, the most current and widely accepted method [98, 102] for measuring the biological impact of light on melanopsin is through "melanopic irradiance" ($W/m^2$) which quantifies the power of melanopically weighted light. Its photometric derivative, "melanopic equivalent daylight illuminance" (M-EDI, lx) [98], expresses the equivalent illuminance under a standardized daylight spectrum. Extensive literature highlights the significance of different light spectra's biological impact on delaying sleep onset [103–105]. Therefore, proper consideration and manipulation of the spectrum are necessary for designing lighting interventions that support health and recovery effectively.

CCT, measured in kelvins (k), was often reported within studies examining the biological effects of short-wavelength (blue) light. However, while this has been common practice, a recent study by Esposito & Houser [106] challenged its validity. They argued that CCT is not a reliable predictor of melatonin suppression or biological potency, as circadian stimulus and melanopic equivalent daylight illuminance can vary significantly even at the same CCT and photopic illuminance [106]. This finding is particularly relevant for manufacturers producing, and clinicians and researchers applying, fixed CCT lighting interventions (e.g. 3500 K) for circadian entrainment and melatonin suppression, as these may not consistently achieve the intended biological effects.

### Measurement methodology and devices

Studies commonly reported actigraphs like Actillume and Actiwatch which measure illuminance (lx). This preference may be attributed to their widespread use for assessing sleep-wake patterns in free-living conditions [107] where polysomnography (PSG) is impractical [108]. Likewise, actigraphy has commonly been employed within many aged care studies [25, 49, 77, 81]. However, concerns with actigraphy in rehabilitation and aged care to be considered include accuracy issues (e.g. sleeve displacement over the device) [18], skin and temperature sensitivities [109], mobility restrictions [110], and adherence challenges, particularly for patients experiencing delirium or dementia [111–113]. Simultaneous measurement of wrist or pendant-style light monitors with stationary illuminance meters or spectrometers has the advantage of providing objective measures of the environment where these limitations may occur [14, 18, 47]. For this purpose, a range of low-cost spectrometers are available which comply with International standards [98] and national calibration standards.

Devices for noise measurement mostly reported bedside recording devices, followed by ambient recording devices and sound level meters. These devices are all generally designed to provide subtle and nonintrusive feedback or information to researchers in their surroundings but are to be located in convenient positions around the ward, contributing to the lack of standardization in care environment measurements in hospital settings.

To date, there are no established universal standard devices or methods for measuring the various care environment factors affecting sleep within rehabilitation and long-term care settings. Moreover, information regarding the location of stationary devices (e.g. vertical and horizontal measurements) was limited, and details of the device make, model, and calibration date were invariably reported. Furthermore, studies measuring environmental factors typically reported point-in-time measurements (e.g. measurements collected at noon) rather than continuous measurements. In these instances, there may be insufficient data available to confidently triangulate measurements of the care environment factors with sleep measurements.

### Gold standards

There are various well-established international and national standards, guidelines, and metrics available for informing the design, implementation, and assessment of care environment interventions and practices, to ensure compliance with established performance metrics and criteria [98, 99, 114, 115]. Yet, few studies utilized these "gold standards," highlighting the lack of methodological consistency within the field. This limited use could be attributed to a range of factors, such as the date of publication and evolving field of research, a lack of standardization of the measurement devices and methodology, and variations in natural lighting exposure across the globe i.e. more sun at the equator and less at the poles [116] negating the applicability of certain gold standards.

The WHO provides reliable guidelines and standardized metrics for care environment factors such as noise [99], temperature, or air quality/humidity [117–119]. For thermal comfort, guidelines are available through the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards 62.1 and 62.2, however, these standards are for commercial and residential buildings. For lighting research, current best practice follows the 2018 international standard CIE 026 [98] and the associated open-access toolbox, which provides clinicians and lighting researchers with a reliable method and standardized measures to analyze light exposures concerning nonvisual photoreception and responses [98]. Following this, recent recommendations [102, 120] and proposed strategies [121] from Spitschan et al provide an evidence-based guide to reporting light exposure in chronobiology and sleep interventions. These guidelines and standards provide a strong basis, yet they lack comprehensive applicability across all scenarios. The current values cater primarily to healthy, young individuals or residential environments. Consequently, there remains a considerable paucity of well-established standard metrics or methodologies to assess the care environment factors affecting the sleep of older adults in rehabilitation and aged care settings.

### Strengths and limitations

Strengths of this review include the broad search strategy implemented and the inclusion of a range of long stay facilities. Thus, the strengths of this study are the breadth of settings, care environment measures, and devices reviewed. The inclusion criteria are confined to studies published in English, potentially omitting valuable research conducted in other languages and thereby introducing a language bias. The search strategy executed for this scoping review also may not have fully accounted for regional and national variations in technical terminology even within the English-speaking world (e.g. "elder care" as an alternate term for "aged care" in some English-speaking countries). The exclusion of individual factors and studies that did not explicitly detail their measurement methodologies or devices may represent another limitation of the available evidence. This exclusion criteria may have resulted in the omission of studies with relevant outcomes but lacking in methodological transparency and adequate detail to answer the review question. Another limitation is the inclusion of studies more than 30 years old, which raises concerns that their methodologies may now be considered outdated in the rapidly evolving field. Despite this, we argue that they offer valuable insight into the progression and evolution of available methodologies.

### Future directions

To facilitate comparability and implementation of findings, future research should focus on applying well-established relevant methodological standards and establishing consensus for standardized devices and methodology protocols, to ensure consistent reporting across intervention studies. Further research exploring bedroom characteristics and hospital functioning aspects of care environment conditions is also essential for unveiling their impact on sleep quality within rehabilitation and aged care settings.

## Conclusion

This scoping review has reported on the research of care environment factors affecting sleep alongside the diversity in measurement methodologies and any existing standards and guidelines. By mapping the range of units, devices, and "gold standards" in current use, this review offers a comprehensive overview of how care environment factors affecting sleep have been measured. Currently, light measurement in lux through actigraphy is most commonly reported, with few studies reporting standard guidelines or methodologies.

## Supplementary material

Supplementary material is available at *SLEEP Advances* online.

## Disclosure Statements

*Financial disclosure*: The authors declare no financial relationships, funding, or commercial affiliations that could influence the content of this study. No financial support was received from any organization, institution, or commercial entity for the research, authorship, or publication of this manuscript. *Nonfinancial disclosure*: The authors declare no conflicts of interest, personal relationships, or nonfinancial competing interests that could inappropriately influence or appear to influence the work reported in this manuscript.

## Author Contributions

Olivia B. O. Dunstan (Conceptualization [equal], Data curation [lead], Formal analysis [lead], Investigation [lead], Methodology

[lead], Project administration [equal], Resources [equal], Software [equal], Validation [equal], Visualization [equal], Writing—original draft [lead], Writing—review & editing [equal]), Leila Shafiee Hanjani (Conceptualization [equal], Data curation [equal], Formal analysis [equal], Investigation [equal], Methodology [equal], Project administration [equal], Resources [equal], Software [equal], Supervision [equal], Validation [equal], Visualization [equal], Writing—review & editing [equal]), Francisca Rodriguez (Validation [equal], Writing—review & editing [supporting]), Veronica Garcia-Hansen (Validation [equal], Writing—review & editing [supporting]), Ruth E. Hubbard (Conceptualization [equal], Project administration [equal], Supervision [equal], Writing—review & editing [equal]), Adrienne Young (Data curation [equal], Formal analysis [equal], Methodology [equal], Project administration [equal], Supervision [equal], Validation [equal], Writing—review & editing [equal]), and Claire M. Ellender (Conceptualization [equal], Data curation [equal], Formal analysis [equal], Investigation [equal], Project administration [equal], Supervision [equal], Validation [equal], Visualization [equal], Writing—review & editing [equal])

## Data Availability

The data underlying this article are available in the article and its online Supplementary Material.

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