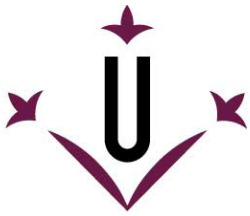
The impact of nursing interventions and hospitalization on patients' sleep quality

Filip Bellon



Universitat de Lleida

TESI DOCTORAL

THE IMPACT OF NURSING INTERVENTIONS AND HOSPITALIZATION ON PATIENTS' SLEEP QUALITY

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Memòria presentada per optar al grau de Doctor amb menció internacional per la Universitat de Lleida

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«The very first requirement in a hospital
is that it should do the sick no harm»

Florence Nightingale

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When an achievement is made, we can look back on the barriers and obstacles who were conquered and how the objective was achieved despite all of life's hazards and difficulties during the process. For me, completing this thesis is an achievement, and I am proud to have arrived at this stage. Nonetheless, the amount of wonderful people who have supported me along this journey has utterly overwhelmed me.

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«*Ab imo pectore*»

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LIST OF ABREVIATIONS

AASM: American Academy of Sleep Medicine

EEG: Electroencephalogram

EOG: Electro-oculography

EMG: Electromyograph

ICN: The international Council of Nursing

NREM: Non-rapid eye movement

NSF: National Sleep Foundation

PSG: Polysomnography

PSQI: Pittsburg Sleep Quality Index

REM: Rapid eye movement

SNC: Suprachiasmatic nucleus

WHO: World Health Organization

ABSTRACT

Objectives: The general objective of this dissertation was to determine the role of hospitalisation, and nursing interventions on sleep quality of hospitalized patients. To achieve this objective, we set several specific objectives:(1) to synthesis the effect of nursing interventions in improving the quality of sleep for patients hospitalized in acute and semi-acute units (**paper I**) (2) to describe the characteristics of nursing interventions to improve sleep and determine which nursing interventions have mayor efficacy in order to recommend future lines of research (**paper II**) (3) to describe self-reported sleep quality and quantity of hospitalized patients, and to assess its association with sociodemographic factors and poor health habits, and sedentary lifestyle (**paper III**) (4) to evaluate the impact of environmental disturbing factors, and night-time nursing care interventions on sleep quality of hospitalized patients (**paper IV**).

Methodology: In order to answer specific objective 1 & 2, two systematic reviews were carried out. One systematic review of randomized controlled trials, afterwards, an umbrella review was conducted in order to obtain the highest possible evidence. To answer specific objectives 3 & 4, two descriptive observational studies were performed on a data set of 343 patients from 12 public hospitals located in nine different Spanish regions.

Results: The use of earplugs and eye masks, music therapy, acupuncture and acupressure, aromatherapy, and educational programs on the use of adjuvant measures seemed to be the most effective nursing interventions in improving inpatients' sleep quality. Patients from Spanish public hospitals showed alarming results on the PSQI score, inpatients reported to sleep a mean of 56 minutes less in hospital compared to at home. Low educational level, comorbidities, or sedative medication were shown to be risk factors for poorer sleep. However, higher physical activity may function as a protective factor. Possible factors associated with poor sleep quality were frequency of nursing care interventions as well as self-reported disturbances.

Conclusions: Findings demonstrated a range of potentially effective nursing interventions to improve sleep quality, and that frequency of night-time nursing care interventions affects sleep quality negatively. However, most performed interventions are potentially modifiable. Results suggest the implementation and research of interventions focused on the reduction of disruptive factors in hospitals during nighttime.
Keywords: Nursing; Sleep; Hospitalization; Sleep quality.

RESUMEN

Objetivos: El objetivo general de esta tesis fue determinar el papel de la hospitalización y las intervenciones de enfermería en la calidad del sueño de los pacientes hospitalizados. Para lograr este objetivo, varios objetivos específicos fueron planteados: (1) sintetizar el efecto de intervenciones de enfermería en la mejora de la calidad del sueño de pacientes hospitalizados (2) describir las características de las intervenciones de enfermería para mejorar el sueño y determinar qué intervenciones tienen mayor eficacia para recomendar futuras líneas de investigación (3) describir la calidad y cantidad de sueño de pacientes hospitalizados y evaluar su asociación con factores sociodemográficos y hábitos de salud (4) evaluar el impacto de los factores ambientales, y las intervenciones de cuidados de enfermería nocturnos en la calidad del sueño.

Metodología: Para responder al objetivo específico 1 y 2, se realizaron dos revisiones. Una revisión sistemática de ECAs, y posteriormente, con el fin de obtener la mayor evidencia posible, una "umbrela review". Para responder a los objetivos específicos 3 y 4, se realizaron dos estudios observacionales sobre un conjunto de datos de 343 pacientes de 12 hospitales públicos situados en nueve regiones españolas diferentes.

Resultados: El uso de tapones para los oídos y antifaces, la musicoterapia, la acupuntura y la acupresión, la aromaterapia y los programas educativos sobre el uso de medidas coadyuvantes parecieron ser las intervenciones de enfermería más eficaces para mejorar la calidad del sueño de los pacientes ingresados. Los pacientes mostraron resultados alarmantes en la puntuación del PSQI, y resultados mostraron que dormían una media de 56 minutos menos en el hospital en comparación con en su casa. El bajo nivel educativo, las comorbilidades o la medicación sedante se mostraron como factores de riesgo para un peor sueño. Sin embargo, una mayor actividad física puede ser un factor de protección. Posibles factores asociados a la mala calidad del sueño fueron frecuencia de las intervenciones de enfermería, así como factores perturbadores.

Conclusiones: Los resultados mostraron intervenciones de enfermería potencialmente eficaces para mejorar la calidad del sueño, y que la frecuencia de las intervenciones de cuidados de enfermería nocturnos afecta negativamente a la calidad del sueño. Sin embargo, la mayoría de las intervenciones realizadas son potencialmente modificables. Los resultados sugieren la implementación e investigación de intervenciones centradas en la reducción de los factores perturbadores en los hospitales durante la noche.

Palabras clave: Enfermería; Sueño; Hospitalización; Calidad del sueño.

RESUM

Objectius: L'objectiu d'aquesta tesi va ser determinar el paper de l'hospitalització i les intervencions d'infermeria en la qualitat del son dels pacients hospitalitzats. Per assolir aquest objectiu, es van plantejar diversos objectius específics: (1) sintetitzar l'efecte d'intervencions d'infermeria en la millora de la qualitat del son de pacients hospitalitzats (2) descriure les característiques de les intervencions d'infermeria per millorar el son i determinar què intervencions tenen més eficàcia per recomanar futures línies de recerca (3) descriure la qualitat i la quantitat de son de pacients hospitalitzats i avaluar la seva associació amb factors sociodemogràfics i hàbits de salut (4) avaluar l'impacte dels factors ambientals, i les intervencions de cures d'infermeria a la qualitat del son.

Metodologia: Per respondre a l'objectiu específic 1 i 2, es van fer dues revisions. Una revisió sistemàtica d'ECAs, i posteriorment, per tal d'obtenir la major evidència possible, una "umbrella review". Per respondre als objectius específics 3 i 4, es van realitzar dos estudis observacionals descriptius sobre dades de 343 pacients de 12 hospitals públics situats a nou regions espanyoles diferents.

Resultats: L'ús de taps per a les orelles i antifaços, la musicoteràpia, l'acupuntura i l'acupressió, l'aromateràpia i els programes educatius sobre l'ús de mesures coadjuvants van semblar que són les intervencions d'infermeria més eficaces per millorar la qualitat del son dels pacients ingressats. Els pacients van mostrar resultats alarmants en la puntuació del PSQI, i resultats van mostrar que dormien una mitjana de 56 minuts menys a l'hospital en comparació de casa seva. El baix nivell educatiu, les comorbiditats o la medicació sedant es van mostrar com a factors de risc per a un pitjor somni. No obstant això, una activitat física més elevada pot ser un factor de protecció. Possibles factors associats a la mala qualitat del son van ser la freqüència de les intervencions d'infermeria, així com els factors pertorbadors.

Conclusions: Els resultats van mostrar intervencions d'infermeria potencialment eficaces per millorar la qualitat del son, a més, que la freqüència de les intervencions de cures infermeres nocturnes afecta negativament la qualitat del son. Tot i això, la majoria de les intervencions d'infermeria realitzades són potencialment modificables. Els resultats suggereixen la implementació i la recerca d'intervencions centrades en la reducció dels factors pertorbadors als hospitals durant la nit.

Paraules clau: Infermeria; Somni; Hospitalització; Qualitat del somni.

SAMENVATTING

Doelstellingen: De doelstelling van dit proefschrift was het bepalen van de rol van hospitalisatie, en verpleegkundige interventies (VI) op slaapkwaliteit van gehospitaliseerde patiënten. Specifieke doelstelling geformuleerd : (1) synthetiseren van het effect van verpleegkundige interventies op het verbeteren van de slaapkwaliteit van gehospitaliseerde patiënten (2) de kenmerken van VI ter verbetering van de slaap te beschrijven en te bepalen welke VI het grootste effect hebben om zo toekomstige onderzoekslijnen aan te bevelen (3) de zelf gerapporteerde slaapkwaliteit en -kwantiteit van gehospitaliseerde patiënten te beschrijven, en mogelijke verbanden met socio-demografische factoren, gezondheidsgewoonten en een sedentaire levensstijl (4) de impact te evalueren van verstorende omgevingsfactoren en nachtelijke interventies op de slaapkwaliteit van gehospitaliseerde patiënten.

Methodologie: Om specifieke doelstelling 1 & 2 te beantwoorden, werden twee systematische reviews uitgevoerd. Een systematische review van gerandomiseerde gecontroleerde studies, daarna werd een "umbrella review" uitgevoerd om de hoogst mogelijke evidentie te verkrijgen. Om specifieke doelstellingen 3 & 4 te beantwoorden, werden twee observationele studies uitgevoerd op 343 patiënten uit 12 openbare ziekenhuizen in negen verschillende Spaanse regio's.

Resultaten: Het gebruik van oordopjes en oogmaskers, muziek, acupunctuur en acupressuur, aromatherapie, en educatieve programma's over het gebruik van adjuvante maatregelen leken de meest effectieve VI te zijn. Patiënten van Spaanse openbare ziekenhuizen vertoonden alarmerende resultaten op de PSQI-score, en patiënten rapporteerden gemiddeld 56 minuten minder te slapen in het ziekenhuis vergeleken met thuis. Een laag opleidingsniveau, pluripatologie, en sedatieve medicatie bleken risicofactoren te zijn voor slechtere slaap. Hogere fysieke activiteit kan echter een beschermende factor zijn. Mogelijke factoren geassocieerd met een slechte slaapkwaliteit waren hogere frequentie van VI en zelf gerapporteerde storende factoren.

Conclusies: De bevindingen toonden potentieel effectieve VI om de slaapkwaliteit te verbeteren, en dat de frequentie van zorginterventies de slaapkwaliteit negatief beïnvloedt. Ook, de meest uitgevoerde interventies zijn potentieel modificeerbaar. De resultaten suggereren de implementatie en onderzoek van interventies gericht op het verminderen van verstorende factoren in ziekenhuizen gedurende de nacht.

Trefwoorden: Verpleging; Slaap; Ziekenhuisopname; Slaapkwaliteit.

LIST OF SCIENTIFIC PAPERS

1. Bellon, F., Mora-Noya, V., Pastells-Peiró, R., Abad-Corpa, E., Gea-Sánchez, M., Moreno-Casbas, T. The efficacy of nursing interventions on sleep quality in hospitalized patients: A systematic review of randomized controlled trials. International Journal of Nursing Studies. 2021, 115, https://doi.org/10.1016/j.ijnurstu.2020.103855. Impact factor: 6.612 – Quartile 1 (JCR)
2. Bellon, F. Beti-Abad, A., Pastells-Peiró, R., Casado-Ramirez, E., Moreno-Casbas, T., Gea-Sánchez, M., Abad-Corpa, E. Effects of nursing interventions to improve inpatients' sleep in intensive and non-intensive care units: Findings from an umbrella review. Journal of Clinical Nursing, 00,1-16,https://doi.org/10.1111/jocn.16251 Impact factor: 4.423 (2021) – Quartile 1 (JCR)
3. Bellon, F., Stremler, R., Rubinat-Arnaldo, E., Padilla-Martinez, J., Casado-Ramirez, E., Sánchez-Orduño, M., Gea-Sánchez, M., Martin Vaquero, Y., Moreno-Casbas, T., Abad-Corpa, E. Sleep quality in Spanish public hospitals. A multicentre, descriptive observational study. *Submitted and under revision*
4. Bellon, F., Targa, A., Padilla-Martinez, J., Casado-Ramirez, E., Gea-Sánchez, M., Moreno-Casbas, T., Abad-Corpa, E., Rubinat-Arnaldo, E. The influence of nursing interventions and hospitalization on inpatients' sleep quality. *In manuscript*

INTRODUCTION AND BACKGROUND

INTRODUCTION

Sleep, regulated by the circadian clock is a basic human mechanism essential for healthy functioning and is characterized by sensory disconnection (Cirelli & Tononi, 2008; Fuller et al., 2006). Sleep has a global restorative function for the organism, fundamental for maintaining neurobehavioral activity and brain health during wakefulness (Cirelli & Tononi, 2008). As a consequence, sleep has been of great importance to human well-being since the dawn of history (Barbera, 2008).

Sleep issues are becoming more prevalent in the population and are being identified as a public health concern. In terms of prevalence and implications, sleep deprivation and possible related conditions are considered a public health problem (World Health Organization. Regional Office for, 2004). Up to 50% of individuals experience transient periods of sleep waking dysfunction, with approximately 10% of adults having a persistent sleep disorder that results in clinically severe symptoms (Ram et al., 2010). In paediatrics, 20–30% of children have a sleep disturbance (Ivanenko & Gururaj, 2009)

and up to 80% of children with chronic illnesses have a co-morbid sleep disorder (Hodge et al., 2014). With age, the likelihood of developing a persistent sleep waking condition rises (Wolkove et al., 2007). Patients with persistent medical conditions are more likely to develop co-morbid sleep-wake problems (Ballard, 2005). Acute hospitalization for medical or surgical disease is, in fact, a high-risk moment for the onset or worsening of sleep-wake disorders, which can have serious repercussions (DePietro et al., 2017; Truong et al., 2016; Young et al., 2008).

The clinical environment may be a cause of sleep impairment (Delaney et al., 2018). Environmental factors such as light, noise, or temperature, and physical and psychological factors are possible causes of disturbing the sleep-wake cycle (Honarmand et al., 2020; Wesselius et al., 2018). Because of the restoring and healing function of sleep hospitalised patients are particularly in need of good sleep (Kryger et al., 2021). Nevertheless, several former studies reported poor

sleep quality during hospitalisation (Delaney et al., 2018; Jakobsen et al., 2020; Wesselius et al., 2018).

Nursing encompasses the promotion of health, and the prevention of illness through nursing care which includes caring for the patient's sleep (International Council of Nurses, 2002). Nurses have the responsibility to provide basic patient care and nursing procedures, also during the night. However, nursing care offered at night differs from that provided during the day in that it aims to provide the patient with the most comfortable resting environment possible. In this regard, nurses have the responsibility to interfere as little as possible with the patients' sleep and to apply sleep-promoting interventions if necessary (Oleni et al., 2004).

BACKGROUND

1. Sleep

From the scientific perspective, the definition of sleep is based on both behavioural characteristics and their related physiological changes occurring in the brains' electrical rhythms during sleep. Sleep can be seen as "a reversible state of perceptual disengagement from and unresponsiveness to the environment". It is typically, although not necessarily, evidenced by the following observable sleep behaviours: closed eyes, a lying down specific sleeping position, behavioural quiescence, lack of mobility, increased reaction time, an impaired cognitive function and a reversible unconscious condition (Carskadon & Dement, 2005; Chokroverty, 2010).

1.1. Sleep disturbances

Sleep is an active and dynamic state indicated by variable and complex brain activity. Based on the physiological measurements of brain waves by electroencephalogram (EEG), eye movement by electro-oculography (EOG) and muscle activity by electromyography (EMG), sleep can be divides into two separate states with autonomous functions and controls: non-rapid eye movement (NREM) and rapid eye movement (REM) sleep (Dement & Kleitman, 1957).

The NREM-REM sleep cycles appear in a predictable order are repeat themselves approximately every 90- 100minutes and about four to six cycles occur every major sleep episode. During the course of the night the content of NREM-REM sleep varies, and typically the early cycles are rich of NREM sleep while the later cycles are mainly dominated by REM sleep (Rama et al., 2005).

NREM sleep accounts for about 80% of our total sleep time and occurs right after the period of wakefulness before sleep, this period is known as sleep latency (Rama et al., 2005). NREM sleep can be divided into stages N1, N2, N3 and N4. The four stages indicate also the depth of sleep, with generally a lower arousal threshold in N1 and higher in N4, and a progressive decrease in brain wave

activity, eye movement, and heart rate (Kryger et al., 2021). N3 and N4 stages are often reported as a combined group in newer nomenclature since the American Academy of Sleep Medicine (AASM) considered it as one sleep stage (Berry et al., 2015). During a sleep cycle the stages progress from stage N1 to REM sleep.

Stage 1 NREM:

N1 stage refers to sleep onset, the transition from wakefulness to shallow sleep occurs. Muscle tone is reduced and eyes will show slow rolling movements.

Stage 2 NREM:

During stage 2 of NREM sleep eye movements stop, a fading of our awareness occurs and the brain waves slow down, also short accelerations (sleep spindles or K-complexes) in the EEG rhythms can be observed. Stage 3 & 4 NREM:

This group can be characterized by the occurrence of high-amplitude, low-frequency brain wave activity, seen as delta activity in the EEG and covers the deepest sleep. Further muscle relaxation occurs and most of recovery processes take place in this stage. There is a larger stimulus needed to produce awakening from the stages N3 or N4 than from the stages N1 and N2. In the first cycle, after going through N4, a brief episode of stage N3 and N2 sleep can occur interrupted by body movements to precede the initial REM episode.

REM:

REM sleep is usually not divided in stages but REM sleep may be subdivided into two types: tonic and phasic. Its distinction mainly based on short-lived events as eye movement usually occurring in clusters separated by periods of relative rest. During REM sleep, the body shows rapid eye movements and higher cerebral activity that occurs simultaneously with atonia in the the mayor body muscles. The EEG is characterized by high frequency, low amplitude brain wave activity, heart rate, respiration and blood pressure become more irregular but not necessarily elevated. REM sleep is also called paradoxical sleep por dream sleep (Kryger et al., 2021; Lee, 2018; Luyster et al., 2012; Mendelson, 2018).

Figure 1 visualizes the EEG recordings during the different sleep stages. Figure 2 summarizes the sequences of different sleep stages throughout each sleep-night.

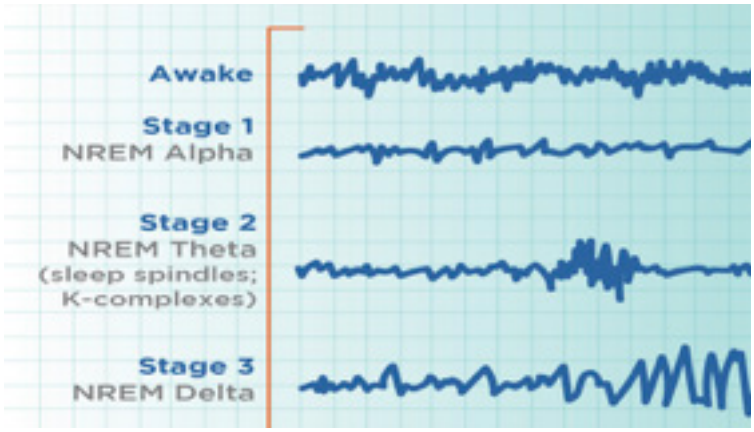

Figure 1. EEG recordings during different sleep phases (Lumen).

Figure 2. Sequences of different sleep stages (Al-Sulami, 2020).

It is generally accepted that the amount, intensity, timing and distribution of sleep are a result of a homeostatic sleep debt process and circadian processes. The two-process model describes sleep and waking timing, and the regulation of this as an interaction between these two processes.

The homeostatic process refers to the increased need for sleep, often known as sleep pressure, as a result of the longer you stay awake. The homeostatic drive peaks in the evening, drops throughout sleep and is at its lowest point when wakening up. People who are sleep deprived have a higher homeostatic drive, or a desire to make up for missing sleep, typically resulting in a shorter sleep latency and a longer overall sleep duration (Borbély, 1982; Fang & Rao, 2017).

The circadian process is controlled by the circadian clock. The primary circadian clock is located in the suprachiasmatic nucleus (SNC), a bilateral structure of cells found in the anterior part of the hypothalamus. It is the central pacemaker of the circadian system and regulates the majority of our circadian rhythms. Although recently was discovered that many tissues and organs are able to generate circadian rhythms in vitro independently from the SNC there is proof that the SNC still is in control of the circadian clock systems. Circadian rhythms contain all intrinsic biological variables that fluctuate over the course of approximately 24 hours. The circadian rhythms are responsible for regulating the timing system for sleep and wakefulness, the rhythms on their turn are mainly regulated by the entrainment of the SNC clock, the process to obtain information from the environment, mostly the exposure to light. Both processes interact to regulate sleep: the homeostatic drive increases sleep pressure throughout the day, but is countered by the circadian process, which sends alerting signals to keep us awake. When night falls, the circadian process abruptly ceases sending alerting signals, allowing the homeostatic sleep drive to take over and sleep to become possible (Easton et al., 2004; Gillette & Tischkau, 1999; Kryger et al., 2021; Markov et al., 2012; Pantazopoulos et al., 2018; Zisapel, 2001).

1.2. Sleep quality

"Sleep quality" is a multidimensional and complex concept. Although the term "sleep quality" is often used in research and considered as a well-known predictor of both mental and physical health, a lack of a well-established and generally accepted definition can be observed. Sleep quality could be defined as the satisfaction one has about their sleep experience by the integration of aspects of sleep initiation, maintenance, quantity, and refreshment upon awaking (Kline, 2013). The National Sleep Foundation (NSF) reported the key variables of quality of sleep among healthy individuals (sleep latency, number of awaking's more

than 5 minutes, wake after sleep onset, and sleep efficiency) without taking into account sleep architecture or nap-relevant factors (Ohayon et al., 2017). Harvey et al. (2008) incorporates aspects of sleep quantity, wakefulness, and waking up feeling refreshed and rested, as well as daytime sleepiness. It has to be noted that subjective sleep quality measurements give various incidence rates when compared to objective sleep measurements (Chen et al., 2018). Sleep quality is seen as a complex experience difficult to represent objectively.

In order to discuss subjective declarations, we choose to base our definition of sleep quality on the one of the developers of the most common used sleep quality measuring tool, the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) stating that from a clinical point of view, the concept of "sleep quality" comprises quantitative aspects of sleep such as number of arousal, sleep duration and sleep latency, as well as just subjective aspects such as "self-perceived sleep quality", "sleep depth", "sleep disturbances", "daytime dysfunction", or "restfulness". Furthermore, they stated that the elements that compose sleep quality, and their relative importance can vary between different individuals (Buysse et al., 1989; Pilz et al., 2018).

1.3. Sleep measurement

Sleep analysis entail the evaluation of multiple sleep indicators, which can be measured objectively or subjectively. Bedtime and rise time, sleep duration, and sleep quality are known as the most important indicators. However, additional key determinants, such as the time it takes to fall asleep (sleep latency), as well as the frequency and length of night-time waking (sleep disturbances) are required to effectively capture sleep duration (Ibanez et al., 2018a, 2018b; Sadeh, 2015).

Subjective sleep quality gives us information about the patients' individual perception and experience of sleep. It relies on the individuals' reporting of their own sleep quality and quantity, including their feelings of feeling rested when waking up (Mallinson et al., 2019). Objective sleep quality, on the other hand, can provide us with bio-vital data of what occurs physically with the help of devices (Ohayon et al., 2017).

For the assessment of objective sleep, polysomnography (PSG) is been regarded as the gold standard for measuring quality and quantity of sleep. PSG records

multiple parameters of the biophysiological changes based on EEG activity, combined with concurrent polygraphed monitoring of EOG, EMG, ECG, and other parameters that occur during sleep such as respiration rate, sleep-disordered breathing, cardiac activity and limb movements (Delaney et al., 2018). These parameters together can provide an accurate measurement of the criteria to diagnose a sleep disorder or abnormalities in sleep and wakefulness (Kryger et al., 2021; Senaratna et al., 2017). This method has excellent internal validity, but it requires of specialized equipment, specially trained personal, and it is measured in an artificial setting which reduces its external validity (Lee, 2018; Markov et al., 2012). To overcome this artificial setting, portable polysomnography instruments are available and used, but they require time and technical skill to place the electrodes and leads and set up the unit for recording. Patients may find the use of head leads to be inconvenient, and there is a danger of data compromise if leads or electrodes are lost during the night's research (Hoey et al., 2014).

Another way to measure sleep objectively is by bispectral index (BIS) measurement. This assessment is mainly used in a specialized environment such as critical care units. EEG data is collected by sensors placed on the forehead of the patient in order to be able to detect cortical arousal and monitor sedation levels. Although BIS was not originally designed to monitor sleep, it can provide a useful measure of sleep depth in critically ill patients (Gimenez et al., 2017; Sleigh et al., 1999).

A way of objectively ambulant monitoring of sleep is by actigraphy. Actigraphy is based on small wrist-watch like devices who contain an accelerometer that monitors movements for longer periods of time in order to estimate if a person is awake or asleep. Based on computerized scoring methods, raw activity data are converted to sleep-wake scores. As there exist a variety of commercialized devices on the market, each with its own measuring properties, necessitating the development of appropriate sleep-wake scoring algorithms (Sadeh, 2011). It is a minimally invasive technique that can give us information on sleep quality, the magnitude of sleep disturbances, and measurement of changes under treatment. In healthy adults, actigraphy has been validated against PSG and is usually used in the outpatient setting (Conley et al., 2019). Actigraphy has two key theoretical advantages when compared to PSG or other objective sleep measurement methods. First, it is inexpensive and unobtrusive. Second, it collects objective

data over extended periods of time, allowing for precise long-term rest and activity evaluation. Actigraphy may also be beneficial for analysing sleep related outcomes as part of more large-scale interventional studies, given current data-management capabilities. However, because actigraphy primarily monitors gross motor activity, the processing algorithm used, limits its capacity to determine sleep (Schwab et al., 2018).

Subjective measurement of sleep can be obtained by querying the individuals' perception of sleep. Among them, one of the most widely used is the sleep diary. The sleep diary can be seen as the accepted standard for self-reported sleep duration because it elicits detailed "real-time" information on daily sleep and timing over a set period of time. On the other hand, diaries rely on participants consistent participation which can be a challenge in populations as older people or chronic ill patients, and until date, the absence of a standardized and widely diary has compromised the ability to interpret results of research for clinical purposes (Carney et al., 2012; Fabbri et al., 2021; Mallinson et al., 2019). Next to sleep diaries assessment of sleep, another way of assessing sleep is by retrospective self-assessment measures such as questionnaires. Self-assessment questionnaires offer various advantages as they do not require supervision, they can be extensively utilized in both routine patient care and research and include a low cost. Additionally, it has been proven that they have a high patient compliance, are convenient to administer and have a lower time demand on medical specialist (Fabbri et al., 2021). Although questionnaires are based on subjective reports and could be biased by this fact, questionnaires have shown a high sensitivity (often above 90%) (Ibanez et al., 2018b). To measure habitual night-time subjective sleep quality, the most widely used questionnaire is the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). The PSQI was not only created to quantify sleep quality, but also has it been used as convergent validity in the majority of research validating sleep questionnaires, implying that the PSQI could be considered an established reference or even gold standard for self-assessed sleep quality. Also, both in clinical and non-clinical settings the PSQI is the most commonly used sleep health assessment instrument (Mollayeva et al., 2016). The PSQI is a validated and highly reliable self-report questionnaire consisting of 19 questions divided into seven major components. These seven components are: subjective quality of sleep, sleep latency, length of sleep, sleep

efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. Scores range from 0 to 3 for each component and the global score ranging from 0 to 21 is obtained by the sum of all components scores. A higher global PSQI score indicates worse sleep quality (Buysse et al., 1989). Using a cut-of score of 5 to differentiate poor sleep with good sleep the PSQI reported a sensitivity of 89,6% and a specificity of 86,5%. The validated Spanish version of the PSQI has shown a correlation coefficient of 0.773 for the global score (Hita-Contreras et al., 2014).

While in general researchers tend to lean more to objective measures, in sleep assessment, it may be argued that, at least to give a broader sleep quality assessment, the subjective sense of sleep and fatigue is as significant as, if not more important than, objective metrics. As a result of this point of view, the use of subjective sleep measurements is widely employed. This is further confirmed by the fact that sleep requirements vary greatly amongst individuals, one person may require 9 hours of sleep to feel rested, whereas another may only need 6 hours (Ferrara & De Gennaro, 2001; Thurman et al., 2018). Furthermore, the physiological aspects of the patient's sleep are limited by the data gained by objective testing methods. They do not provide information on patients' sleep quality from the patients' perspective, despite the fact that a patient's own sleep experience is an important part of evaluating sleep quality (Aitken et al., 2017; Ohayon et al., 2017). Individuals reporting that sleep has been neither sufficient nor restorative despite normal PSG readings best highlight the importance of this element of sleep quality (Edinger et al., 2000; Hughes et al., 2018).

1.4. Bidirectional relationship between sleep and health

Sleep deprivation, the acute or chronic lack of sleep is a common phenome. In Spain, it was reported that 20% of the adult population had difficulties falling asleep or maintain sleep, and 6,4% was diagnosed with insomnia (Ohayon & Sagales, 2010). During the COVID-19 pandemic and its lockdown periods the increase in prevalence of sleep problems and poor sleep quality was highlighted by several surveys (Maestro-Gonzalez et al., 2021; Targa et al., 2021).

Sleep can be seen as an indicator of health and quality of life and there is evidence of a bidirectional relationship between sleep and health (Jin & Choi, 2021). Sleep disruptions have a wide range of risk factors, including physiological,

psychologic, genetic, and social aspects. Excessive caffeine consumption and alcohol consumption are two lifestyle factors interrupting sleep. Circadian rhythms can be disrupted by excessive nocturnal light pollution (Choi et al., 2022) and underexposure to daytime sunlight. Stressful living circumstances, such as being a parent of a small child or caring for a family member who has a chronic, life-threatening, or terminal illness, can also cause sleep disorders (Feeley et al., 2014; Gao et al., 2019). Sleep disturbances and significant medical conditions have a bidirectional association. Individuals with a sleep disturbance are more likely to develop for example hypertension and cardiovascular (Kervezee et al., 2020; Li et al., 2021) cerebrovascular disease (Fernandez-Mendoza et al., 2019), or depression (Lee et al., 2013; Suh et al., 2013). Similarly, a patient with any of these conditions is more likely to develop a sleep disturbance or disorder. The anxiety that comes with sleep loss might lead to more stress in order to get more sleep, which can exacerbate (rather than improve) sleep disturbance (Medic et al., 2017). Sleepiness, for example, is a symptom of depression, and people who are depressed are more prone to avoid activities or spend more time in bed. Sedentary behaviour and spending too much time in bed might have a detrimental impact on the quantity of restful and restorative sleep one can obtain (Aukia et al., 2020).

The key mechanisms by which sleep disturbance is thought to exert its harmful short- and long-term health impacts have been established through sleep deprivation research and insomniac studies (figure 3).

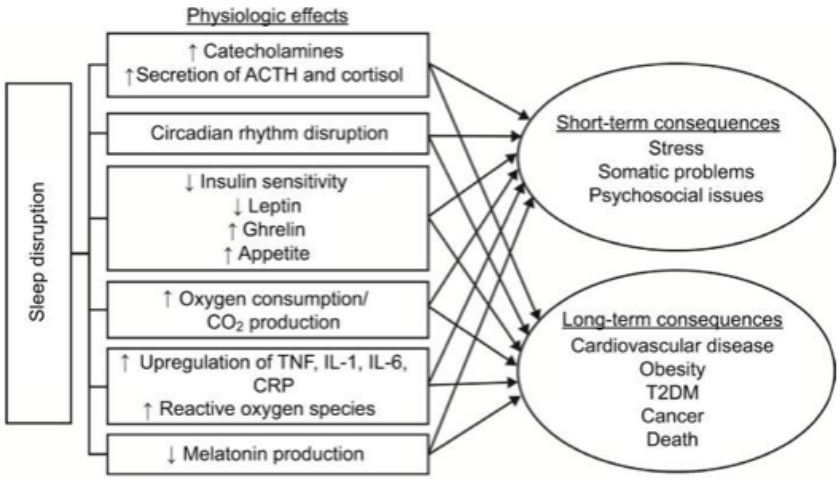

Figure 3. Mechanism sleep disruptions (Medic et al., 2017)

Higher metabolism is evidenced by increased oxygen use and carbon dioxide production during both brief and extended arousals during sleep. Catecholamine, norepinephrine, and epinephrine levels have been linked to sleep fragmentation. Furthermore, chronic persistent insomnia is linked to increased adrenocorticotropic hormone and cortisol release, both of which are present throughout a 24-hour sleep–wake cycle. The stimulation of the sympathetic nervous system, the sympathoadrenal system, and the hypothalamic–pituitary–adrenal axis may be involved in the health effects of sleep disruption, according to these studies.

Furthermore, suppression of Slow wave sleep was linked to a loss in insulin sensitivity that did not result in an increase in insulin release; these findings may explain why patients with poor sleep quality have a higher risk of type 2 diabetes mellitus. Other metabolic changes that may contribute to increased appetite include decreased leptin and increased ghrelin. Sleep disturbances have a reciprocal effect on immune function, resulting in changes in proinflammatory cytokines such as tumour necrosis factor, interleukins 1& 6, and C-reactive protein. The numerous systems that respond to sleep loss suggest that the effects extend beyond the central nervous system and include total body functioning (Medic et al., 2017). Also, it was demonstrated that decreased sleep and reduced sleep quality have an impact

on the cognitive functions (Zavecz et al., 2020), and sleep disturbances, overall, are strongly linked to poorer well-being and quality of life (Akinci et al., 2018).

2. Sleep disturbance in hospital

Among the different situations that can alter the sleep/wake cycle and so affect the restorative capacity of sleep is hospitalization (Morse & Bender, 2019). Patients are taken away from their familiar surroundings which makes that for many patients, sleeping in a hospital is a source of stress and poor sleep has a negative impact on patients' health and hospital experience (Kamdar et al., 2012). This poor sleep experience can cause sleepiness, more fatigue, negative moods, episodes of disorientation or confusion could all have severe consequences on patients' health, reducing their recovery from illness (Hillman, 2021). Recent studies demonstrated that both objective and subjective sleep quality was impaired during hospitalization. Studies using polysomnographic methods showed that aside from a reduction in total time slept, sleep efficiency and the proportion of time in phase N3 and REM sleep are significantly reduced (Chung et al., 2018; Ibala et al., 2021). Consistent with these findings, patients reported their sleep in hospital as more restless, of lower quality and less refreshing in hospital. Moreover, patients reported to sleep about 83 minutes less in hospital when compared with sleep duration at home, also, patients woke up about 44 minutes earlier than their habitual wake-up time (Delaney et al., 2018; Wesselius et al., 2018). It has been argued that these could be short-term effects, however research on subjective sleep quality during recovery of illness showed that sleep quality effects might last for a longer period after hospital stay (Altman et al., 2017; McKinley et al., 2013).

This alteration of the sleep/wake cycle and poor sleep quality can be caused by intrinsic factors such as pathological processes the patient is undergoing, or extrinsic factors, such as noise, light or interruptions due to therapeutic procedures (Bano et al., 2014; Venkateshiah & Collop, 2012).

2.1. Intrinsic factors

Various internal factors can lead to or increase the risk of sleep disturbances. In this dissertation we interpreted internal factors as factors related to the

patient. There are numerous patient-related factors that have potential impact on sleep of patients such as pre-existing sleep disorders, medication use, sociodemographic characteristics, pain, anxiety, or other psychological factors (Gehlbach et al., 2012).

Sleep quality studies in hospitals tend to exclude patients with pre-existing sleep disorders or patients who habitually use sleep medication at home, to be able to isolate the hospital experience (Aitken et al., 2017). Also, information and understanding of sleep quality at home is necessary to assess whether the hospital environment plays a role in sleep disruptions of patients (Kamdar et al., 2012; Yilmaz et al., 2012). A number of medications can cause changes and have effect on both sleep quality and quantity are frequently used in the hospital setting (Song et al., 2018). For example, sedative-hypnotic (e.g. benzodiazepines, propofol,…) medication is often described to promote comfort and sleep, however they are associated with a more superficial sleep due to the suppression of slow wave sleep and REM sleep (Stoschitzky et al., 1999; Wright et al., 2015), other examples are cardiovascular medication such as β-blockers, causing less REM sleep and increased nightmares (Scheer et al., 2012; Stoschitzky et al., 1999), or opioids, affecting sleep architecture by causing a significant reduction in slow wave sleep (Cutrufello et al., 2020; Dimsdale et al., 2007).

A multiple other related factors may contribute to poor sleep quality in hospital. Hospitalized patients often suffer from a combination of health conditions or chronic diseases which makes it more difficult to study the effects of a specific health condition, also the severity of the illness plays a significant role in sleep disruptions (Pisani et al., 2015). There exists growing evidence of a bidirectional relationship between pain and disturbed sleep. Pain seems to have a direct negative influence on sleep quality and nightly awaking's (Frohnhofen, 2018; Tang et al., 2012), and restorative sleep seems to be involved in the resolution of pain (Davies et al., 2008; Hamilton et al., 2007).

In addition to physiological factors such as the burden of disease, and pain other sociodemographic or health behaviour factors may be related to sleep quality and duration. Multiple studies showed a higher prevalence of self-reported sleep disturbances in women compared to men despite their longer sleep duration, shorter sleep-onset latency, and higher sleep efficiency (Krishnan & Collop,

2006; Lindberg et al., 1997). Mainly these differences are explained as a result of hormonal mechanisms in conjunction with cultural and societal demands, and psychosocial factors (Joffe et al., 2010; Mallampalli & Carter, 2014), although recent research suggests that female vulnerability to poor sleep quality should be explored more beyond the psycho-social differences (Fatima et al., 2016).

Also, differences in sleep quality could be observed for ethnicity/race. In comparison to whites, racial/ethnic minorities are more likely to have shorter sleep durations, less slow wave sleep, more inconsistent sleep timing, and higher sleep latency (Grandner et al., 2010; Johnson et al., 2019; Stamatakis et al., 2007). Low socioeconomic status, low education, shift work and specially night-shift workers are associated with short sleep duration and lower sleep quality levels (Stamatakis et al., 2007), but also alcohol use (Stein & Friedmann, 2005) smoking (Peters et al., 2011), recreational drug use (Schierenbeck et al., 2008), and low physical activity (Wang & Boros, 2019) were correlated to poor sleep quality.

Patients describe sleeping in a clinical and hospital setting as a stressor (Ritmala-Castren et al., 2016). Psychological factors such as anxiety and emotional distress have been shown to be negatively correlated to sleep quality in hospitalised (Alvaro et al., 2013; Dobing et al., 2016; Yang et al., 2015). Stress-induced activation of the hypothalamic-pituitary-adrenal (HPA) axis disrupts sleep, and variations in sleep enhance this activation, causing a vicious cycle of stress and sleeplessness (Åkerstedt, 2006; Littlewood et al., 2017).

2.2. Extrinsic factors

The environmental stimuli can be considered as another important source of sleep deprivation in hospital (Honarmand et al., 2020). Aside from the physical illness that led to admission and the psychological stress associated with it, the hospital environment can be detrimental to the induction and maintenance of a normal sleep-wake cycle (Bano et al., 2014). Commonly identified factors are uncomfortable beds, environmental temperature, and bedding, but especially noise, light, and night-time nursing care interventions are known to be addressed by patients as disturbing factors and add to the difficulties of sleeping in a clinical setting (Dobing et al., 2016; Gellerstedt et al., 2019; Venkateshiah & Collop, 2012; Zhang et al., 2013).

Noise: Environmental noise has increased in recent years, resulting in an important public health problem (Hanninen et al., 2014). Noise in hospital has a variety of sources, including conversations, phones, music, alarms, technical medical devices, televisions, but may also originate from outdoors (Khaiwal et al., 2016). Noise has been experienced as one of the most disruptive factors for sleep in hospitalised patients (Delaney et al., 2018; Wesselius et al., 2018). According to the World Health Organization (WHO), in the hospital environment, noise levels should not exceed 35dB-A during the day and 30 dB-A at night, and special attention should be given to sound pressure levels in ICU and operation rooms (Berglund et al., 1999). Several studies have quantified the level of noise in clinical environments, and evidenced that noise levels in hospital very often exceed the noise levels recommended for a healthy environment with measurements during peak times up to 100 dB-A (Hill & LaVela, 2015; Khaiwal et al., 2016; Kol et al., 2015; Montes-González et al., 2019).

Light: The main environmental signal (Zeitgeber) used to synchronize the circadian clock with environmental rhythms is light. The circadian phase can be advanced or delayed by light exposure in the morning or evening (Lack & Wright, 2007). To date there are no suggested illuminance levels to be exposed to, and no minimum luminance value that can keep the circadian master clock synchronized has been established (Middleton et al., 2002). Because patients spend extended periods of time in their hospital rooms, hospital rooms are the most significant settings in terms of environmental light exposure, and significant differences were found in daytime light exposure between window hospital beds and non-window hospital beds (Iwamoto et al., 2018). Previous research has revealed that hospitalized patients in general are exposed to too low luminance levels, with little variation in day-night light exposure, which may be insufficient for circadian entrainment and contribute to advanced or delayed rhythms, depending on timing and intensity (Delaney et al., 2018; Iwamoto et al., 2018).

Night-time nursing care: Caring for ill patients necessarily requires numerous patient interactions, also at night. Nursing procedures such as lab draws, monitoring vital sign, administration of medication, and other nursing interventions have the potential to disrupt sleep. The amount of nursing care that patients require is directly related to the nature of their health problems, rather than the severity of their sickness (Pyykko et al., 2001). Although noise is

rated as the main environmental factor disturbing sleep in hospital, nursing care interventions during the night are frequently pointed out as causes of insufficient and poor sleep quality in hospitalised patients (Dobing et al., 2016; Honarmand et al., 2020; Wesselius et al., 2018).

3. Nursing and sleep

There is a wide range of definitions to explain the concept nursing. The international Council of Nursing (ICN) describes nursing as: "Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings. Nursing includes the promotion of health, prevention of illness, and the care of ill, disabled and dying people. Advocacy, promotion of a safe environment, research, participation in shaping health policy and in patient and health systems management, and education are also key nursing roles" (International Council of Nurses, 2002)

The importance of sleep has been reflected and occupied an important role in nursing theories. The nursing metaparadigm was first classified by (Fawcett, 1984) in order to use it as a device for organizing areas of nursing interest into a philosophical power structure of knowledge and thereby claiming nursing research and practice to be rigorously scientific (Bender, 2018). According to Fawcett, four core concepts—person, environment, health, and nursing—and three specific links between the principles unified the nursing discipline: person–health, person–health–environment, and person–health–nursing are all terms used (Fawcett, 1984).

Florence Nightingale in the late 1800's advocated for the importance of sleep of her patients. Nightingale saw the role of the nurse to provide an environment in which perfection might be achieved. She stated that patients should never be "waked intentionally" or accidentally during the first part of sleep. She asserted that whispered or long conversations about patients are thoughtless and cruel. She viewed unnecessary noise, including noise from the female dress, as cruel and irritating to the patient (Nightingale, 1992). Virginia Henderson in her need theory included a component on sleep and rest as a basic need and required in order to recover health. The 14 components of Virginia Henderson's' Need Theory are based on a on a holistic approach covering physiological, psychological,

spiritual, and social areas (Henderson, 1967). Other nursing theorists such as Martha Rogers, in het science of unitary man (Rogers 1981), or Elisabeth Lenz in her theory of unpleasant symptoms (Lenz et al., 1997) also included the wake/sleep cycles as one of the key points in their nursing theory. In the same way, sleep and rest occupy a domain in for example; the nursing diagnosis taxonomy of the North American Nursing Diagnosis (NANDA) (Herdman & Kamitsuru, 2019) and the Nursing Diagnosis and 11 Gordon's Functional Health Patterns (Gordon, 2014).

In agreement with the before mentioned nursing theories, nursing is a profession that plays an important role in meeting patients' basic needs, including also the need for sleep as sleep deprivation harms patients' health and general well-being. Nurses should have a basic understanding of sleep problems, a correct assessment of its sleep patterns, a holistic and critical approach on environmental disturbing factors, and intervene when patients' sleep is disturbed (Dogan et al., 2005). Former studies have shown the disturbance of sleep in hospital, and pointed out the share nurses and the organization of nursing care have on this disturbances (Hamilton-Fairley et al., 2014; Wesselius et al., 2018). Hospital settings have several different environmental factors contributing to sleep disruption and poor sleep quality. Nurses as the largest group of the global healthcare workforce, providing care 24 hours a day, 7 days a week and therefore could have an important impact in the promotion of a favourable environment in order to give patients the best possible sleep opportunity.

OBJECTIVES

OBJECTIVES

General objective

To determine the role and impact of hospitalisation, and nursing interventions on the sleep quality of patients hospitalized in acute and semi-acute units.

Specific objectives

1. To synthesise the effect of nursing interventions in improving the quality of sleep for patients hospitalized in acute and semi-acute units
2. To describe the characteristics of nursing interventions to improve sleep and determine which nursing interventions have mayor efficacy in order to recommend future lines of research
3. To describe self-reported sleep quality and quantity of hospitalized patients, and to assess its association with sociodemographic factors and poor health habits, and sedentary lifestyle
4. To evaluate the impact of environmental disturbing factors, and night-time nursing care interventions on sleep quality of hospitalized patients.

METHODOLOGY

METHODOLOGY

Given the nature of this doctoral thesis, which is a thesis submitted as papers, the specific methodology and variables studies are described in each of the published or drafted papers included in the following section. For this reason, throughout this chapter, a general description will be given of the methodology used to respond to the objectives initially proposed.

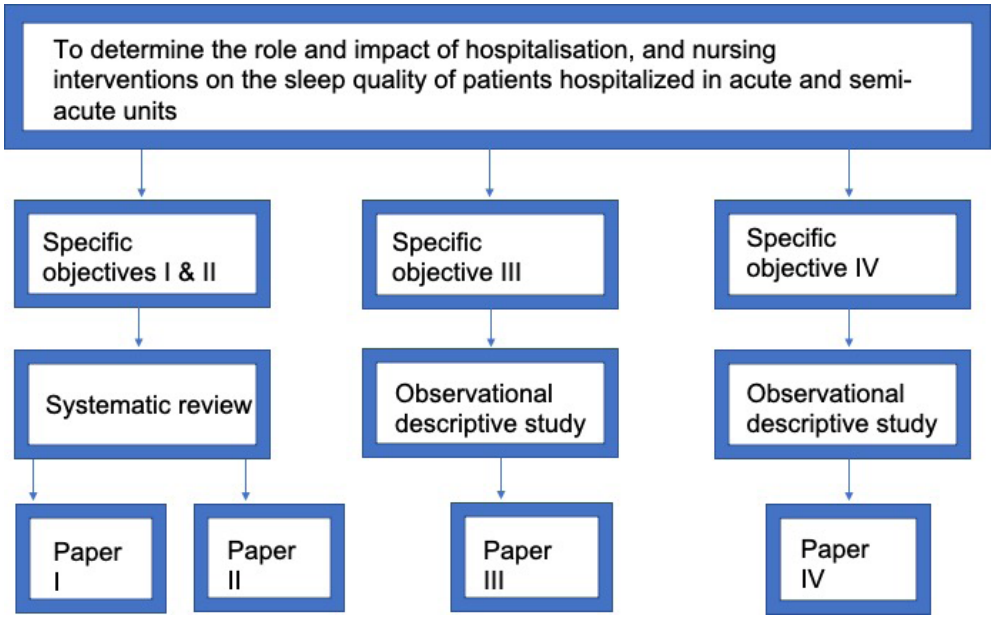

Figure 4. Overview of methodologies of papers.

Methodology to address specific objectives I & II

- To synthesise the effect of nursing interventions in improving the quality of sleep for patients hospitalized in acute and semi-acute units
- To describe the characteristics of nursing interventions to improve sleep and determine which nursing interventions have mayor efficacy in order to recommend future lines of research

To give answer to specific objectives I & II we developed two systematic reviews. The first systematic review gave rise to:

The efficacy of nursing interventions on sleep quality in hospitalized patients: A systematic review of randomized controlled trial

Design

A systematic review of randomized controlled trials was conducted and reported according to the PRISMA guidelines (Moher et al., 2009). We registered the protocol of this review on the PROSPERO website (Protocol number: CRD42020154034).

Search strategy

We generated the search string for Pubmed with MeSH terms and free text words for each conceptual area. Afterwards, searches were adapted to and performed in the following databases: CINAHLPlus, Scopus, ISI WoS, CENTRAL, PsycInfo, and Embase. An additional search in Google Scholar was conducted. This review searched for interventional studies written in English, Spanish, Portuguese, French, or Dutch from January 2009 to June 2019.

Inclusion and exclusion criteria

The inclusion criteria for this review were as follows: randomized controlled trials reporting on the outcomes of interventions led, or primarily delivered, by nurses to improve the sleep quality in patients hospitalized in acute or semi-acute units.

We excluded studies with patients on current sedation. Studies on long-term care hospitalization, nursing homes, palliative care, paediatric care, post-anaesthetic or psychiatric units, and studies evaluating pharmacological interventions.

Study selection

After the removal of duplicates, two reviewers independently screened the search results by title and abstract for potential eligibility. Full text articles of relevant studies were then screened individually against eligibility criteria by two reviewers for inclusion. Any conflicts between the two investigators were independently assessed by a third investigator.

Data extraction and synthesis

Author and publication year, participants and setting, intervention, intervention in the control group, outcomes reported, sleep quality tool used for measurement, and main study findings were extracted. Two reviewers discussed and resolved any discrepancies in the data extracted. A narrative synthesis of the results was performed.

Risk of bias assessment

The risk of bias for each study was assessed independently by two reviewers, and any disagreements were resolved by discussion. The Cochrane Risk of Bias Tool (Sterne et al., 2019) was used to assess randomized controlled trials.

Afterwards, in order to include the highest possible evidence, we performed a systematic review of systematic reviews (Umbrella review) titled:

Effects of nursing interventions to improve inpatients' sleep in intensive and non-intensive care units: Findings from an umbrella review

Design

An umbrella review was conducted in accordance with the methodological recommendations of Joanna Briggs Institute (JBI) (Aromataris et al., 2015) and reported following the PRISMA 2020 statement (Page et al., 2021). The review protocol was registered on the PROSPERO website (CRD42020158790).

Search strategy

The Medical Subject Headings terms and free-text words were identified based on the following concepts to generate the search string in PubMed: "circadian rhythm", "hospitalisation", and "nursing interventions". Searches were conducted in PubMed, CINAHL Plus, Scopus, Institute for Scientific Information Web of Science, Joanna Briggs Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials databases.

Inclusion and exclusion criteria

Reviews that fulfilled the following eligibility criteria were included in the review:

1. Quantitative systematic review articles following a systematized review process (including a review question, defined inclusion and exclusion criteria, search strategy, quality appraisal and selection of studies, and data synthesis) published in English, Spanish, Dutch, French, or Portuguese
2. Reviews describing nursing interventions to promote sleep quality in adult patients aged ≥18 years admitted to intensive care and non-intensive care units
3. Reviews published in 2009 or later

Review articles including patients in long-term care settings, psychiatric settings and reviews on the use of pharmacological interventions were excluded.

Study selection

After removing duplicates, two reviewers screened separated the results yielded from the search by title and abstract, and later from full-text papers. Any conflicts were assessed by a third investigator.

Data extraction and synthesis

Data from the included review articles were independently extracted by 2 authors using an adapted version of the Joanna Briggs data extraction form. Disagreements between reviewers were resolved through discussion. The following data were extracted: authors, design, objectives, participants and settings, types of studies included, interventions, and key findings.

Quality appraisal

The methodological quality of each review article was independently assessed by 2 reviewers using the Checklist for Systematic Reviews and Research Syntheses (Aromataris et al., 2015). Each of the 11 items in the checklist was rated as "yes," "no," or "unclear." At the end of the appraisal process, the reviewers met to reach consensus and resolve any doubts. When disagreements could not be resolved, a third reviewer was consulted. The quality of each review article was rated as follows depending on the number of "yes" responses: low quality (<40%), medium quality (40%–70%), or high quality (>70%).

Methodology to address specific objective III

- To describe self-reported sleep quality and quantity of hospitalized patients, and to assess its association with sociodemographic factors and poor health habits, and sedentary lifestyle

In order to respond to objective III, an observational descriptive study was carried out entitled:

Sleep quality in Spanish public hospitals. A multicentre descriptive study

Study design and participants

A multicentre, observational descriptive study was carried out, recruiting patients from medical and surgical units in 12 hospitals of the Spanish National Health System located in nine Spanish regions (Figure 5). All hospitals were participants of the SueñOn ® health awareness initiative (Sueñon, 2022).

Inpatients, aged 18 years or older with at least 4 consecutive nights of hospitalisation consenting voluntary participation in the study were included. Patients with visual or auditory impairment, intellectual disability or moderate to severe cognitive impairment as reflected in the clinical patients' record were excluded from this study. Data were collected between January 2020 to January 2022 and patients were included on pre-established days every month. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline was followed for reporting this study.

Figure 5. Demographical distribution of participating hospitals.

Data collection

Sociodemographic and clinical characteristics

Data were collected on age, gender, education level, current work situation, mean income per household (euros per month), Body Mass Index, and unhealthy habits such as smoking or any other recreational drug intake.

Patients' clinical characteristics were collected by the nursing staff of the unit. The motive of admission was classified and data on diagnosed and self-reported comorbidities of the patient were collected. Patients were classified as having multimorbidity if multiple diseases or conditions were reported using a definition of two or more conditions (Johnston et al., 2019). Also, covariates such as sedative hypnotic medication use, and staying in a single or shared room were recorded. To assess physical activity level over the last seven days before hospitalisation, the International Physical Activity Questionnaire (IPAQ) was used.

Sleep quality and quantity

The Pittsburgh Sleep Quality Index (PSQI) was used to assess patients' perception of sleep quality and quantity at admission referring to the past 1 month, and at discharge referring to the patients' hospital stay. The PSQI consists of 19 questions divided into seven major components. These seven components

are: subjective quality of sleep, sleep latency, length of sleep, sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. Scores range from 0 to 3 for each component and the global score ranging from 0 to 21 is obtained by the sum of all components scores. Using a cut-of score of 5 to differentiate poor sleep with good sleep the PSQI reported a sensitivity of 89,6% and a specificity of 86,5%. The validated Spanish version of the PSQI has shown a correlation coefficient of 0.773 for the global score (Hita-Contreras et al., 2014).

Data analysis

Data were collected on paper and entered into an online REDCap electronic database (Harris et al., 2009). Analysis of data was performed using SPSS 25.0. Descriptive data were categorized and compared with study variables. Categorical variables were summarised by percentages and continuous variables were reflected by means and SD. Kolmogorov-Smirnov test was used for checking whether sleep quality and quantity could be assumed to be normally distributed. For skewed or non-normality data non-parametric analysis were performed. Sleep quality and quantity differences at admission and during hospitalization were compared with student's paired t test (Wilcoxon test) and differences between groups were analysed with the student's t test (Mann-Whitney test) or ANOVA (Kruskal-Wallis test). Correlation of physical activity level measured with the IPAQ questionnaire was calculated with the Spearman Rho test. All tests were two-tailed at 0.05 significance level.

Ethical approval

Patients participated voluntarily and were included in this study after giving their written consent in the informed consent document in regulation with the law 14/2007 on biomedical research and ethical principles after the declaration of Helsinki. Patients were previously informed of the entire process, and their possibility to revoke their participation at any time. Approval of all ethical committees of all participating hospitals were obtained as well as the approval of the ethical committee of the Carlos III health institute (HIP CI CEI PI 18_2019-V3). Additionally, this study was registered with Clinicaltrials.gov (#NCT04113876).

Methodology to address specific objective objective IV

- To evaluate the impact of environmental disturbing factors, and night-time nursing care interventions on sleep quality of hospitalized patients.

In order to respond to objective VI, an observational descriptive study was carried out entitled:

The influence of nursing interventions and hospitalization on inpatients' sleep quality

Study design

Observational, descriptive multicentre study. Data from patients hospitalized in both surgical and medical units were collected during four consecutive nights. Where applicable, we reported this study following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline (von Elm et al., 2007).

Participants and setting

Patients from 12 hospitals across Spain, covered both rural and urban areas, were recruited between January 2020 and January 2022. The nursing supervisor of each unit included patients aged 18 years or older, and who gave consent to participate in the study voluntarily. The exclusion criteria comprised patients who suffered from visual or auditory impairment, intellectual disability or cognitive impairment as documented in their medical record.

Data collection

Data were collected on sociodemographic variables, clinical characteristics of patients and hospital related information, nursing night-time care interventions, self-reported disturbance factors, and sleep quality.

Sociodemographic and clinical variables

Sociodemographic data (sex, age, BMI) were collected. Clinical characteristics and hospitalization-related information such as reasons of admission, comorbidities, and intake of sleep-related medication were collected by the nursing staff of the unit for each included patient. Additionally, nurses were asked to report on room type (single or shared), and length of hospital stay.

Nursing care interventions

Night time nursing care interventions were collected through a diary during the first four days of admission. A total of 31 nursing interventions that could potentially disrupt patients' sleep were selected from the Nursing Interventions Classification (NIC) (Butcher et al., 2018). Interventions were categorized in 4 main categories: (a) emergency interventions, (b) symptom management, (c) treatment interventions, and (d) care interventions. Nightshift nurses were also asked to record how many times each intervention was performed during 12pm and 06am. They were given the choice between 0, 1, 2, or 3 or more.

Self-reported disturbances

Patients were asked to rate on a ten-point Likert-type scale the disturbance received from their roommate (if applicable), and from the night time nursing activities. Furthermore, patients were asked if they experienced disturbances from bed comfort, room temperature, and bedding.

Sleep quality

Patients' sleep quality was evaluated through the Pittsburgh Sleep Quality Index (PSQI). We used the validated Spanish version of the PSQI (Hita-Contreras et al., 2014).

Data analysis

Descriptive statistics were performed to describe sociodemographic and clinical characteristics as well as hospitalization-related information. Absolute and relative frequencies were used for qualitative data. The means (SD) and medians (25th–75th percentile) were estimated for quantitative variables with normal and non-normal distributions, respectively. The normality of the distribution was assessed by the Kolmogorov-Smirnov test.

Univariate analysis was performed for duration of hospitalization, number of interventions, room type, disturbance with bed comfort, disturbance with room temperature, and disturbance with bedding with the bedding. The delta was obtained through the following formula: Delta = (PSQI during hospitalization – PSQI before hospitalization)/PSQI before hospitalization.

Spearman coefficient tests were performed to assess correlations between continuous variables (duration of hospitalization, annoyance with the room partner, annoyance with the interventions) and sleep quality (PSQI score).

Linear regression models (crude and adjusted by comorbidities and pharmacological treatment) were performed to evaluate possible associations between relevant hospitalization-related factors (duration of hospitalization, number of interventions, room type, annoyance with the room partner, annoyance with the interventions, bed comfort, room temperature, and bedding) and sleep quality (PSQI score). The number of interventions was calculated considering all interventions along the first four nights of hospitalization. The p-value threshold defining statistical significance was set at less than 0.05. All statistical analyses were performed using SPSS 25.0 software.

Ethical approval

This study was conducted according to the principles outlined by the Declaration of Helsinki. Patients were included after providing written consent in accordance with the law 14/2007. They were informed about the full procedure in advance, as well as their right to withdraw at any time. All ethics committees of all participating hospitals, as well as the Carlos III Health Institute's ethical committee (HIP CI CEI PI 18 2019-V3), gave their approval. The study is registered in Clinicaltrials.gov (#NCT04113876).

PAPERS

PAPERS

This dissertation is presented as a thesis by compendium of scientific papers. In this chapter, the four papers, two of which have been published in JCR indexed journals, are presented.

Paper I: **The efficacy of nursing interventions on sleep quality in hospitalized patients: A systematic review of randomized controlled trials.**

Journal: **International Journal of Nursing Studies**

Year: **2021**

Paper II: **Effects of nursing interventions to improve inpatients' sleep in intensive and non-intensive care units: Findings from an umbrella review**

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SPECIAL ISSUE REVIEW

Effects of nursing interventions to improve inpatients' sleep in intensive and non-intensive care units: Findings from an umbrella review

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Abstract

Aim: This review aimed to synthesise the available reviews on the effects of nursing interventions on sleep quality among patients hospitalised in intensive care and non-intensive care units.

Background: Poor sleep quality is a common fact in hospitalised patients. Nurses can contribute to the improvement of patients' sleep quality and duration.

Design: A review of intervention reviews was carried out and reported following the PRISMA guidelines and checklist.

Methods: We systematically searched for reviews published from January 2009 to December 2019 in PubMed, CINAHL Plus, Scopus, Institute for Scientific Information Web of Science, Joanna Briggs Database of Systematic Reviews and Cochrane Central Register of Controlled Trials databases. Searches were repeated at 24 November 2020 to include the most recent evidence. A narrative synthesis of the results was conducted.

Results: Nine reviews (representing 109 original papers) met the selection criteria and were included for critical appraisal. Overall, nursing interventions and sleep quality were poorly defined. We grouped the interventions into 3 categories (environmental, barrier and internal interventions) to provide a more comprehensive overview and examine effects of nursing interventions on inpatients sleep quality. Inconsistent results were obtained and low quality of the original articles was reported, making it difficult to establish absolute conclusions.

Conclusion: The impact of environmental changes on patients' sleep was positive but inconclusive, while use of earplugs and eye masks, music and acupuncture generally showed positive results with moderate quality of evidence, and no harmful effects were reported.

KEYWORDS
circadian rhythm, hospitalisation, nursing, sleep, umbrella review

1 | INTRODUCTION

Sleep, which is regulated by the circadian biological clock, is an essential mechanism in the human body. It allows the control and regulation of the metabolic and hormonal responses, brain function, cardiovascular system, body temperature and immune system (Medic et al., 2017). Sleep quality is defined by the number of awakenings, the perception to fall asleep easily, having sufficient sleep time, and feeling rested and restored on awakening, avoiding daytime sleepiness and tiredness (Harvey et al., 2008). The American Academy of Sleep Medicine and Sleep Research Society stated that healthy sleep 'requires adequate duration, good quality, appropriate timing and regularity and the absence of sleep disturbances or disorders' (Watson et al., 2015).

Despite the importance of sleep, sleep disruption defined as the inability to maintain sleep continuity, and sleep deprivation defined as the failure to obtain the necessary amount or quality of sleep (Medic et al., 2017) is a frequent concern among hospitalised patients, particularly those admitted in the intensive care unit (ICU), and is a major stressor during hospitalisation that can negatively affect patient recovery and survival (Naik et al., 2018; Tembo et al., 2013). In fact, the prevalence of sleep deprivation and poor sleep quality described by patients during hospitalisation has been reported to be 43%–91% (Kulpatcharapong et al., 2020; Wilcox et al., 2018).

There are several factors associated with sleep deprivation during hospitalisation, including physical factors inherent to patients' health conditions (e.g. pre-existing sleep disorders, acute severe illness, pain or organ dysfunction), psychological factors (e.g. stress and anxiety) and hospital environmental factors (e.g. noise and light disturbance, patient care activities, diagnostic procedures and mechanical ventilation) (Dobing et al., 2016; Kulpatcharapong et al., 2020; Little et al., 2012; Park et al., 2014; Pisani et al., 2015). Sleep deprivation delays healing, impairs immune function, decreases pain tolerance, causes emotional distress and mood disorders, and increases the risk of delirium and confusion. It is also associated with poor glycaemic control, hypertension and higher heart rate (Arora et al., 2011; Irwin et al., 2016; Lee et al., 2017b; Medic et al., 2017). In addition, sleep deprivation is frequently associated with long-term repercussions, including decreased performance of daily activities after discharge, increased risk of developing medical complications, development of psychological comorbidities and shorter survival (Altman et al., 2017; Bakken et al., 2012; Martin et al., 2011).

As mentioned above, sleep deprivation and poor sleep quality can have significant adverse health consequences in hospitalised patients, increasing the need for healthcare services and leading to poor health outcomes. Consequently, it can have a significant economic impact, and addressing this problem is a challenge for healthcare systems (Medic et al., 2017; Sarsour et al., 2011).

In the last few years, different strategies have been implemented to promote and improve sleep; however, hospitalised patients are unable to achieve a good quality of sleep (Dobing et al., 2016; Menear et al., 2017). Because there is a growing interest in evaluating various nursing interventions that can be implemented in hospitals to improve patients' sleep quality and a number of reviews have been performed in the last few years to demonstrate their effectiveness, we conducted a review of reviews, also known as umbrella review. To our knowledge, this is the first umbrella review to appraise and synthesise the available evidence on nursing interventions to improve sleep quality in patients admitted to the intensive and non-intensive care units.

What does this paper contribute to the wider global clinical community?

- This review highlights the importance of good sleep quality in hospitalised patients.
- Nurses can play a key role in improving sleep quality of hospitalised patients.

2 | AIM

We aimed to synthesise the available evidence on the effects of nursing interventions on sleep quality to explore whether these types of interventions can be implemented in clinical practice. The review question was as follows: Which nursing interventions can improve the sleep quality of patients admitted in intensive and non-intensive care units?

3 | METHODS

An umbrella review was conducted in accordance with the methodological recommendations of Joanna Briggs Institute (JBI) (Aromataris et al., 2015) and reported following the PRISMA 2020 statement: An updated guideline for reporting systematic reviews (Supplementary File 1) (Page et al., 2021). The review protocol was registered on the PROSPERO website (CRD42020158790). We opted to perform a review of intervention reviews as we had prior knowledge on reviews that may be eligible for inclusion. In addition, we wanted to compare and evaluate the findings of published reviews to obtain the best available evidence (Papatheodorou, 2019).

Reviews that fulfilled the following eligibility criteria were included in the review:

1. Quantitative systematic review articles following a systematised review process (including a review question, defined inclusion and exclusion criteria, search strategy, quality appraisal and selection of studies, and data synthesis) published in English, Spanish, Dutch, French or Portuguese.
2. Reviews describing nursing interventions to promote sleep quality in adult patients aged ≥18 years admitted to intensive care and non-intensive care units using the criteria from the CDC's National Healthcare Safety Network (Washington State Department of Health).
3. Reviews published in 2009 or later.

Review articles including patients in long-term care settings, psychiatric settings and reviews on the use of pharmacological interventions were excluded.

3.1 | Search strategy

The search strategy was designed by an information specialist (RPP) and peer reviewed by a second author (FB) in concordance with the PRESS Statement (McGowan et al., 2016). The Medical Subject Headings terms and free-text words were identified based on the following concepts to generate the search string in PubMed: 'circadian rhythm', 'hospitalisation' and 'nursing interventions' related to the objectives of this review. The search string in PubMed was modified for the other databases considering the properties and specificities of each database. To identify all relevant reviews, we searched PubMed, CINAHL Plus, Scopus, Institute for Scientific Information Web of Science, Joanna Briggs Database of Systematic Reviews and Cochrane Central Register of Controlled Trials databases (Supplementary File 2). During the data extraction process, we repeated systematically the searches in order to dispose to the most recent published information. The latest search dates from 24 November 2020.

3.2 | Selection process and quality appraisal

The screening process was carried out by three reviewers (FB, ABA and MGS). After removing duplicates, two reviewers screened separated the results yielded from the search by title and abstract. Any conflicts were assessed by a third investigator. The same strategy was used by screening of full-text papers.

The methodological quality of each review article was independently assessed by 2 reviewers (FB and ABA) using the Checklist for Systematic Reviews and Research Syntheses (The Joanna Briggs Institute, 2017). The JBI checklist is used to assess the methodological quality and define whether a review has investigated the possibility of bias in its design, execution and analysis (The Joanna Briggs Institute, 2017). Each of the 11 items in the checklist was rated as 'yes', 'no' or 'unclear'. At the end of the appraisal process, the reviewers met to reach consensus and resolve any doubts. When disagreements could not be resolved, a third reviewer (ECR) was consulted. The quality of each review article was rated as follows depending on the number of 'yes' responses: low quality (<40%), medium quality (40%–70%) or high quality (>70%).

3.3 | Data extraction

Data from the included review articles were independently extracted by 2 authors (F.B. and A.B.A.) using an adapted version of the Joanna Briggs data extraction form for systematic reviews and research syntheses. Disagreements between reviewers were resolved through discussion. The following data were extracted: authors, design, objectives, participants and settings, types of studies included, interventions and key findings. Finally, the data extraction process was cross-checked by another author (M.G.S.) to ensure completeness and accuracy.

4 | RESULTS

4.1 | Search outcomes

The database search yielded a total of 3008 articles; after removing duplicates, 2106 unique registries were identified. We excluded 2041 articles for title and abstract articles as they were either not relevant to the topic or did not meet the inclusion criteria. Then, the full text of the remaining 65 articles was retrieved and examined in more detail. After screening the full text, 56 articles were excluded. Finally, nine review articles were included for quality assessment, data analysis and synthesis. The adapted Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart (Figure 1) presents detailed information on the screening process.

4.2 | Characteristics of included reviews

The nine review articles covered 109 studies (some overlapping) published between 1989 and 2019. The number of primary studies of interest included per review ranged from two (Jagan et al., 2019; Poongkunran et al., 2015) to 30 (Hu et al., 2015). Of the nine review articles included in our synthesis, all were systematic reviews, of which three included a meta-analysis (Garside et al., 2018; Hu et al., 2015; Poongkunran et al., 2015).

The review articles differed in terms of the primary study designs. Three systematic review articles only included randomised controlled trials (RCTs) in their synthesis (Bion et al., 2018; Hadjibalassi et al., 2018; Hu et al., 2015; Poongkunran et al., 2015; Vieira et al., 2018; Xie et al., 2009), one reviews included both RCTs and quasi-experimental studies (Korompeli et al., 2017; Locihova et al., 2017), and the remaining five reviews included articles with all types of interventional designs (Brito et al., 2019; DuBose & Hadi, 2016; Garside et al., 2018; Jagan et al., 2019; Lim, 2018; Miller et al., 2019; Tamrat et al., 2013; Weiss et al., 2016).

Most of the included review articles (66%) focused on primary studies performed exclusively in an ICU setting (Bion et al., 2018; Brito et al., 2019; Hadjibalassi et al., 2018; Hu et al., 2015; Jagan et al., 2019; Korompeli et al., 2017; Lim, 2018; Locihova et al., 2017; Poongkunran et al., 2015; Vieira et al., 2018; Weiss et al., 2016; Xie et al., 2009), and three systematic reviews included studies conducted in non-intensive hospital care units (Garside et al., 2018; Miller et al., 2019; Tamrat et al., 2013). The studies included in the reviews were mainly performed in North America, Europe and Asia. The baseline characteristics of the nine review articles are presented in Table 1.

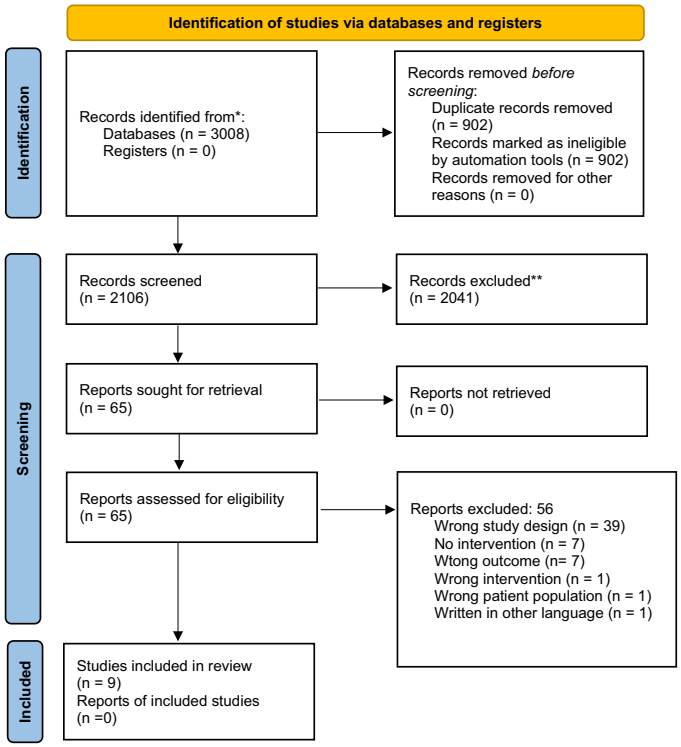

FIGURE 1 Adapted PRISMA flowchart

*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

4.3 | Methodological quality of the included reviews

The results of the methodological quality assessment of the review articles using the JBI appraisal checklist are presented in Supplementary File 3. Eight (89%) of the nine review articles had a high methodological quality score; one (11%) had a medium-quality score.

One review (Tamrat et al., 2013) met all the quality criteria. The main quality issue among the included articles was that the likelihood of publication bias was not analysed. Only two of the nine review articles assessed publication bias; however, an overwhelming evidence showed its existence and impact on the results of systematic reviews (Moher et al., 2009). Furthermore, another possible point of concern might be the lack of information regarding the criteria for appraising appropriate studies and the performance of critical appraisal by two reviewers, given that in four reviews, it was unclear whether it had been performed in duplicate and independently.

4.4 | Classification of interventions and findings of the included review articles

The included review articles varied in terms of the applied interventions, measurement techniques and reported outcomes.

To provide a comprehensive overview and examine the effects of nursing interventions that can increase sleep quality among patients, we classified the interventions performed into the following groups: (1) environmental interventions, (2) barrier interventions and (3) internal interventions. The definitions of these interventions are presented in Table 2.

To assess the grade of quality of evidence and strength of recommendations, we took into account the design of the original studies included in the systematic reviews and the quality assessment of the included reviews. The starting point for the quality of evidence was high if reviews included only randomised controlled trials and if the reviews showed risk of bias and inconsistency of the results. The grade of quality of evidence is presented with the different interventions, outcome measures and settings in Table 3.

TABLE 1 Characteristics of included reviews

Authors, year, country	Study design, setting	Key words, databases, timeframe	Characteristics of included studies of interest	Interventions of interest	Main findings of interest
Garside et al. (2018), UK	Systematic review and meta-analysis To identify, critically appraise and summarise primary research that reports studies that tested interventions to reduce nighttime noise levels in ward settings	*Key words*: Hospital, interventions, noise, sleep, systematic review *Databases*: AMED, BNI, CINAHL, EMBASE, Health Business Elite, Health Management Information Consortium, MEDLINE, The Cochrane Library, PsycINFO, NHS Evidence, Google Scholar *Timeframe*: no date limits—April 2017	9 interventional studies in an acute inpatient setting	Noise reduction interventions: Noise warning system Sleep promotion Environmental repair Window blinds Turning down alarms HUSH time Silence strategies	(1) Individual studies show that noise reduction interventions are feasible in ward settings and suggest they have potential to improve patients' in-hospital sleep experiences. (2) Meta-analyses showed insufficient evidence to support that noise reduction interventions in general ward, had a beneficial effect on sleep, while not identifying any specific intervention to be ineffective
Hadjibalassi etal.(2018), Canada	Systematic literature review To systematically review and synthesise the evidence on the effects of guided imagery on physiological and psychological outcomes of adult critically ill patients	*Key words*: Critical illness Guided imagery Relaxation Complementary alternative therapies Systematic review *Databases*: CINAHL, PubMed, EMBASE, Cochrane Database of Systematic Reviews, Psych-Info *Timeframe*: No date limits—May 2016	3 randomised controlled trials performed on adult ill patients admitted to the ICU	Guided imagery	The effect of guided imagery on sleep quality appears ambiguous and needs further research
Huetal.(2015), China	Systematic review and meta-analysis To assess the efficacy of non-pharmacological interventions for sleep promotion in critically ill adults in the ICU	*Key words*: Not reported *Databases*: CENTRAL, MEDLINE, EMBASE, CINAHL, ISI Web of Science, CAM, Alt Health Watch, PsychINFO, CBM-disc, CNKI *Timeframe*: 1990—2013	29 randomised controlled trials and 1 quasi-randomised trial on critically ill adult patients admitted to intensive care units with a length of more than 24 h	Non-pharmacological interventions: Earplugs or eye mask or both Music Back massage and relaxation Foot bath Acupressure Aromatherapy Sound masking	Some evidence in the meta-analysis was found on the use of earplugs or eye masks or both but the quality of the evidence was low. Low evidence was found for music, relaxation techniques, foot massage, acupressure, nursing or social intervention and sound masking on the improvement of sleep quality

(Continues)

TABLE 1 (Continued)

Authors, year, country	Study design, setting	Key words, databases, timeframe	Characteristics of included studies of interest	Interventions of interest	Main findings of interest
Jagan etal.(2019), Canada	Systematic review To systematically review evidence on the effects of massage on outcomes of adult critically ill patients	*Key words*: Complementary and alternative therapies, critical illness, massage therapy, physiological outcomes, psychological outcomes *Databases*: Pubmed, CINAHL, Scopus, EMBASE-Ovid, Google Scholar *Timeframe*: CINAHL (1937– November 2017), PubMed (1966– November 2017), Scopus (1823– November 2017), EMBASE-Ovid databases (1974–November 2017)	1 randomised controlled trial and 1 non-randomised, pre-test–post-test study on critically ill adult patients admitted to intensive care units	Different types of massage interventions	Massage interventions were found to be effective in improving the quality of sleep in critical illness. However, the effect of confounding factors (disease severity, noise and environment factors) was not taken into account
Locihova etal.(2017), Czech Republic	Systematic review To use available recent and relevant literature sources to confirm whether selected non-pharmacological interventions (earplugs, eye masks) have a positive effect on the quality of sleep in ICU patients	*Key words*: Earplugs, eye mask, quality of sleep, hospitalisation, intensive care unit *Databases*: CINAHL, PubMed, SCOPUS *Timeframe*: 1990– 2015	12 randomised controlled trials and 7 quasi-experimental study design studies including patients admitted to intensive care units	Earplugs and eye masks	Analysis of identified studies suggests that the use of earplugs and eye masks may have a positive effect on the subjective sleep quality of patients in an ICU

TABLE 1 (Continued)

Authors, year, country	Study design, setting	Key words, databases, timeframe	Characteristics of included studies of interest	Interventions of interest	Main findings of interest
Miller et al. (2019),USA	Systematic review To investigate the current state of literature and summarise the clinical evidence for non-pharmacological sleep intervention efficacy and/or effectiveness for patients in hospital setting	*Key words*: Sleep, non-pharmacological intervention, hospitalised patients *Databases*: PsycINFO, PubMed, World Health Organization's clinical trials search portal and further articles were identified for inclusion using a snowball search strategy *Timeframe*: No date limit—December 2017	15 randomised controlled trials, 7 quasi-experimental pre-test–post-test study design and 4 non-randomised controlled trials including patients with medical conditions on hospital care units	Non-pharmacological sleep interventions: Relaxation exercise Quiet time protocol, limit night care Environmental changes, earplugs and eye masks Bright therapy Acupuncture Foot soaking and/or progressive relaxation Back rub Aromatherapy Massage Guided imagery Light therapy Relaxation training Music, music video	Non-pharmacological sleep interventions could be effective for patients in hospital setting; however, low quality of included studies prevented from drawing conclusions. Acupuncture had the most consistently positive effects on subjective and objective measures of sleep.
Poongkunran et al. (2015),USA	Meta-analysis To synthesise the randomised controlled trials that measured the efficacy of sleep-promoting interventions on sleep quality and quantity in critically ill patients	*Key words*: Artificial respiration, critical care, critical illness, hypnotics and sedatives, polysomnography, positive-pressure respiration, sleep *Databases*: Medline, Cochrane Central, DynaMed *Timeframe*: 1966—October 2014	2 randomised controlled trials on critically ill patients admitted to the intensive care unit	Non-pharmacological interventions: Back massage Music therapy	(1) Back massage may be useful in promoting sleep but no significant results were obtained. (2) There is evidence that soothing music improves intensive care unit patients' sleep

(Continues)

TABLE 1 (Continued)

Authors, year, country	Study design, setting	Key words, databases, timeframe	Characteristics of included studies of interest	Interventions of interest	Main findings of interest
Tamrat et al. (2013),USA	Systematic review To identify non-pharmacologic interventions that have been used to improve sleep quality and quantity of non-intensive care unit inpatients	*Key words*: sleep deprivation, inpatient sleep, hospital sleep, hospital Medicine, systematic review *Databases*: Pubmed, Embase, Web of Science, CINAHL, Cochrane Library *Timeframe*: No date limit–January 2013	4 randomised controlled trials, 4 non-randomised controlled trials and 5 pre-test–post-test trial on adult inpatients in non-intensive care units	Relaxation techniques Quiet time or improved sleep hygiene Bright light therapy	A low strength of evidence was found for the implementation of relaxing techniques, quiet time or bright light therapy to improve sleep quality of hospitalised patients
Weiss etal.(2016), Germany	Systematic literature review To analyse studies that investigated the effect of exposure to light or darkness on physiological measures and clinical outcomes of adult ICU patients	*Key words*: Light, intensive care unit, critical care, sleep, melatonin *Databases*: The Cochrane Central Register of Controlled Trials, MEDLINE *Timeframe*: No date limit–October 2015	3 randomised controlled trials, 1 quasi-experimental pre-test–post-test design studies, and 1 experimental prospective study on adults admitted to the intensive care units	Eye masks	Subjective sleep quality improved for patients in the intervention groups. No significant differences were found between groups in objective sleep quality

Abbreviations: HUSH, hospital's ultimate silence for healing; ICU, intensive care unit.

4.5 | Environmental interventions

Three of the nine reviews included in this umbrella review analysed environmental interventions that can prevent sleep disturbances at night. These mainly consisted of implementing quiet-time protocols, increasing the exposure to light during the day and reducing it at night and, the use of sound masking techniques.

Hu et al. (2015) in a systematic review and meta-analysis concluded that sound masking (adding continuous background sound to reduce noise distractions) appeared to be an environmentally effective technique for improving subjective sleep in ICU patients; however, a minimal number of studies performed this type of intervention and quality of the evidence was considered low.

A high-quality systematic review (Tamrat et al., 2013) reported that daytime bright light therapy in non-intensive care units can improve sleep quantity (+7% to +18% improvement) in these types of patients, but the level of evidence was considered low due to a high risk of bias in original studies.

The most common environmental intervention studied is noise reduction at night. Two review articles examined the effects of implementation of noise reduction at night in non-ICU settings. However, noise reduction at night is not frequently used as a single intervention; it is usually implemented with light reduction and patient-centred care. All reviews reported inconclusive results with the implementation of environmental interventions. In medical and surgical ward settings, a recent systematic review and meta-analysis (Garside et al., 2018) reported that noise reduction interventions were feasible and suggested their potential to improve patients' sleep experiences. However, their meta-analysis showed insufficient evidence to support that noise reduction interventions in general had a beneficial effect on sleep, the standardised mean difference in total hours sleep was −0.11 h (95% CI −0.46 to 0.25 h), and the standardised mean difference in awakenings per night was 0.05 (95% CI −0.20 to 0.29) without mentioning a specific intervention that can be considered ineffective. Moreover, a high-quality systematic review article (Tamrat et al., 2013) reported that there was insufficient evidence showing that sleep hygiene, quiet time programmes or programmes for reducing sleep interruption improved subjective sleep quality in patients admitted in non-intensive care units due to the paucity of studies, high risk of bias and inconsistent results.

4.6 | Barrier interventions

Three reviews investigated the effectiveness of barrier interventions led by nurses to promote sleep among patients admitted in ICUs. These review articles confirmed that use of earplugs and eye masks can play an important role in improving patients' sleep quality. In one review (Bion et al., 2018; Brito et al., 2019; Locihova et al., 2017), use of eye masks and earplugs showed potential positive effects on subjective sleep quality; however, further studies are needed as the reviewed articles had a small sample size and short

TABLE 2 Definitions of categories

Categories	Definitions
Environmental interventions	Interventions performed with the aim of changing the hospital environment. They try to reduce or eliminate the external stimulus (noise, light or nursing care activities) that may affect patients' sleep quality or quantity. The interventions included in this group involve; quiet time protocols, reducing light/noise at night, the use of noise warning systems, bright light therapy during daytime and the evaluation of hospital unit layout on sleep.
Barrier interventions	Interventions using devices that block the external stimulus avoiding it to reach directly to the patient. This section includes the use of earplugs and eye masks.
Internal interventions	This category gathers the strategies performed to help the patient calming the mind and be predisposed to sleep. (e.g. relaxation strategies, guided imagery, aromatherapy, acupuncture, soothing music and massage).

evaluation time or were highly heterogeneous. A systematic review and meta-analysis conducted by Hu et al. (2015) showed that use of earplugs or eye masks or both had a positive effect on subjective sleep quality compared with usual care, but the quality of evidence of the included primary studies was low. Results for objective sleep quality remained inconsistent and their meta-analysis showed that total sleep time was significantly greater in the intervention group compared with the control group (MD 2.19 h, 95% CI 0.41 to 3.96). However, the great heterogeneity between studies made it impossible to draw firm conclusions.

Similarly, Weiss et al. (2016) analysed the use of earplugs and eye masks, respectively, and reported that the use of these devices is promising for improving subjective sleep quality.

4.7 | Internal strategies

Six review articles used strategies that can help patients calm their mind and predispose them to sleep (e.g. relaxation strategies, guided imagery, aromatherapy, acupuncture, soothing music and massage).

Four review articles reported the effects of a combination of relaxation techniques. They concluded that there is a low strength of evidence showing that relaxation techniques can improve sleep quality. A systematic review article (Tamrat et al., 2013) examined various relaxation techniques, including massage, music and aromatherapy, which seemed to have a modest effect in general inpatient settings obtaining from 0% to 28% improvement in overall sleep quality. Similar results were reported in a systematic review article (Jagan et al., 2019) and a meta-analysis (Poongkunran et al., 2015) performed in intensive care settings, indicating that massage interventions might be useful in promoting sleep.

Furthermore, a systematic review (Hadjibalassi et al., 2018) showed inconclusive results regarding the application of guided imagery in the ICU. The article concluded that the effect of guided imagery on sleep quality appears ambiguous; hence, further studies are warranted due to a lack of statistically significant results.

A meta-analysis (Poongkunran et al., 2015) showed strong evidence regarding the positive impact of calming and soothing music on sleep quality in hospitalised patients. Poongkunran et al. (2015) found evidence that soothing music improved objective sleep quality in ICU patients with a greater amount of slow-wave sleep. Furthermore, the systematic review performed by Hu et al. (2015) found some evidence that music interventions may improve subjective sleep quality; however, the results were inconsistent across studies with a high risk of selection bias.

Furthermore, the above-mentioned systematic review and meta-analysis (Hu et al., 2015), which included 30 RCTs, examined the effects of other internal interventions (e.g. aromatherapy, foot massage, foot bath and acupressure) and concluded that these interventions may improve sleep quality in ICU patients. However, a limited number of studies were found per intervention type and the risk of selection bias was unclear or high.

In a recent high-quality systematic review article (Miller et al., 2019), the positive effects of acupuncture on subjective and objective measures of sleep were consistently high among the internal strategies evaluated (e.g. relaxation techniques, guided imagery, deep breathing techniques, watching relaxing music videos, aromatherapy, massage, light therapy or multiple interventions). However, further studies are needed to confirm these findings.

5 | DISCUSSION

The increasing number of published review articles on interventions to promote sleep in a hospital environment demonstrates the need to provide the best evidence-based practice to solve problems in clinical policy making (Gopalakrishnan & Ganeshkumar, 2013; Saunders et al., 2016). Although nurses are first line care givers, and they play an important role in promoting good sleep habits (Collis Pellatt, 2007), our review shows that there is limited research on the topic done to evidence the importance of nursing interventions in inpatient settings.

TABLE 3 Synthesis of characteristics, outcome and grade of evidence

Category	Intervention	Appears in study	Setting	Outcome	Grade quality of evidence
Environmental interventions	Sound masking Daytime bright light therapy Noise reduction	(Hu et al., 2015) (Tamrat et al., 2013) (Garside et al., 2018) (Tamrat et al., 2013)	ICU Non-ICU Non-ICU Non-ICU	Subjective sleep quality Objective and subjective sleep quality and quantity Subjective sleep quality Subjective sleep quality	Low evidence for improvement Low evidence for improvement Low evidence for improvement Low evidence for improvement
Barrier interventions	Earplugs and eye masks	(Locihova et al., 2017) (Hu et al., 2015) (Weiss et al., 2016)	ICU ICU ICU	Subjective sleep quality Objective and subjective sleep quality and quantity Subjective sleep quality	Moderate evidence for improvement Moderate evidence for improvement Low evidence for improvement
Internal intervention	Relaxation techniques (massage, music, aromatherapy) Massage Guided imagery Soothing music Relaxation techniques (aromatherapy, foot bath, acupressure) Acupuncture	(Tamrat et al., 2013) (Jagan et al., 2019) (Poongkunran et al., 2015) (Hadjibalassi et al., 2018) (Poongkunran et al., 2015) (Hu et al., 2015) (Hu et al., 2015) (Miller et al., 2019)	Non-ICU ICU ICU ICU ICU ICU ICU Non-ICU	Subjective sleep quality Subjective sleep quality Objective sleep quality Objective and subjective sleep quality and quantity Objective sleep quality Objective and subjective sleep quality Subjective sleep quality Objective and subjective sleep quality	Low evidence for improvement Low evidence for improvement Low evidence for improvement Low evidence for improvement Moderate evidence for improvement Low evidence for improvement Low evidence for improvement Moderate evidence for improvement

Abbreviation: ICU, intensive care unit.

5.1 | Methodological concerns

We aimed to identify nursing interventions that can be implemented in both ICU as general ward settings. Nursing interventions that can be implemented in both settings can be hard to find as there are differences in extrinsic and intrinsic sleep-disrupting factors (Hellström & Willman, 2011), although former studies (Delaney et al., 2018; DuBose & Hadi, 2016; Elliott et al., 2014) reported the same sleep-disturbing factors in both settings. While the majority of the review articles focused mainly on ICU patients, we opted to include patients admitted in ICU and non-ICU settings to have a wider view of these patients. In this context, it is important to not only take into account general characteristics of patient's populations but consider individual patients' characteristics and preferences in the implementation of new interventions and clinical decision-making (Ringdal et al., 2017; van der Weijden et al., 2010).

A major challenge detected in this umbrella review was the consistency in measuring sleep outcomes. Most reviews included both objective as subjective sleep outcome measures in their analysis, although various studies detected discrepancies in the correlation of both outcome measures and agreements of subjective sleep assessment and objective sleep measures (DiNapoli et al., 2017; Herbert et al., 2017; Hughes et al., 2017) as both may measure unique aspects of sleep quality (Landry et al., 2015). This can explain the weak and suggestive findings and the difficulty of drawing firm conclusions.

The methodological quality of the included review articles was generally rated as high. However, evidence supporting the effectiveness of the interventions and the methodological quality in most primary studies were considered low (as reported by the review authors). Only 2 reviews (Poongkunran et al., 2015; Tamrat et al., 2013) judged some of the studies on relaxation interventions, light therapy, or music intervention as having medium or low risk of bias; however, insufficient strength of the evidence was found.

Despite the low quality of evidence and the difficulty in drawing strong conclusions from the findings of the included review articles, this umbrella review provides an overview of the nursing interventions that are potentially effective, which can help develop health policies and design further studies.

As the interventions in the included review articles were not standardised, different intervention terms may indicate the same intervention, and interventions can be implemented in various ways to promote sleep; we discussed our main findings below according to the different interventions found.

5.2 | Light and noise

Previous studies have pointed out that environmental factors, such as noise, light or nursing interventions performed at night, can cause sleep disturbance (Bernat Adell et al., 2020; Bihari et al., 2012; Dobing et al., 2016). The included review articles reported moderate evidence that reducing light exposure and sound level and developing quiet-time protocols at night can improve patients' subjective and objective sleep quality. Additionally, sound masking proved to be effective because of its capacity to minimise distracting sounds. In the past, healing environments have been effective in accelerating the recovery process and improving the patient's well-being (Huisman et al., 2012; Zhang et al., 2018). Moreover, well-designed healthcare environments could be considered 'smart investment' (Iyer et al., 2020). The World Health Organization has stated that sound levels in hospital settings should not surpass 35 dBA, with a maximum of 40 dBA, during the night, to prevent sleep disturbance (Berglund et al., 1999). However, the noise levels in hospital settings are often above 50 dBA (Basner & McGuire, 2018; Park et al., 2014). Our findings on interventions to reduce noise levels in hospitals confirm that these guidelines are still up to date, and these interventions can reduce patients' exposure to noise pollution.

Light is considered the main element for synchronising the circadian rhythms (Bano et al., 2014). Interventions based on reducing light levels during nighttime can improve the sleep quality of hospitalised patients. However, the interventions were all combinations of sleep-promoting measures, combining dimming lights at night with quiet-time protocols. A previous study reported that inpatients in general wards who are exposed to low light levels and a diminished contrast between day and night illuminance, the circadian clock may be weak, contributing to poor sleep (Bernhofer et al., 2014). In this context, interventions using bright light exposure during the daytime were effective in improving sleep quality and quantity. These findings indicate that nurses should pay attention to not only reducing light and noise during night hours but also administering the right amount of intervention at the right time.

5.3 | Eye masks and earplugs

Despite the growing awareness on environmental interventions and the existence of the above-mentioned guidelines, there is a lack of efforts in implementing these sleep-promoting interventions to reduce environmental disturbing factors (Kamdar et al., 2016; Madrid-Navarro et al., 2015). Therefore, there is scope for improvements in various areas (Jaiswal et al., 2017).

The review articles on use of earplugs and eye masks reported similar conclusions regarding the beneficial effects of these devices on different aspects of sleep quality in critically ill patients. However, the low quality of the primary studies should be considered, and the review articles mentioned the need for more high-quality studies to confirm their results. According to Ye et al. (2019), a tool should be used to evaluate factors that can cause sleep disturbance to establish a personal action plan for providing more patient-centred care as it has been demonstrated to improve healthcare outcomes (Rathert et al., 2013). Patient preferences should be assessed as in previous studies, patients classified the interventions from very comfortable to very uncomfortable (Richardson et al., 2007) or low adherence to the intervention was reported (Litton et al., 2016). Patient needs and the risks of using eye masks and earplugs should be assessed individually, as sound and light masking can lead to sensory deprivation

and cognitive disturbances. Hence, reduction of patient autonomy among intubated patients can be avoided (Simons et al., 2012, 2018).

5.4 | Relaxation techniques

In general, review articles including strategies to stimulate patients' internal capacity to sleep and calm the mind reported low evidence supporting the effectiveness of these types of interventions.

Guided imagery as an integrative therapy did not yield significant results for sleep improvement. However, the authors suggested an improvement in sleep quality and attributed the lack of evidence to the nature of the intervention and the difference in philosophy compared with normal care (Hadjibalassi et al., 2018).

Various review articles have reported moderate-to-low evidence regarding a combination of relaxation interventions and massage. In accordance with these findings, an earlier systematic review article showed insufficient evidence to conclude the effectiveness of relaxation interventions on sleep quality in acute hospital settings; hence, further studies are needed in order to strengthen the evidence on relaxation therapies (Richards et al., 2003). Previous studies have provided strong evidence regarding the effectiveness of music interventions in improving sleep quality. The beneficial effects of music have been demonstrated in previous studies (Chen et al., 2014; Hansen et al., 2018; Lee et al., 2017a). Moreover, music had a positive effect on patients with an existent sleep disorder (Feng et al., 2018; Jespersen et al., 2019; Wang et al., 2014). However, previous studies have also shown that the results could be influenced by patient preferences (Lai & Good, 2005; Trahan et al., 2018) and that the music that patients are familiar with seemed to have a more relaxing and analgesic effect (Loewy, 2020; Tan et al., 2012).

Interventions using acupuncture seemed to obtain positive effects on improving self-reported sleep quality. These findings are in line with those of previous studies that have provided evidence on the effectiveness of acupuncture in improving sleep quality in patients with depression (Wen et al., 2018), cancer (Choi et al., 2017) or insomnia (Shergis et al., 2016). However, acupuncture can be classified as an alternative medicine that is mainly practiced in Asian countries, and there is a contrast in the prevalence of complementary and alternative medicine utilisation between continents because of social and cultural factors. These differences could lead to difficulties in the implementation of such interventions in healthcare systems such as established healthcare systems in Western countries (Walker & Tangkiatkumjai, 2017).

5.5 | Limitations

Several limitations of this umbrella review should be considered when interpreting the results. First, a comprehensive and systematic search was performed covering a broad range of databases and languages, but grey literature was not included (Charrois, 2015). Therefore, we might have missed some available evidence.

Second, all review articles that met the eligibility criteria were included according to the JBI appraisal checklist for systematic reviews. Although review articles with low-quality scores were not excluded by this system, all of the review articles included in our umbrella review had medium-to-high quality results on the critical appraisal scale, which did not compromise the quality of this umbrella review (Aromataris et al., 2015).

Lastly, we identified some weaknesses due to the limitations of the primary research studies included in the review articles. The high heterogeneity in patient profiles, generally small sample size, low quality, variability in the study designs and the lack of specific details made it difficult to compare the findings and draw firm conclusions. Moreover, with regard to sleep quality, most of the review articles and studies regarding this topic did not make a clear distinction between objective and subjective sleep quality, which restricts the comparison of findings.

As the nursing interventions found in this review were heterogeneous, and their results were highly narrative, little synthesis of the results was possible. Taking into account the promising results of this umbrella review and noting the growing interest in quality care and nursing interventions contributing to this, the results of this review indicate a need for more experimental studies. The discipline of nursing is very diverse, as are the nursing interventions. Therefore, experimental studies testing interventions to improve sleep quality in hospitalised patients are essential to advance the quality of care (Bolton et al., 2007).

6 | CONCLUSION

This umbrella review provides a wide range of nursing interventions and their effectiveness in intensive and non-intensive care inpatients. Considering the aforementioned limitations, review articles with moderate grade of evidence showed positive but inconsistent interpretation of the quality of evidence between reviews on the same intervention regarding the impact of environmental changes; however, they reported positive effects of using earplugs and eye masks, music therapy, and acupuncture; no harmful effects were reported. Although the overall methodological quality of the included review articles was acceptable, the quality of the primary studies was cited as poor by the majority of the reviews, which made our umbrella review limited and did not allow us to draw firm conclusions. Hence, future studies on subjective and objective sleep quality focusing on factors influencing the sleep quality in inpatients are warranted (Padilla-Martinez et al., 2020). In addition, patient preferences should be considered to deliver a tailored intervention and offer patient-centred care.

7 | RELEVANCE TO CLINICAL PRACTICE

Sleep disruptions are very common among hospitalised patients, and there is still a lack of knowledge about the effectiveness of nursing

interventions to improve sleep quality. The use of earplugs and eye masks, music therapy and acupuncture appeared to be the most effective nursing interventions in improving sleep quality in hospitalised patients. These findings can help nursing staff and hospital organisations to develop practical policies to offer a better patient-centred care.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTION

FB involved in conceptualisation, data curation, formal analysis, methodology, validation, and writing–review and editing. ABA and RPP involved in data curation, formal analysis, and writing–review and editing. ECR involved in data curation, formal analysis, methodology and validation. EAC and TMC involved in validation, writing–review and editing, and funding acquisition. MGS involved in conceptualisation, formal analysis, funding acquisition, methodology, supervision, validation, and writing–review and editing.

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SUPPORTING INFORMATION

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Paper III: **Sleep Quality in Spanish Public Hospitals. A multicentre descriptive study**

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SLEEP QUALITY IN SPANISH PUBLIC HOSPITALS. A MULTICENTRE, DESCRIPTIVE STUDY

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Abstract

Sleep is a complex process and is needed both in health and illness. Deprivation of sleep is known to have multiple negative physiological effects on people's bodies. Despite the awareness of these harmful effects, previous studies have shown that sleep is poor among hospitalised patients. We utilized an observational descriptive design with 343 patients recruited from medical and surgical units in 12 hospitals located in nine Spanish regions. Sociodemographic and clinical characteristics of included patients were collected. Sleep quality at admission and during hospitalisation was measured by the Pittsburgh Sleep Quality Index. Sleep quantity was self-reported by patients in hours. Mean global sleep quality score before hospitalisation was 8.62±4.49 and 11.31±4.04 during hospitalisation and inpatients slept a mean difference of 56 minutes less. Lower educational level, sedative medication intake, and multi-morbidity was shown to be a risk factor for poorer sleep quality during hospitalisation. Higher physical activity has shown to correlate positively with sleep quality in hospital. Our study showed poor sleep quality and quantity of inpatients and a drastic deterioration of sleep in hospital versus at home. These results may be helpful in drawing attention to patients' sleep in hospitals and encouraging interventions to improve sleep.

Background

Sleep, essential for healthy functioning, is characterized by sensory disconnection[1]. Buysse[2] defined sleep as "a multidimensional pattern of sleep-wakefulness, adapted to individual, social and environmental demands, that promotes physical and mental well-being". Without question, sleep has a global restorative function for the organism, fundamental for maintaining neurobehavioral activity and brain health during wakefulness [1,3]. As a consequence, sleep has been of great importance to human well-being since the dawn of history [4]. However, it was not until the mid-19th century that sleep became a subject of experimental research [5] . Sleep can be seen as a multidimensional concept, and so is its analysis. As a result, in the last 20 years, there has been an exponential increase in scientific literature taking into account characteristics such as sleep timing, quality, and variability as an important factor of sleep health [6].

Sleep quality and quantity have a critical role in promoting health [7]. Poor sleep quality and sleep deprivation have been associated with an increased risk of cardiovascular events [8], cancer [9], impaired glycaemic control and metabolic disorder [10], and all-cause mortality [11]. Moreover, chronic poor sleep has been related to cognitive function impairment and neurodegenerative diseases [12], a weakened immune system [13,14] and a higher fall risk [15]. Additionally, it has been demonstrated that good sleep quality can be of therapeutic use for patients with chronic pain [16], or mental disorders [17].

Previous studies have suggested that sleep during hospitalisation is not optimal [18-21], and those associated sleep disturbances are shown to continue after hospitalisation [22]. The clinical environment may be a cause of this sleep impairment [18]. Factors such as light and sound disturbances, night-time care interventions, environmental temperature, and psychological factors are possible factors that can lead to poor sleep, inducing misalignment in the sleep-wake cycles [21,23]. However, as hospitals are a place of healing, it could be expected that they should provide the best possible conditions to achieve this healing process. Also, hospitals could have an educational function by offering exemplary behaviour and support to patients in order to achieve sleep health in the long term, even after hospitalisation [24].

To date, in Spain, no previous multicentre studies have been carried out in medical and surgical hospital units to describe sleep quality and quantity.

Therefore, we aimed:

- To assess self-reported sleep quality and quantity of medical and surgical unit inpatients.
- To compare sleep quality of patients before and during their hospitalisation
- To describe the association of inpatients' sociodemographic and poor health habits and sedentary life to their sleep quality

Methods

Study design and participants:

A multicentre, descriptive observational study was carried out, recruiting patients from medical and surgical units in 12 hospitals of the Spanish National Health System located in nine Spanish regions (Figure 1). All hospitals were participants of the SueñOn ® health awareness initiative [25]. Inpatients, aged 18 years or older with at least 4 consecutive nights of hospitalisation who consented to participate voluntarily in the project were included in this study. Patients with visual or auditory impairment, intellectual disability or moderate to severe cognitive impairment as reflected in the clinical patients' record were excluded from this study.

Data were collected between January 2020 to January 2022 and patients were included on pre-established days every month. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline was followed for reporting this study.

Data collection

Sociodemographic and clinical characteristics

Data were collected on age, gender, education level, current work situation, mean income per household (euros per month), Body Mass Index, and unhealthy habits such as smoking or any other recreational drug intake.

Patients' clinical characteristics were collected by the nursing staff of the unit. The motive of admission was classified and data on diagnosed and self-reported comorbidities of the patient were collected. Patients were classified as having multimorbidity if multiple diseases or conditions were reported using a definition of two or more conditions [26]. Also, covariates such as sedative hypnotic medication use, and staying in a single or shared room were recorded.

To assess physical activity level over the last seven days before hospitalisation, the International Physical Activity Questionnaire (IPAQ) was used.

Sleep quality and quantity

The Pittsburgh Sleep Quality Index (PSQI) was used to assess patients' perception of sleep quality and quantity at admission referring to the past 1 month, and at discharge referring to the patients' hospital stay. The PSQI is a validated and highly reliable self-report questionnaire consisting of 19 questions divided into seven major components. These seven components are: subjective quality of sleep, sleep latency, length of sleep, sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. Scores range from 0 to 3 for each component and the global score ranging from 0 to 21 is obtained by the sum of all components scores. A higher global PSQI score indicates worse sleep quality [2]. Using a cut-of score of 5 to differentiate poor sleep with good sleep the PSQI reported a sensitivity of 89,6% and a specificity of 86,5%. The validated Spanish version of the PSQI has shown a correlation coefficient of 0.773 for the global score [27].

Data analysis

Data were collected on paper and entered into an online REDCap electronic database [28]. Analysis of data was performed using SPSS 25.0. Descriptive data were categorized and compared with study variables. Categorical variables were summarised by percentages and continuous variables were reflected by means and SD. Kolmogorov-Smirnov test was used for checking whether sleep quality and quantity could be assumed to be normally distributed. For skewed or non-normality data non-parametric analysis were performed. Sleep quality and quantity differences at admission and during hospitalization were compared with student's paired t test (Wilcoxon test) and differences between groups were analysed with the student's t test (Mann-Whitney test) or ANOVA (Kruskal-Wallis test). Correlation of physical activity level measured with the IPAQ questionnaire was calculated with the Spearman Rho test. All tests were two-tailed at 0.05 significance level.

Ethical approval

Patients participated voluntarily and were included in this study after giving their written consent in the informed consent document in regulation with the law 14/2007 on biomedical research and ethical principles after the declaration

of Helsinki. Patients were previously informed of the entire process, and their possibility to revoke their participation at any time. Approval of all ethical committees of all participating hospitals were obtained as well as the approval of the ethical committee of the Carlos III health institute (HIP CI CEI PI 18_2019-V3). Additionally, this study was registered with Clinicaltrials.gov (#NCT04113876).

Results

General characteristics of the participants

A total of 343 patients from 12 different Spanish public hospitals with a minimum hospital stay of 4 days were included in our study. Our study included hospitals of both rural and urban regions and covered hospitals from geographical areas all over Spain. The mean age of the participants was 63.47 ± 14.96 years. Our sample was comprised of 143 (41.69%) female, and 199 (58.02%) male participants (one patient didn't identify their sex) and 20.41% of the participants reported being habitual smokers. Included patients were hospitalised in surgical n=162 (47.23%) and medical n=181 (52.77%) units. The majority of the patients were retired n= 202 (58.89%), 97 (28.28%) were employed, 37(10.79%) were unemployed, and 2 (0.58%) were students. Over half of our sample (54,52%) had been educated only to the primary level, and only 9.62% were university graduates. Household incomes per capita were mostly (38.38%) between 0 and 1000 euros, 35.86% had an average income between 1001 and 2000 euros monthly, and 9.33% of the participants disposed of >2000 euros a month (9.33% of the participants did not want to provide data about their income). The mean BMI of the participants was 27.70 ± 5.98. Most patients were diagnosed with multimorbidity (62,09%). Main hospital admission motives were digestive diseases (27.41%), neoplasms (25.07%) and respiratory diseases (20.41%). Most of the patients stayed in double rooms n=289 (84.26%) and the median hospital stay was 8 days (IQR=7.00-11.00). More details about sociodemographic variables, hospital admission motive, comorbidities, and the distribution of the 343 participants and missing data are shown in Table 1.

Sleep quantity and quality before and during hospitalisation

Looking at total sleep quantity, participants' report of how many hours they actually slept before and during hospitalisation resulted in a mean total sleep time of 56 minutes less during hospitalisation (6.28 ± 1.64 vs 5.34 ± 1.58, p<0.001).

Global PSQI scores measuring overall sleep quality could be calculated in only 298 patients (86.88%) because of missing data. However, because missing data was sporadic across the 19 questions, we also calculated the scores of the seven PSQI components relating to sleep quality.

Poor sleep quality (PSQI >5) before hospitalisation was present in 77.00% and was 95.10% during hospitalisation. Mean global PSQI score before hospitalisation was 8.62 ± 4.49 and rose to 11.31 ± 4.04 during hospitalisation showing a decrease in overall sleep quality during hospitalisation compared to sleep quality before admission in the hospital (Z= -8.539, p<0.001). Daytime dysfunction was the lowest scoring component of the PSQI (0.67 ± 0.88) and sleep latency was the highest (1.52 ± 1.09) before hospitalisation. When participants answered the PSQI at discharge, daytime dysfunction remained the lowest component (1.12 ± 1.01), and sleep latency was scored the highest (1.98 ± 1.03), along with sleep duration (1.98 ± 0.94), and sleep efficiency (1.98 ± 1.18). The greatest increases could be seen also in these components; sleep efficiency (+0.63, p<0.001), sleep duration (+0.54, p<0.001), and sleep latency (+0,46, p<0.001) comparing PSQI scores before and during hospitalisation suggesting that these components had the greatest influence on the decline of patients' sleep quality in the hospital. Student´s t-test and Mann-Whitney test confirmed increases in all seven components, all statistically significant except for component 1: subjective sleep quality (p=0.056). Changes in PSQI scores and reported sleep quantity are summarized in Table 2.

Effects of patients' sociodemographic and clinical characteristics on sleep quality and quantity

A decrease in sleep quality could be observed in all sociodemographic categories during hospitalisation, all statistically significant except for age 31-50 (p = 0.071), unemployed participants (p = 0.071), students (p = 0.655) and participants with underweight (p = 0.157). Self-reported total sleep hours also

decreased significantly in all almost all groups except for students ($p = 0.180$) and participants that were underweight ($p = 0.714$), however, this could be explained by small sample size in these categories. No significant differences in sleep quantity or quality could be observed between groups for motive of admission before or during hospitalisation (all >0.05).

It was shown that age, income, room type, length of hospital stay, smoking or recreational drug intake, or BMI had no significant influence on the patients' sleep quality at admission or during the hospital stay (all $p > 0.05$). Patients' sleep quality scores at admission were higher in patients admitted to medical units ($Z= -4.144$, $p < 0.001$) and a higher PSQI score could be demonstrated in female patients ($Z= -3.284$, $p = 0.001$). Also, a significant difference between groups at admission could be observed for patients' working situation, with a better sleep quality for employed patients ($H(3) = 9.736$, $p = 0.021$). However, these differences between groups were not maintained during hospitalisation. Patients' sleep quality scores during hospitalisation were higher in those with only primary education than in those with education at the secondary or university level ($H (2) = 6.246$, $p = 0.044$), whereas there was no difference found between these groups at admission. This difference could also be observed in reported sleep hours during hospitalisation ($H (2) = 6.833$, $p = 0.033$). Having 2 or more comorbidities was associated with a significant difference in sleep quality both at admission ($Z= -3.441$, $p = 0.001$) and during hospitalisation ($Z=-2.731$, $p = 0.006$). Patients taking sedative-hypnotic medication had poorer sleep quality both before ($Z= -2.285$, $p = 0.022$) and during hospitalisation ($Z= -6.092$, $p < 0.001$) compared to those who didn't. These differences were not shown for sleep duration.

Finally, correlation with the Spearman's Rho test showed evidence that higher physical activity measured with the IPAQ questionnaire led to better sleep quality during hospitalisation ($R= -0.148$, $p = 0.012$). However, differences were not significant at admission, nor were they significant for sleep quantity. No other differences between groups for both sleep quality (Table 3) or quantity (Table 4) were statistically significant.

Discussion

To our knowledge, this nationwide, multicentre study is the first to examine subjective sleep quality and quantity in patients of surgical and medical units in Spain. Sleep is necessary for the human being to lead normal activities and maintain good health [29]. Hospitalised patients who are recovering from surgery or illness are supposed to have an even greater need of restorative sleep to achieve full recovery [30]. However, our results demonstrated that sleep quality in patients admitted to hospitals of the public national health system experienced poorer sleep quality and slept almost one hour less than before hospitalisation. This suggests that the experience of hospitalisation has a negative effect on both sleep quality and sleep duration. These findings are in line with other studies reporting poor sleep quality in hospitalised patients [20,21,31-35], although comparison with other studies could not be done because of reporting on patients from specific units, single hospital samples, patients with specific conditions, or the use of other sleep quality measurement tools. Therefore, we believe that this study adds information to the existing literature.

Highest PSQI scores during hospitalisation could be observed in the components of sleep latency, sleep duration and sleep efficiency which may suggest a lack of the use of behavioural intervention to improve the sleep experience in hospital [36]. Using the cut-of score of 5 proposed by Buysse et al. [2], more than three quarters of our included sample had poor sleep quality at admission to the hospital with a mean PSQI score of 8.62. This mean score is significantly higher than in recent studies on sleep quality in the general population in Spain who reported PSQI scores of 5.14 [37] and 5.45 [38] respectively. This higher score may be due to the effects of acute illness before hospitalisation. Also, our data were collected during the COVID-19 pandemic. Although our study did not include COVID-19 patients, there is evidence that COVID-19 outbreak-associated factors correlate with a decrease in sleep quality [38]. This would also explain why the results of a study conducted during the COVID-19 period on general Spanish population observed a similar global PSQI score (8,17) with our study population [39]. During the COVID-19 outbreak an increase of stress, anxiety and depression affected the general population [40,41]. Anxiety and emotional distress have been shown to be negatively correlated to sleep quality in hospitalised [32,42,43]. Stress-induced

activation of the hypothalamic-pituitary-adrenal (HPA) axis disrupts sleep, and variations in sleep enhance this activation, causing a vicious cycle of stress and sleeplessness [44]. Also, quarantine and social isolation may have caused changes in sleep-wake rhythms and a reduction of sleep quality [45]. These factors could have had an even greater impact on hospitalised patients during peak COVID-19 periods due to restrictions on visitors or night-companions, or a higher fear of getting infected with COVID-19 in the hospital [46]. Treatment delay because of the pandemic could also have caused patients to be in a more acute phase of their illness before getting admitted to the hospital.

Our sample was comprised of 83% of patients older than 50 years and 37% older than 70 years. Changes in the normal sleep-cycle and a variety of sleep problems are reported in elderly people and sleep quality is expected to deteriorate with age [47]. Our study found higher PSQI scores as age groups increased, but differences were not found to be significant at admission or during hospitalisation. Having higher educational level was observed to be a protective factor for poor sleep quality and quantity during hospitalisation, however, these results could be related to the age of the participants as secondary education became mandatory in 1964 in Spain [48]. At admission women had poorer sleep quality than men. Taking into account the mean age of our sample, it has been demonstrated that several hormonal, such as menopause, and physical changes in women's life can have impact on their sleep health [49]. A previous study demonstrated that menopause was associated with increased sleep-onset insomnia, but no association was found with sleep duration [50], which is consistent with our finding. Additionally, the social aspect of women being more likely to be caregiver may lead to higher stress levels.

Patients with 2 or more comorbidities were found to have poorer sleep quality which could also be related to higher age, but also because of more physical symptoms. Higher physical activity has also been shown to lead to better sleep quality during hospitalisation and no association was found for BMI which confirms the findings of prior researches [51,52].

Although a decrease in the consumption of benzodiazepines is reported in Spain [53], over 40% of our included population regularly took sedative medication at home or in hospital. A negative association at admission and during

hospitalisation was found for sedative medication intake and sleep quality. This confirms findings of other studies suggesting that benzodiazepines do not improve sleep quality and cause a significant risk of falls, especially in elderly patients what makes that it should be regularly reviewed whether intake is necessary [54-56] and the implementation of other non-pharmacological therapies with a long-term effect and fewer side effects should be considered [57]. The length of hospital stay was not associated with differences in sleep quality or quantity in our sample, although due to our inclusion criteria of a minimum length of stay of 4 nights in hospital this result could be biased and short-term effects of hospitalisation on the sleep wake cycle could not be explored.

Management of sleep in-hospital is challenging as intrinsic sleep disturbances are clinically heterogeneous and complex [31]. Also, although it is observed that sleep is insufficient among patients, several studies reported a lack of the use of standardized sleep assessment tools and sleep promoting interventions in hospital [58].

Limitations

This study has some limitations. The dependence on patient recall for their regular sleep time prior to and during hospitalisation is one of the study's limitations. Reported sleep quality before admission may have been deviated from habitual sleep quality because of the situation of illness of the participant. We used the PSQI to measure sleep quantity and quality, we did not report on sleep dimensions with objective measurements, future research could focus on verifying and comparing our findings with non-subjective sleep evaluation methods such as actigraphy or polysomnography. Also, The PSQI was developed evaluating "usual" sleep of the past month [2]. PSQI scores during hospitalisation could be biased because of a short hospital stay and patients with a hospital stay shorter than 7 days could not have had the opportunity to answer correctly on the 4 answers provided in some components of the PSQI. This could have led to a sub estimation of sleep quality during hospitalisation. However, median length of stay was 8 days and before passing the test to patients, we made a clear statement that this their answers should only reflect on sleep experience during their stay in hospital. Finally, the study counted 13% missing data in the PSQI test. This can be explained by the high workload of the nurses who could not go through every questionnaire or by the acute illness which caused patients to leave some

questions unanswered. Although there is no established cut-off from the literature regarding an acceptable percentage of missing data in a data set for valid statistical inference, Enders [59] stated that a missing rate of 15% to 20% was common.

Conclusion

This study demonstrated poor sleep quality in patients admitted to hospitals of the public health system in Spain. Significant differences between sleep quality at admission and during hospitalisation in most of the components and global score of the PSQI were found, and inpatients slept a mean difference of 56 minutes less. A lower educational level, two or more morbidities and the intake of sedative hypnotic medication were shown to be risk factors for poorer sleep in hospital. However, a higher physical activity level before hospitalisation may function as a protective factor for poor sleep quality in hospital. Future research should focus on disturbing factors causing this sleep quality and quantity decrease in order to draw attention of healthcare workers and design evidence-based interventions that improve the sleep experience in the hospital.

Author contribution statement

FB: Conception and design of study, data collection, data analysis, manuscript writing

RS: Data analysis, manuscript writing and revision

ERA: Data analysis, manuscript writing and revision

JPM: Conception and design of study, data collection, manuscript revision

ECR: Conception and design of study, data collection, manuscript revision

MSO: Conception and design of study, data collection, manuscript revision

MGS: Conception and design of study, manuscript revision, funding acquisition

YMV: Data collection, manuscript revision

TMC: Conception and design of study, manuscript revision, funding acquisition

EAC: Conception and design of study, manuscript revision, funding acquisition

Competing interests

The author(s) declare no competing interests.

Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figure 1. Geographical distribution of included hospitals.

1: Hospital Universitario Arnau de Vilanova
2: Hospital de Tremp
3: Hospital Universitario Marques de Valdecilla
4: Hospital de San Eloy
5: Hospital general Universitario de Ciudad Real
6: Hospital Virgen de la Concha Zamora
7: Hospital Universitario Juan Ramón Jiménez
8: Hospital Clínico Universitario Virgen de la Arrixaca
9: Hospital General Universitario Santa Lucía
10: Hospital Central de la Cruz Roja San José y Santa Adela
11: Hospital Universitario 12 de Octubre
12: Hospital Universitario La Paz

Table 1. Sociodemographic characteristics and admission motive of participants.

Total sample	343	%
Age (mean ± SD)	63,47 ± 14,69	
<30	9	2,62
31-50	48	13,99
51-70	159	46,36
>70	127	37,03
Unit		
Surgical unit	162	47,23
Medical unit	181	52,77
Gender		
Male	199	58,02
Female	143	41,69
Missing data	1	0,29
Hospital stay (Median [IQR])	8,00 [7,00-11,00]	
≤ 7days	123	35,86
>7 days	176	51,31
Missing data	44	12,82
Educational level		
Primary	187	54,52
Secondary	112	32,65
University	33	9,62
Missing data	11	3,21
Working situation		0,00
Working	97	28,28
Unemployed	37	10,79
Retired	202	58,89
Student	2	0,58
Missing data	5	1,46
Income (euro/month)		
0-500	29	8,45
501-1000	103	30,03
1001-2000	123	35,86
>2000	32	9,33
Missing data	54	15,74

Room type		
Single	54	15,74
Double	289	84,26
BMI (mean ± SD)	27,70 ± 5,98	
<18.5	5	1,46
18.5 to <25	117	34,11
25 to <30	122	35,57
30 or more	96	27,99
Missing data	3	0,87
Smoker	70	20,41
Drug consumer	10	2,92
Multimorbity		
Yes	213	62,09
No	78	22,74
Missing data	52	15,16
Hospital admission motive		
Neoplasms	86	25,07
Blood and immunological diseases	12	3,50
Endocrine diseases	16	4,66
Cardiovascular diseases	45	13,12
Respiratory diseases	70	20,41
Digestive diseases	94	27,41
Skin diseases	10	2,92
Musculoskeletal diseases	36	10,50
Genito-urinary diseases	27	7,87

Table 2. Sleep quality and quantity at admission and during hospitalization.

	At admission			During hospitalization			Test and (p-value) *
	n	Mean	SD	n	Mean	SD	
Sleep quality component							
1. Subjective sleep quality	339	1,42	0,89	339	1,54	0,82	Z= -1.915 (0.056)
2. Sleep latency	335	1,52	1,09	335	1,98	1,03	Z= -6.282 (<0.001)
3. Sleep duration	338	1,44	1,00	338	1,98	0,94	Z= -7.707 (<0.001)
4. Sleep efficiency	332	1,35	1,22	332	1,98	1,18	Z= -7.128 (<0.001)
5. Sleep disturbances	316	1,27	0,60	316	1,47	0,60	Z= -4.606 (<0.001)
6. Sleeping medication	342	1,00	1,34	342	1,28	1,49	Z= -2.887 (0.04)
7. Daytime dysfunction	334	0,67	0,88	334	1,12	1,01	Z= -6.595 (<0.001)
Global PSQI score	298	8,62	4,49	298	11,31	4,04	Z= -8.539 (<0.001)
Sleep quantity (h)	338	6,28	1,64	338	5,34	1,58	Z= -8.411 (<0.001)
SD: standard deviation. * Student's paired t-test or Wilcoxon test							

Table 3. Effects PSQI global scores and sleep quantity.

	Sleep quality (PSQI global scores)					
	At admission			During hospitalization		
	n	Mean	SD	n	Mean	SD
Age						
<30	8	6,25	4,37	8	13,13	5,41
31-50	44	7,84	4,14	44	10,59	3,69
51-70	140	8,56	4,59	140	10,94	3,82
>70	106	9,20	4,44	106	11,96	4,27
test and p-value**	H (3) =5.208, P = 0.157			H (3) =6.528, P =0.089		
Unit						
Surgical unit	139	7,49	4,42	139	11,15	4,03
Medical unit	158	9,65	4,30	158	11,51	4,02
test and p-value**	Z= -4.144, P < 0.001			Z= -0.591, P = 0.555		
Gender						
male	173	7,86	4,32	173	11,15	3,80
female	124	9,67	4,54	124	11,49	4,35
test and p-value**	Z= -3.284, P < 0.001			Z= 0-565, P = 0,572		
Hospital stay						
<7 days?	105	8,76	4,44	105	10,9	4,11
>7days?	156	8,57	4,56	156	11,37	3,94
test and p-value**	Z= 0.502, P = 0.616			Z= -0.990, P = 0.322		
Educational level						
primary	161	8,65	4,69	161	11,85	4,19
secondary	98	8,66	4,31	98	10,58	3,86
university	29	8,00	3,85	29	11,00	3,64
test and p-value**	H (2) = 0.724, P = 0.696			H (2) = 6.246, P = 0.044		
working situation						
employed	84	7,50	4,38	84	10,57	3,75
unemployed	32	9,66	4,67	32	11,34	4,27
retired	176	8,91	4,44	176	11,63	4,08
student	2	9,50	0,71	2	11,50	7,78
test and p-value**	H (3) = 9.736, P = 0.021			H (3) = 3.974, P = 0.264		

Income (euros/month)						
0-500	26	8,15	3,83	26	11,35	3,52
501-1000	92	8,84	4,60	92	10,85	4,42
1001-2000	103	8,17	4,65	103	11,16	4,23
>2000	30	8,83	3,76	30	11,33	3,69
test and p-value**	H (3) = 1.514, P = 0.679			H (3) = 0.32, P = 0.956		
Room type						
Single	46	7,26	4,55	46	10,65	3,76
Double	252	8,87	4,44	252	11,43	4,08
test and p-value**	Z= -1.945, P = 0.052			Z= -1.19, P = 0.231		
BMI						
<18.5	3	13,00	4,58	3	12,33	4,04
18.5 to <25	99	8,28	4,23	99	11,78	4,04
25 to <30	108	8,38	4,82	108	11,10	3,96
30 or more	85	9,01	4,28	85	10,85	4,13
test and p-value**	H (3) = 1.514, P = 0.642			H (3) = 2.909, P = 0.406		
Comorbidities						
Single	73	7,14	3,84	73	10,15	3,93
multimborbidity	183	9,28	4,52	183	11,6	4,08
test and p-value**	Z= -3.441, P = 0.001			Z= -2.731, P = 0.006		
Sedative hypnotic						
Intake	126	9,34	4,55	126	13,04	3,82
No intake	172	8,08	4,37	172	10,04	3,71
test and p-value**	Z= -2.285, P = 0.022			Z= -6.092, P <0.001		

** student's t test or ANOVA

Table 4. Effects sleep quantity (in hours).

	Sleep quantity (h)					
	At admission			During hospitalization		
	n	Mean	SD	n	Mean	SD
Age						
<30	9	6,92	1,33	9	5,48	1,61
31-50	46	6,03	1,36	46	5,54	1,39
51-70	159	6,16	1,66	159	5,33	1,55
>70	124	6,48	1,72	124	5,26	1,67
test and p-value**	H (3)= 3.183, P = 0.364			H (3) = 1.586, P = 0.663		
Unit						
Surgical unit	160	6,28	1,51	160	5,42	1,32
Medical unit	177	6,28	1,75	177	5,25	1,77
test and p-value**	Z= -0.264, P = 0.792			Z= -0.639, P = 0.523		
Gender						
male	196	6,32	1,59	196	5,37	1,44
female	141	6,21	1,71	141	5,29	1,76
test and p-value**	Z= -0.645, P = 0.519			Z= -0.554, P = 0.579		
Hospital stay						
<7 days?	123	6,29	1,65	123	5,32	1,65
>7days?	174	6,24	1,64	174	5,37	1,48
test and p-value**	Z= -0.393, P = 0.694			Z= -0.152, P = 0.879		
Educational level						
primary	184	6,35	1,71	184	5,18	1,65
secondary	111	6,16	1,60	111	5,62	1,54
university	33	6,39	1,16	33	5,24	1,19
test and p-value**	H (2) = 0.871, P = 0.647			H (2) = 6.833, P = 0.033		
Working situation						
employed	97	6,21	1,35	97	5,43	1,49
unemployed	35	5,89	1,68	35	5,30	1,50
retired	200	6,38	1,75	200	5,31	1,63
student	2	8,00	0,71	2	6,40	1,27
test and p-value**	H (3) = 4.859, P = 0.182			H (3) = 1.646, P = 0.649		

Income (euro/month)						
0-500	29	6,38	1,49	29	5,34	1,40
501-1000	101	6,43	1,76	101	5,54	1,62
1001-2000	122	6,04	1,65	122	5,28	1,75
>2000	32	6,81	1,55	32	5,48	1,31
test and p-value**	H (3) = 4.756, P = 0.191			H (3) = 1.597, P = 0.660		
Room type						
Single	52	6,46	1,62	52	5,51	1,41
Double	286	6,25	1,64	286	5,31	1,60
test and p-value**	Z= -0.807, P = 0.42			Z= -1.364, P = 0.173		
BMI						
<18.5	5	5,50	2,29	5	5,60	0,82
18.5 to <25	114	6,34	1,63	114	5,30	1,54
25 to <30	122	6,43	1,72	122	5,35	1,53
30 or more	94	6,11	1,51	94	5,39	1,71
test and p-value**	H (3) = 2.407, P = 0.492			H (3) = 0.200, P = 0.978		
Comorbidities						
Single	78	6,49	1,56	78	5,48	1,44
multimborbidity	213	6,17	1,66	210	5,21	1,63
test and p-value**	Z= -1.274, P = 0.203			Z= -1.311, P = 0.190		
Sedative hypnotic						
Intake	141	6,18	1,80	141	5,40	1,5
No intake	197	6,34	1,50	197	5,29	1.57
test and p-value**	Z= -1.039, P = 0.299			Z= -0.493, P = 0.622		

** student's t test or ANOVA

Paper IV: **The influence of nursing interventions and hospitalization on inpatients' sleep quality**

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THE INFLUENCE OF HOSPITALIZATION AND NURSING INTERVENTIONS ON INPATIENTS' SLEEP QUALITY

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Abstract

Background: Sleep is essential for peoples' health, and poor sleep has been linked to a variety of harmful health effects. Several factors including the environment, the health condition, and the psychological state of the patients can affect their sleep quality during hospitalization.

Objectives: We aimed to evaluate the impact of the hospitalization and its context on the sleep quality of non-critical patients.

Design: A descriptive observational study was carried out.

Settings and participants: Medical and surgical patients from 12 Spanish public hospital were recruited.

Methods: Sleep quality was recorded with the Pittsburgh Sleep Quality Index (PSQI). We collected data on sociodemographic and clinical characteristics. Nursing night-time interventions were collected by the nightshift nurses by mean of a diary. Patients were asked about disturbing factors during their hospital stay. Spearman coefficient tests were performed to assess correlations between continuous variables. Linear regression models were carried out to evaluate associations between hospitalization-related factors and sleep quality.

Results: A total of 343 patients were included in our study. Most of the patients presented poor sleep quality (94.97%). Univariate analysis showed differences in the PSQI score according to the number of interventions (p=0.003). The multivariate analysis adjusted for potential confounding factors (Table 4), revealed that patients with 8-20 interventions had an increase of 1.46 (95% confidence interval (CI): 0.35 to 2.58; p=0.010) points in the PSQI. We observed that a worse sleep quality was associated with discomfort with the roommate (r=0.257, p<0.001, for the PSQI; r=0.180, p=0.004, for the delta), with the nursing care interventions (r=0.280, p<0.001, for the PSQI; r=0.136, p=0.021, for the delta), with the bed (p<0.001), with the room temperature (p=0.009), and with the bedding (p<0.001).

Conclusions: Our findings demonstrated that the frequency of night-time nursing care interventions affect sleep quality negatively and the most frequently performed interventions are potentially modifiable.

1. Background

Sleep quality is regarded as a complex clinical concept and includes both qualitative and quantitative characteristics (Buysse et al., 1989). Harvey et al. (2008) indicated that the definition of sleep quality should include the number of awakenings that occur during the night, along with feeling refreshed and rested upon waking versus feeling tired at waking and throughout the following day.

Sleep is essential to human health, contributing to the daily functioning and quality of life (Ramar et al., 2021). Human beings spend about one third of their lives sleeping, as a result, it is the activity that takes up the most of our time (Biddle & Hamermesh, 1990). Nevertheless, previous research demonstrated that sleep problems are common in Europe, with a prevalence in adults that ranges from 16% to 31% (van de Straat & Bracke, 2015). Poor sleep has been linked to a variety of harmful health effects. These negative effects can prejudice various organ systems (Chang et al., 2020), and lead to higher risk on multiple complications such as delirium (Pisani & D'Ambrosio, 2020), hyperglycaemia and impaired fasting glucose (DePietro et al., 2017), cardiovascular disease (Liu & Chen, 2019), pneumonia (Lin et al., 2018; Patel et al., 2012), and the immune response (Moldofsky, 1995).

The importance of sleep in hospital care has been emphasized throughout history and can be considered as a major component of health care. Accordingly, Florence Nightingale argued this in the late 1800s, describing that a patient should never be waked intentionally (Nightingale, 1992). Given the restoring and healing properties of sleep, a good sleep quality is particularly important for hospitalised patients (Kryeger et al., 2021). However, several studies report poor sleep quality during hospitalisation (Altman et al., 2017; Delaney et al., 2018; Dwiastani & Gayatri, 2021; Jakobsen et al., 2020; Manian & Manian, 2015). Altman and collaborators (2017) observed that sleep disturbances are common in hospital, and this can persist up to 12 months after hospital discharge.

Several factors including the environment, the health condition, and the psychological state of the patients can affect their sleep quality during hospitalization (Zhang et al., 2013). The hospital environment is particularly prejudicial for sleep quality due to mistimed artificial light at the detriment

of sunlight exposure, excessive noise during the night, and unusual feeding schedules (Honarmand et al., 2020; Lane & East, 2008; Pisani et al., 2015; Wesselius et al., 2018). In addition, hospitalized patients need constant care, which leads to frequent interruptions during the nighttime period (Fąfara et al., 2018). Accordingly, previous studies demonstrate that one of the most common causes of sleep disruptions in hospital is noise, followed by nighttime nursing care interventions (Astin et al., 2020; Wesselius et al., 2018). However, such studies are mainly focused on critically ill patients, a particular context in terms of environmental noise, continuous lightning, and regular monitoring (Ritmala-Castren et al., 2015).

Considering this, we aimed to evaluate the impact of the hospitalization and its context on the sleep quality of non-critical patients. To our knowledge, this is the first study addressing this matter in Spain. To accomplish this, we collected several variables related to hospitalization such as the time spent at the hospital, number of nursing care interventions during the night, among others. We considered a possible influence of those over the sleep quality, which was evaluated through the Pittsburgh sleep quality index (PSQI).

2. Methods

2.1. Study design

Observational, descriptive multicentre study aiming to evaluate the sleep quality hospitalized patients.

Data from patients hospitalized in both surgical and medical units were collected during four consecutive nights. Where applicable, we reported this study following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline (von Elm et al., 2007).

2.2. Participants and setting

Patients from 12 hospitals across Spain were recruited between January 2020 and January 2022. The hospitals belonged to the Spanish National Health System and covered both rural and urban areas. The nursing supervisor of each unit included patients hospitalized in surgical or medical units, aged 18 years or

older, and who gave consent to participate in the study voluntarily. The exclusion criteria comprised patients who suffered from visual or auditory impairment, intellectual disability or cognitive impairment as documented in their medical record. Patients were recruited on pre-established days each month.

2.3. Data collection

Data were collected on sociodemographic variables, clinical characteristics of patients and hospital related information, nursing night-time care interventions, self-reported disturbance factors, and sleep quality.

2.3.1. Sociodemographic and clinical variables

We collected sociodemographic data (sex, age, BMI), educational level, employment status, working time, and habits on smoking and intake of other recreational drugs. Clinical characteristics and hospitalization-related information such as such as reasons of admission, comorbidities, and intake of sleep-related medication were collected by the nursing staff of the unit for each included patient. Additionally, nurses were asked to report on room type (single or shared), and length of hospital stay.

2.3.2. Nursing care interventions

Night time nursing care interventions were collected through a diary during the first four days of admission. A total of 31 nursing interventions that could potentially disrupt patients' sleep were selected from the Nursing Interventions Classification (NIC) (Butcher et al., 2018). Nightshift nurses were also asked to record how many times each intervention was performed during 12pm and 06am. They were given the choice between 0, 1, 2, or 3 or more.

2.3.3. Self-reported disturbances

Patients were asked to rate on a ten-point Likert-type scale the disturbance received from their roommate (if applicable), and from the night time nursing activities. Furthermore, patients were asked if they experienced disturbances from bed comfort, room temperature, and bedding.

2.3.4. Sleep quality

Patients' sleep quality was evaluated through the Pittsburgh Sleep Quality Index (PSQI). The assessments were performed at the hospital admission referring to the patients' sleep quality during the previous month, and at hospital discharge referring to the patients' sleep quality during the hospital stay. The PSQI is composed of several questions representing one of the seven components of sleep quality: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, sleep medication intake, and daytime dysfunction. Each component score is rated on a 3-point scale, leading to a sum of up to 21 points. Higher scores indicate worse sleep quality. A score greater than 5 indicates a poor sleep quality, whereas a PSQI score less than or equal to 5 indicates a good sleep quality (Buysse et al., 1989). We used the validated Spanish version of the PSQI (Hita-Contreras et al., 2014).

2.4. Data analysis

Descriptive statistics were performed to describe sociodemographic and clinical characteristics as well as hospitalization-related information. Absolute and relative frequencies were used for qualitative data. The means (SD) and medians (25th–75th percentile) were estimated for quantitative variables with normal and non-normal distributions, respectively. The normality of the distribution was assessed by the Kolmogorov-Smirnov test.

Univariate analysis was performed for duration of hospitalization, number of interventions, room type, disturbance with bed comfort, disturbance with room temperature, and disturbance with bedding with the bedding. The delta was obtained through the following formula: Delta = (PSQI during hospitalization – PSQI before hospitalization)/PSQI before hospitalization.

Spearman coefficient tests were performed to assess correlations between continuous variables (duration of hospitalization, annoyance with the room partner, annoyance with the interventions) and sleep quality (PSQI score).

Linear regression models (crude and adjusted by comorbidities and pharmacological treatment) were performed to evaluate possible associations between relevant hospitalization-related factors (duration of hospitalization, number of interventions, room type, annoyance with the room partner, annoyance

with the interventions, bed comfort, room temperature, and bedding) and sleep quality (PSQI score). The number of interventions was calculated considering all interventions along the first four nights of hospitalization. The p-value threshold defining statistical significance was set at less than 0.05. All statistical analyses were performed using SPSS 25.0 software.

2.5. Ethical approval

This study was conducted according to the principles outlined by the Declaration

of Helsinki. Patients were included after providing written consent in accordance with the law 14/2007. They were informed about the full procedure in advance, as well as their right to withdraw at any time. All ethics committees of all participating hospitals, as well as the Carlos III Health Institute's ethical committee (HIP CI CEI PI 18 2019-V3), gave their approval. The study is registered in Clinicaltrials.gov (#NCT04113876).

3. Results

3.1. Baseline characteristics

Our sample was composed of 343 patients admitted to surgical or medical hospital units. Most of them were males (58.18%) with a mean (SD) age of 63.47 (14.69) years. The most prevalent comorbidities were cardiovascular (46.93%), endocrine (32.65%), and digestive diseases (31.19%). Patients spent a median (IQR) number of 8.0 (7.0-11.0) days at the hospital for different reasons including digestive diseases (27.40%), neoplasms (25.07%), and respiratory diseases (20.40%). The majority of the patients (84.26%) stayed in shared double rooms.

Nurses registered between 0 and 90 nursing care interventions in the first four days of hospital admission. A total of 120 (34,99%) patients received between 0 and 8 night time nursing care interventions, 105 (30,61%) received between 9 and 20 interventions, and 118 (34,40%) were intervened more than 20 times.

The most frequent nursing care interventions carried out during night time hours were medication administration, vital signs control, pain management, collection of blood samples, and management and reduction of anxiety (Table 1).

3.2. Sleep quality

According to the PSQI, most of the patients presented poor sleep quality (94.97%) with a mean (SD) score of 11.31 (4.04) after hospital discharge (Table 2). The sleep components were substantially affected especially the sleep latency, sleep duration, and sleep efficiency. Accordingly, more than 80% of the patients presented a sleep efficiency lower than 85%.

3.3. Hospitalization-related factors, night-time nursing interventions and sleep quality

Univariate analysis revealed differences in the PSQI score according to the number of interventions (p=0.003), but not according to the duration of hospitalization and room type (Table 3). Instead, by considering the PSQI score at the baseline through the delta, we observed an effect of the room type over the sleep quality (p=0.008), which was not observed for the other parameters. Given the observed effect related to the number of interventions, we performed a multivariate analysis adjusted for potential confounding factors (Table 4), revealing that patients with 8-20 interventions had an increase of 1.46 (95% confidence interval (CI): 0.35 to 2.58; p=0.010) points in the PSQI. Similarly, having more than 20 interventions was associated with an increase of 1.88 (95% CI: 0.80 to 2.97; p<0.001) points in this questionnaire.

3.4. Self-reported disturbances and sleep quality

Patients rated on a ten-point-Likert-type scale night time nursing care interventions disturbed 4,57 ± 2,97 out of 10, and roommates were scored as 4,51 ± 3,2 disturbing. A total of 110 (32%) of patients reported that room temperature interfered with their sleep, 104 (30%) patients' sleep was affected by poor bed comfort, and 54 (16%) indicated to have suffered sleep disturbances because of bedding. Disturbance because of room temperature was higher in women compared to men (p = 0.041) and in patients receiving more than 8 interventions (p = 0.040), also patients who reported their sleep was disrupted by the room temperature had statistically significant higher PSQI global score at discharge (10.9 ± 4.0 vs 12.3 ± 3.9, p = 0.009, respectively). Patients with 2 or more comorbidities, and patients with a hospital stay of more than 7 days experiences more discomfort because of the hospital bed (p = 0.01 and p = 0.012 respectively).

We observed that a worse sleep quality was associated with discomfort with the roommate (r=0.257, p<0.001, for the PSQI; r=0.180, p=0.004, for the delta), with the nursing care interventions (r=0.280, p<0.001, for the PSQI; r=0.136, p=0.021, for the delta), with the bed (p<0.001), with the room temperature (p=0.009), and with the bedding (p<0.001) (Table 5). Multivariate analysis adjusted by confounding factors confirmed these findings, demonstrating that discomfort with the roommate and with the nursing care interventions increased the PSQI score in 0.41 (95% CI: 0.27 to 0.56; p<0.001) and 0.43 (95% CI: 0.27 to 0.58; p<0.001) points, respectively (Table 6). In addition, there was an increase in the PSQI global score of 1.92 (95% CI: 0.93 to 2.90; p<0.001) in patients reporting discomfort with the bed, 1.27 (95% CI: 0.31 to 2.22; p=0.009) in those reporting discomfort with the room temperature, and 3.20 (95% CI: 2.08 to 4.38; p<0.001) in those disturbed by the bedding.

4. Discussion

The aim of this study was to describe the quality of sleep as well as the impact of night-time nursing care interventions, and disturbing factors on sleep quality in surgical and medical inpatients. Results from the PSQI global score revealed poor sleep quality in almost the entire study sample. Possible factors associated with such outcome were the number of nursing care interventions as well as self-reported disturbances such as discomfort with the roommate, with the nursing care interventions, with the hospital bed, with the room temperature, and with the bedding.

The present findings corroborate those previously reported (Dogan et al., 2005; Kulpatcharapong et al., 2020; Matsuda et al., 2017; Szymanski et al., 2014) which demonstrated a poor sleep quality in up to 91% of hospitalized patients of different surgical and medical units. Our cohort presented an even higher score in the PSQI that can be partially explained by the period of recruitment. Accordingly, the study took place during the COVID-19 pandemic, a context related to alterations in the circadian rhythms and to a compromised sleep quality (Kiss et al., 2021; Silva et al., 2020). Despite the importance of sleep for the general health and for the recovery of the patients, the sleep quality in the hospital context does not appear to be a priority for

professionals. The subtle consequences of poor sleep quality in the short-term does not aid in this context. Accordingly, the impact of poor sleep quality is more visible in the long term, in sustained conditions that go beyond the average length of hospital stay. In addition, previous studies demonstrated that nurses often overestimate the sleep quality of their patients (Delaney et al., 2018), identify different factors as possible disturbances (Lei et al., 2009), and the existence of heterogeneity in measuring sleep quality (Matsuda et al., 2017). The improvement of the sleep quality in hospitalized patients has the potential to positively effect, both on short- and long-term patients' comfort, safety, and health outcomes (Hillman, 2021). Considering this, the sleep in the hospital should be regarded as a priority by both patients and nurses, and a valid and reliable instrument to assess a patients' sleep could bring solution to these problems (Gellerstedt et al., 2020; Hoey et al., 2014).

Nurses have a primary role in ensuring patient care during sleep. In 1996 Dreher (Dreher, 1996) highlighted the importance of sleep stating that "destructive activities that impair sleep should be of concern to any nurse." However, this is challenging in several ways. Environmental disturbing factors are often difficult to modify in the context of public hospitals, each patient has its own sleep habits, and operational models in hospitals are organization focused, which makes the provision of patient-centred care very difficult for nurses despite their best intentions (Stuck et al., 2011). Likewise, the night-time nursing care itself has a high impact on the quality of sleep. Our findings demonstrated that a higher amount of nursing activities received by the patients during the night was significantly associated with poorer sleep quality.

The nursing interventions identified in our study as the most frequent during the night are largely likely to be modified, either by reducing their frequency, by organizing nursing care that permits their patients a night of undisturbed sleep, or by implementation of sleep friendly technology. A practical example; the clinical rational for the collection of blood samples carried out in the early morning is unclear. Sorita (2014) provided evidence of a quality improvement interventions altering the timing of routine blood draws from early morning to midnight demonstrating more agreeable from patients, a better distribution of workload, and an improvement of efficiency of care. Another example is vital sign control. Night shift nurses often experience a dilemma between the control

of vital signs during the night and the sleep of the patient. In fact, there exists difficulty in applying early warning score algorithms and unclear guidelines for the ideal frequency of vital sign checks (Hope et al., 2018). Given the relevance of vital sign control in the prevention of major events like death or cardiac arrest, its avoidance is extremely dangerous. However, recent research suggests promising results for the screening of vital sign by use of infrared thermography (Sun et al., 2017), RGB- thermal image sensors (Negishi et al., 2020), bed-based contactless mattress sensor, or a patient-worn monitor (Breteler et al., 2020).

In this study, no differences in PSQI global score were found for room type. However, the vast majority (80.33%) of the patients stayed in shared rooms which might explain these results. However, our data showed a statistically significant increase in discomfort with nursing interventions and roommate which could indicate that single rooms patients dispose of better sleeping conditions, as they could experience disturbances from roommate and interventions carried out on roommate (data not shown). The connection between longer duration of sleep and single rooms was shown in previous research (Dobing et al., 2016). Also, patients experiencing disturbance with environmental factors such as bed comfort, room temperature and bedding had a negative association with their sleep quality. These results are in line with other studies detecting this factors as disturbing for hospitalized patients (Chauny et al., 2019; DuBose & Hadi, 2016; Morse & Bender, 2019).

Several previous studies (Chung et al., 2018; Lopez et al., 2018; Morse & Bender, 2019; Thomas et al., 2012) showed promising results on the implementation of strategies to prevent the development of sleep-wake disorders by quiet time protocols or educational programs for nursing staff to minimize night time disturbances in order to improve the sleep quality of hospitalized patients. However, more research is needed to confirm the effectiveness of these interventions.

One of the limitations of our study is that we did not verify these results with objective sleep quality measures such as polysomnography or actigraphy. However, in our study we measured sleep quality with a validated and highly reliable questionnaire (Carpenter & Andrykowski, 1998). Because of the added value of objective measured sleep quality, future research should focus on

contrasting findings from both subjective as objective measured sleep variables. Another limitation of our study is that PSQI scores at discharge could be biased because of short hospital stay as the PSQI is designed to measure sleep over the term of 30 days. However, this would be likely to have led to a sub estimation of sleep as patients were not able to answer "less than one week" in some parts of the questionnaire, and we made patients clear that answers should be based on their hospital stay. Also, data was collected during the COVID-19 pandemic which could have influenced routine care, presence of family care givers at night and the restrictions on mobility within the hospital.

5. Conclusions

Despite the proven influence of sleep on the recovery ill people, patients of Spanish public hospitals still suffer from poor sleep quality. Our findings demonstrated that the frequency of night-time nursing care interventions affect sleep quality negatively and the most frequently performed interventions are potentially modifiable. The results of this study suggest the implementation of interventions focused on the reduction of disruptive factors in hospitals at night.

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Table 1. Baseline characteristics of the cohort.

	Global
	n = 343
Sociodemographic data	
Sex, male	199 (58.19%)
Age, years	63.47 (14.69)
BMI, $kg \cdot m^{-2}$	27.7 (5.98)
Educational level	
Primary education	187 (56.32%)
Secondary education	112 (33.73%)
Higher education	33 (9.95%)
Employment status	
Working	97 (28.45%)
Unemployed	37 (10.85%)
Retired	202 (59.24%)
Studying	5 (1.47%)
Working time	
Morning	30 (9.15%)
Evening	2 (0.61%)
Night	2 (0.61%)
Shifts without nights	65 (19.82%)
Shifts including nights	27 (8.23%)
Not applicable	202 (61.59%)
Habits	
Smoking	70 (20.41%)
Recreational drugs	10 (2.91%)
Comorbidities	
Cardiovascular diseases	161 (46.94%)
Endocrine diseases	112 (32.65%)
Digestive diseases	107 (31.20%)
Musculoskeletal diseases	77 (22.45%)
Neoplasms	74 (21.57%)

Reasons of hospitalization	
Digestive diseases	94 (27.41%)
Neoplasms	86 (25.07%)
Respiratory diseases	70 (20.41%)
Cardiovascular diseases	45 (13.12%)
Musculoskeletal diseases	36 (10.50%)
Hospitalization	
Duration, days	8.00 (7.00 - 11.00)
Unit, surgical	162 (47.23%)
Room type, double	289 (84.26%)
Number of interventions	13.50 (6.00 - 25.75)
Type of interventions	
Medication administration	272 (79.30%)
Vital sign control	186 (54.23%)
Pain management	154 (44.90%)
Collection of blood	127 (37.03%)
Anxiety management	91 (26.53%)
Sleep-related medication	
Psychotropics	76 (22.16%)
Opiates	92 (26.82%)
Hipnotics-sedatives	145 (42.27%)

Qualitative data are represented as n (%). The means (SD) and medians [p_{25};p_{75}] were estimated for quantitative variables. BMI, body mass index; n, number; p, percentile.

Table 2. Sleep quality (PSQI).

	Global
	n = 298
PSQI	11.31 (4.04)
Good sleep quality (≤5 points)	15 (5.03%)
Poor sleep quality (>5 points)	283 (94.97%)
Subjective sleep quality	1.54 (0.82)
Very good	25 (7.44%)
Fairly good	152 (45.24%)
Fairly bad	113 (33.63%)
Very bad	46 (13.69%)
Sleep latency	1.98 (1.03)
≤ 15 min	45 (13.43%)
16-30 min	46 (13.73%)
31-60 min	116 (34.63%)
> 60 min	128 (38.21%)
Sleep duration	1.98 (0.94)
> 7 hours	38 (11.24%)
6-7 hours	37 (10.95%)
5-6 hours	157 (46.45%)
< 5 hours	106 (32.82%)
Sleep efficiency	1.98 (1.18)
≥ 85%	60 (18.02%)
75-84%	53 (15.92%)
65-74%	53 (15.92%)
< 65%	167 (50.15%)
Sleep disturbance	1.47 (0.60)
Not during past month	5 (1.55%)
Less than once a week	173 (53.56%)
Once or twice a week	132 (40.87%)
Three or more times a week	13 (4.02%)
Sleep medication intake	1.28 (1.49)
Not during past month	196 (57.31%)
Less than once a week	0 (0%)
Once or twice a week	0 (0%)
Three or more times a week	146 (42.70%)

Daytime dysfunction	1.12 (1.01)
Never	116 (34.22%)
A few times	104 (30.68%)
Sometimes	82 (24.19%)
A lot of times	37 (10.91%)

Qualitative data are presented as n (%). Quantitative data are presented as mean (SD). n, number; PSQI, Pittsburgh Sleep Quality Index; SD, standard deviation.

Table 3. Hospitalization-related factors and sleep quality (univariate analysis).

	PSQI			Delta		
	Mean (SD)		*p-value*	*Mean (SD)*		*p-value*
Number of interventions						
0-8	10.30	(4.10)		0.84	(1.77)	
9-20	12.13	(3.87)	0.003	0.70	(1.26)	0.913
>20	11.80	(3.88)		0.81	(1.78)	
Duration of hospitalization						
≤ 7 days	10.96	(4.07)	0.322	0.61	(1.19)	0.298
> 7 days	11.41	(3.91)		0.86	(1.85)	
Room type						
Individual	11.10	(3.75)	0.506	1.06	(1.45)	0.008
Shared	11.44	(4.13)		0.72	(1.67)	

Univariate analysis representing the sleep quality according to the hospitalization-related factors. PSQI, Pittsburgh sleep quality index; SD, standard deviation.

Table 4. Self-reported disturbances and sleep quality (univariate analysis).

	PSQI			Delta		
	Mean (SD)		*p-value*	*Mean (SD)*		*p-value*
Bed						
Yes	12.86	(3.91)	<0.001	0.81	(1.63)	0.467
No	10.69	(3.90)		0.78	(1.62)	
Room temperature						
Yes	12.27	(3.89)	0.009	0.87	(1.88)	0.549
No	10.95	(4.02)		0.75	(1.50)	
Bedding						
Yes	14.00	(3.43)	<0.001	0.52	(0.79)	0.813
No	10.90	(3.95)		0.83	(1.72)	

Univariate analysis representing the sleep quality according to the self-reported disturbances. PSQI, Pittsburgh sleep quality index; SD, standard deviation.

Table 5. Hospitalization-related factors and sleep quality (multivariate analysis).

	Model 1		Model 2	
	β (95%CI)	*p-value*	*β (95%CI)*	*p-value*
Number of interventions				
9-20	1,83 (0.76 to 2.90)	<0.001	1,46 (0.35 to 2.58)	0,010
>20	1,50 (0.43 to 2.57)	0.006	1,88 (0.80 to 2.97)	0,001

Multivariate analysis representing the sleep quality according to the hospitalization-related factors. Model 1, unadjusted analysis; Model 2, adjusted by comorbidities and pharmacological treatment; CI, confidence interval.

Table 6. Self-reported disturbances and sleep quality (multivariate analysis).

	Model 1		Model 2	
	β (95%CI)	*p-value*	*β (95%CI)*	*p-value*
Roommate	0.34 (0.20 to 0.49)	<0.001	0.41 (0.27 to 0.56)	<0.001
Nursingcare interventions	0.39 (0.24 to 0.54)	<0.001	0.43 (0.27 to 0.58)	<0.001
Bed	2.17 (1.23 to 3.11)	<0.001	1.92 (0.93 to 2.90)	<0.001
Room temperature	1.32 (0.37 to 2.28)	0.006	1.27 (0.31 to 2.22)	0.009
Bedding	3.10 (1.89 to 4.30)	<0.001	3.20 (2.08 to 4.38)	<0.001

Multivariate analysis representing the sleep quality according to the self-reported disturbances. Model 1, unadjusted analysis; Model 2, adjusted by comorbidities and pharmacologial treatment; CI, confidence interval.

DISCUSSION

DISCUSSION

To ensure a good recuperation, patients need good sleep. However, previous research has revealed that hospital inpatients struggle to get adequate sleep as a result of factors related to their stay.

The general aim of this dissertation was to determine the role and impact of hospitalisation, and nursing interventions on the sleep quality of patients hospitalised in acute and semi-acute units. The results provide relevant findings on evidence of specific nursing interventions that can be effective on the improvement of the sleep quality of hospitalised patients. On the other hand, it gives an overview of the current situation in Spanish public hospitals, and sought to evaluat the impact of nursing night-time intervention and hospitalization regarding the quality of sleep of their patients in non-critical wards. Findings from this dissertation may be seen as a first step in identifying a problem in Spanish the National Health System, and can offer options to nurses in order to improve clinical practice.

Nursing interventions to improve sleep quality in hospitalized patients

Two systematic reviews were performed to give answer to the effectiveness of nursing interventions to improve sleep quality in hospitalized patient. In **paper I**, fourteen of the seventeen randomized controlled trials included in this study obtained statistically significant improvements. The overall quality of the evidence was considered low as only four studies were assessed as having a low risk of bias, mostly the result of the impossibility to blind participants and personnel on subjective outcomes with self-reported questionnaires. Due to the low quality if the included studies, firm conclusions could not be drawn regarding the effectiveness of various interventions. However, the results of this paper provided a rich dataset of promising interventions, and indicates the need of future research. In **paper II**, an umbrella review was performed to provide the best-evidence-based practice

(Gopalakrishnan & Ganeshkumar, 2013). Although the methodological quality of the included reviews was generally rated as high, evidence supporting the effectiveness of the interventions and the methodological quality in most primary studies were reported low. Another major challenge detected in this review was the consistency in measuring sleep quality. Most of the included reviews included both subjective as objective sleep quality measures, and in several studies, there was no correlation between two measurements, as both measure unique aspects of sleep quality. Despite these challenges, this umbrella review provides an overview of nursing interventions that are potentially effective, and can help to develop health policies and further research on this topic. Findings are discussed below according to the different effective interventions identified.

Environmental measures

Moderate evidence was shown in **Paper II** for environmental measures such as reduction of light exposure, sound levels, and quiet-time protocols at night. Sound masking proved to be effective because of its capacity to minimise distracting sounds. Also, bright light therapy during the day showed to be effective for sleep quantity in non-intensive care patients with improvements ranging from +7% to +18% (Tamrat et al., 2014). In this context, well-designed healthcare environments could be considered as "smart investments", and nurses should not only pay attention on reducing light and noise during the night, but also administering sufficient light during the day.

Eye masks and earplugs

Findings in **Paper I** suggested that the use of eye masks, earplugs, or both may improve subjective sleep quality of hospitalized patients. These findings were not supported by the results of one included trial measuring objective sleep quality by PSG. However, certain limitations should be taken into account, namely that various patients did not adhere to the intervention because of discomfort, resulting in a high risk of missing outcome data. **Paper II** reported similar positive findings on the use of eye masks and earplugs, but the low quality of primary studies should be considered, and there is a need of more high-quality research. Ye et al. (2019) state that a tool should be used to assess potential causes of sleep disruptions in order to create more patient-centered care. Patient preferences

should be assessed, a former study reported there was a great difference in satisfaction with eye masks and earplugs, and patients rated its use from very comfortable to very uncomfortable (Richardson et al., 2007). Also, limited adherence to the intervention can be observed (Litton et al., 2016). As sound and light masking can result in sensory deprivation and cognitive problems, resulting in less patient autonomy, it is important to evaluate the need of each patient as well as the potential risks.

Aromatherapy, acupressure, relaxing techniques, music

Findings from both **Paper I and Paper II** provided evidence that the use of diffusing or inhalation of essential oils or aromatherapy resulted in improvements in patients sleep perception as a result of calming patients' minds and predispose them to sleep. This was consistent with a prior systematic review on the effect of aromatherapy on sleep quality (Lin et al., 2019). Also, the use of acupressure and acupuncture provided positive effects on subjective and objective measure of sleep reported in both **Paper I and Paper II.** However, it is important to highlight that acupressure and acupuncture mainly is performed in Asian countries, which may be due to the fact that the predominance of the use of complementary and alternative medicine differs between continents due to cultural, social, and economic factors. Because of these differences, it may be difficult to implement such interventions in well-established Western healthcare systems. The use of relaxation techniques was discussed in **Paper II**. In general, low evidence was found supporting the effectiveness of these type of interventions. A combination of relaxing techniques with massage showed low evidence for the improvement of sleep quality and was in line with an earlier systematic review who concluded that insufficient evidence was found for the effectiveness of relaxation techniques (Richards et al., 2003).

Paper I showed considerable enhanced subjective sleep quality according to five studies after the implementation of a music-based intervention or music combined with adjuvant instruments (earplugs or eye masks). These results were supported by objective sleep measurements from one of the included studies (Su et al., 2013), which showed that, measured by PSG, the N3 stage had significantly improved, and the N2 stage had significantly decreased. The findings were consistent with other research (Feng et al., 2018), which showed

that music therapy is simple to use, secure, and economic. These findings were confirmed in **Paper II,** where evidence was found for the positive impact of calming and soothing music on sleep quality in hospitalized patients. Moreover, previous studies have also shown that the results could be influenced by patient preferences (Lai & Good, 2005; Trahan et al., 2018), and that a more relaxing and analgesic effect could be obtained with music that patients are familiar with (Loewy, 2020).

Behavioural measures

Paper I provided evidence for an educational program on the use of earplugs, eye masks, and white noise machines which led to significant results on the fatigue score of patients from a cardiac unit, and better adherence to the use of these adjuvant measures. These findings strengthen the notion that not only the environment plays an important role but also psychosocial components such as safety and individual care, are of great importance.

Study I and II limitations

Paper I: This study counted with some limitations. The majority of the studies had small sample sizes, which suggests that a significant number of our included studies may have missed some of the opportunities to recognize contrasts between intervention and control groups. Some of the included studies made use of non-validated measuring tools. We included these studies as they measured one of the components included in our definition of sleep quality. Although, the use of these not validated could be considered as a limitation. We developed our search strategy with a documental specialist including the main databases of health care with a wide language selection; nevertheless, it is possible that some published and unpublished articles were overlooked, as also was grey literature possibly overlooked. Publication bias was not assessed due to the small number of studies of each intervention.

Paper II: Several limitations of this umbrella review should be considered when interpreting the results. First, a comprehensive and systematic search was performed covering a broad range of databases and languages, but grey literature was not included. Therefore, we might have missed some available evidence.

Second, all review articles that met the eligibility criteria were included according to the JBI appraisal checklist for systematic reviews. Although review articles with low-quality scores were not excluded by this system, all of the review articles included in our umbrella review had medium-to-high quality results on the critical appraisal scale, which did not compromise the quality of this umbrella review (Aromataris et al., 2015).

Lastly, we identified some weaknesses due to the limitations of the primary research studies included in the review articles. The high heterogeneity in patient profiles, generally small sample size, low quality, variability in the study designs and the lack of specific details made it difficult to compare the findings and draw firm conclusions. Moreover, with regard to sleep quality, most of the review articles and studies regarding this topic did not make a clear distinction between objective and subjective sleep quality, which restricts the comparison of findings.

As the nursing interventions found in this review were heterogeneous, and their results were highly narrative, little synthesis of the results was possible. Taking into account the promising results of this umbrella review and noting the growing interest in quality care and nursing interventions contributing to this, the results of this review indicate a need for more experimental studies. The discipline of nursing is very diverse, as are the nursing interventions. Therefore, experimental studies testing interventions to improve sleep quality in hospitalised patients are essential to advance the quality of care (Bolton et al., 2007).

Sleep quality in Spanish public hospitals

According to the results of **Paper III**, sleep quality in patients admitted to hospitals of the public national health system experienced poorer sleep quality and slept almost one hour less than before hospitalisation. This suggests that the experience of hospitalisation has a negative effect on both sleep quality and sleep duration. These findings are in line with other studies reporting poor sleep quality in hospitalised patients (Azizoglu Sen et al., 2021; Dobing et al., 2016; Dogan et al., 2005; Lei et al., 2009; Wesselius et al., 2018; Yilmaz et al., 2012), although comparison with other studies could not be done because of reporting on patients from specific units, single hospital samples, patients with specific conditions, or the use of other sleep quality measurement tools. Therefore, we believe that this

study adds information to theexisting literature. Highest PSQI scores during hospitalisation could be observed in the components of sleep latency, sleep duration and sleep efficiency which may suggest a lack of the use of behavioural intervention to improve the sleep experience in hospital (Baron et al., 2021). This poor sleep quality may be due to the effects of acute illness before hospitalisation. Also, our data were collected during the COVID-19 pandemic. Although our study did not include COVID-19 patients, there is evidence that COVID-19 outbreak-associated factors correlate with a decrease in sleep quality (Targa et al., 2021). This would also explain why the results of a study conducted during the COVID-19 period on general Spanish population observed a similar global PSQI score (8,17) with our study population (Maestro-Gonzalez et al., 2021). During the COVID-19 outbreak an increase of stress, anxiety and depression affected the general population (Altena et al., 2020; Sher, 2020). Anxiety and emotional distress have been shown to be negatively correlated to sleep quality in hospitalised (Alvaro et al., 2013; Dobing et al., 2016; Yang et al., 2015). Also, quarantine and social isolation may have caused changes in sleep-wake rhythms and a reduction of sleep quality (Cellini et al., 2020). These factors could have had an even greater impact on hospitalised patients during peak COVID-19 periods due to restrictions on visitors or night-companions, or a higher fear of getting infected with COVID-19 in the hospital (Nicholls, 2020). The sample was comprised of 83% of patients older than 50 years and 37% older than 70 years. Changes in the normal sleep-cycle and a variety of sleep problems are reported in elderly people and sleep quality is expected to deteriorate with age (Gulia & Kumar, 2018). Having higher educational level was observed to be a protective factor for poor sleep quality and quantity during hospitalisation, however, these results could be related to the age of the participants as secondary education became mandatory in 1964 in Spain (Flecha Garcia, 2011). Taking into account the mean age of our sample, it has been demonstrated that several hormonal effects, such as menopause, and physical changes in women's life can have impact on their sleep health (Kravitz et al., 2018). Additionally, the social aspect of women being more likely to be caregiver may lead to higher stress levels. Patients with 2 or more comorbidities were found to have poorer sleep quality which could also be related to higher age, but also because of more physical symptoms. Higher physical activity has also been shown to lead to better sleep quality during hospitalisation and no association was found for BMI which confirms the findings of prior researches

(DeSantis et al., 2019; Gothe et al., 2020). A negative association at admission and during hospitalisation was found for sedative medication intake and sleep quality. This confirms findings of other studies suggesting that benzodiazepines do not improve sleep quality and cause a significant risk of falls, especially in elderly patients what makes that it should be regularly reviewed whether intake is necessary (Beland et al., 2010; Holbrook et al., 2000; Marron et al., 2020) and the implementation of other non-pharmacological therapies with a long-term effect and fewer side effects should be considered. The length of hospital stay was not associated with differences in sleep quality or quantity in our sample, although due to our inclusion criteria of a minimum length of stay of 4 nights in hospital this result could be biased and short-term effects of hospitalisation on the sleep wake cycle could not be explored.

Study III limitations

Study III has some limitations. The dependence on patient recall for their regular sleep time prior to and during hospitalisation is one of the study's limitations. Reported sleep quality before admission may have been deviated from habitual sleep quality because of the situation of illness of the participant. We used the PSQI to measure sleep quantity and quality, we did not report on sleep dimensions with objective measurements, future research could focus on verifying and comparing our findings with non-subjective sleep evaluation methods such as actigraphy or polysomnography. Also, The PSQI was developed evaluating "usual" sleep of the past month. PSQI scores during hospitalisation could be biased because of a short hospital stay and patients with a hospital stay shorter than 7 days could not have had the opportunity to answer correctly on the 4 answers provided in some components of the PSQI. This could have led to a sub estimation of sleep quality during hospitalisation. However, median length of stay was 8 days and before passing the test to patients, we made a clear statement that this their answers should only reflect on sleep experience during their stay in hospital. Finally, we counted with 13% missing data in the PSQI test. This can be explained by the high workload of the nurses who could not go through every questionnaire or by the acute illness which caused patients to leave some questions unanswered. Although there is no established cut-off from the literature regarding an acceptable percentage of missing data in a data set for valid statistical inference, (Enders, 2003) stated that a missing rate of 15% to 20% was common.

The influence of hospitalization and nursing interventions on inpatients' sleep quality

The findings of **Paper IV** corroborate those previously reported (Dogan et al., 2005; Kulpatcharapong et al., 2020; Matsuda et al., 2017; Szymanski et al., 2014; Yilmaz et al., 2012) which demonstrated a poor sleep quality in up to 91% of hospitalized patients of different surgical and medical units. Despite the importance of sleep for the general health and for the recovery of the patients, the sleep quality in the hospital context does not appear to be a priority for professionals. The subtle consequences of poor sleep quality in the short-term does not aid in this context. Accordingly, the impact of poor sleep quality is more visible in the long term, in sustained conditions that go beyond the average length of hospital stay. In addition, previous studies demonstrated that nurses often overestimate the sleep quality of their patients (Delaney et al., 2018), identify different factors as possible disturbances (Lei et al., 2009), and the existence of heterogeneity in measuring sleep quality (Matsuda et al., 2017). The improvement of the sleep quality in hospitalized patients has the potential to positively effect, both on short- and long-term patients' comfort, safety, and health outcomes (Hillman, 2021). Considering this, the sleep in the hospital should be regarded as a priority by both patients and nurses, and a valid and reliable instrument to assess a patients' sleep could bring solution to these problems (Gellerstedt et al., 2020; Hoey et al., 2014).

The findings demonstrated that a higher amount of nursing activities received by the patients during the night was significantly associated with poorer sleep quality. The nursing interventions identified in our study as the most frequent during the night are largely likely to be modified, either by reducing their frequency, by organizing nursing care that permits their patients a night of undisturbed sleep, or by implementation of sleep friendly technology. A practical example; the clinical rational for the collection of blood samples carried out in the early morning is unclear. Sorita et al. (2014) provided evidence of a quality improvement interventions altering the timing of routine blood draws from early morning to midnight demonstrating more agreeable from patients, a better distribution of workload, and an improvement of efficiency of care. Another example is vital sign control. Night shift nurses often experience a dilemma between the control of vital signs during the night and the sleep of the patient. In fact, there exists

difficulty in applying early warning score algorithms and unclear guidelines for the ideal frequency of vital sign checks (Hope et al., 2018). Given the relevance of vital sign control in the prevention of major events like death or cardiac arrest, its avoidance is extremely dangerous. However, recent research suggests promising results for the screening of vital sign by use of infrared thermography (Sun et al., 2017) RGB- thermal image sensors (Negishi et al., 2020), bed-based contactless mattress sensor, or a patient-worn monitor (Breteler et al., 2020).

The data showed a statistically significant increase in discomfort with nursing interventions and roommate which could indicate that single rooms patients dispose of better sleeping conditions, as they could experience disturbances from roommate and interventions carried out on roommate. The connection between longer duration of sleep and single rooms was shown in previous research (Dobing et al., 2016). Also, patients experiencing disturbance with environmental factors such as bed comfort, room temperature and bedding had a negative association with their sleep quality. These results are in line with other studies detecting this factors as disturbing for hospitalized patients (Chauny et al., 2019; DuBose & Hadi, 2016; Morse & Bender, 2019).

Several previous studies (Chung et al., 2018; Lopez et al., 2018; Morse & Bender, 2019; Saneie & Otaghi, 2018; Thomas et al., 2012) showed promising results on the implementation of strategies to prevent the development of sleep-wake disorders by quiet time protocols or educational programs for nursing staff to minimize night time disturbances in order to improve the sleep quality of hospitalized patients. However, more research is needed to confirm the effectiveness of these interventions.

Study IV limitations

One of the limitations of our study is that we did not verify these results with objective sleep quality measures such as polysomnography or actigraphy. However, in our study we measured sleep quality with a validated and highly reliable questionnaire (Carpenter & Andrykowski, 1998). Because of the added value of objective measured sleep quality, future research should focus on contrasting findings from both subjective as objective measured sleep variables. Another limitation of our study is that PSQI scores at discharge could be biased because of short hospital stay as the PSQI is designed to measure sleep over the

term of 30 days. However, this would be likely to have led to a sub estimation of sleep as patients were not able to answer "less than one week" in some parts of the questionnaire, and we made patients clear that answers should be based on their hospital stay. Also, data was collected during the COVID-19 pandemic which could have influenced routine care, presence of family care givers at night and the restrictions on mobility within the hospital.

FUTURE LINES OF RESEARCH

FUTURE LINES OF RESEARCH

This dissertation answers the before stated objectives, but on the other hand opens doors for future research. Based on the findings, it is obvious that there is a need for further research to improve sleep quality in hospitalised patients, and the importance of nursing interventions in this regard.

According to the findings on the effectiveness of nursing interventions to improve sleep quality in hospitalised patients, health policy makers should take into account these result in order to design and implement new evidence-based strategies. The presented interventions showed promising results. However, the evidence of the effectiveness in most interventions was weak. Taking into account the results of **Paper III and IV**, further and larger studies are desired in the field of reducing or restructuring night-time nursing care interventions could have a major effect on the sleep quality of our patients.

Also, as highlighted in the results of this dissertation, patients' preferences should be taken into account when aiming for patient-centred care. As are research, most studies investigating sleep quality utilise a quantitative approach. By establishing agreements with patients and nurses, a patient-centred approach can be implemented to reduce disruptions and improve sleeping conditions. For this reason, a qualitative study protocol was designed to investigate the perceptions and factors affecting sleep quality based on the experiences of patients and nurses. This qualitative approach could bridge a research gap and contribute evidence for policymakers to implement correct actions. The qualitative study protocol can be consulted in Appendix 1.

CONCLUSIONS

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The conclusions derived from the papers included in this present dissertation are:

- A wide range of nursing interventions and their effectiveness on hospitalized patients are presented. The use of earplugs and eye masks, music therapy, acupuncture and acupressure, aromatherapy, and educational programs on the use of adjuvant measures appeared to be the most effective nursing interventions in improving sleep quality in hospitalized patients.
- Despite efforts made in the last year to improve sleep in the hospital setting, patients from Spanish public hospitals showed alarming results on the PSQI score. Significant differences were found in most of the components and global score of the PSQI, and inpatients reported to sleep a mean of 56 minutes less in hospital compared to at home. A lower educational level, having comorbidities, or the intake of sedative medication were shown to be risk factors for poorer sleep. Higher physical activity may function as a protective factor for poor sleep quality in hospital.
- The findings of this dissertation demonstrated that the frequency of night-time nursing care interventions affect sleep quality negatively, and the most frequently performed interventions are potentially modifiable. The results suggest the implementation and research on interventions focused on the reduction of disruptive factors in hospitals during the nighttime.

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APPENDICES

APPENDIX 1

Comparison between patients' and nurses' perspectives on the sleep quality of hospitalized patients: a protocol for a qualitative study.

Abstract

Background: Hospitalized patients are more likely to experience poor sleep quality, which can negatively affect their recovery. Several factors can affect patients sleep quality experiences, however there is a lack of qualitative research on patients' sleep quality from the patients' and nurses' perspective, leaving a knowledge gap in the understanding of disturbing factors during hospitalization.

Aim: This paper outlines the protocol for a study investigating the perspectives of patients and nurses regarding the quality of sleep and disturbing factors for hospitalized patients.

Design: Semi-structured qualitative study.

Methods: The data will be collected through semi-structured interviews with nurses and patients at a hospital in Lleida, Spain, between September and November 2022. A thematic approach will be employed, and Roy's adaptation framework will be used to structure the categories. Data will be managed and analyzed using the Atlas.ti software.

Discussion: Sleep is an essential component of the patient experience during hospitalization, and the results of this study can be used to develop practical strategies which are focused on sleep quality and include nurses and patients.

Keywords: sleep quality; patient experiences; nurses experiences; semi-structured interviews; Spain

Introduction

Sleep is essential to human health, as well as daily functioning and well-being (Buysse, 2014). Sleep quality is regarded as a complex clinical concept and sleep quality includes both qualitative and quantitative characteristics (Buysse, 2014). Quality of sleep is defined by Harvey et al. (2008) as indicating the number of awakenings that occur during three consecutive nights of sleep along with feeling refreshed and rested upon waking versus feeling tired at waking and throughout the following day. Additionally, subjective, and objective measures of sleep quality cannot always be compared (Buysse et al., 1989).

The importance of sleep-in hospital care has been emphasized throughout history and can be considered as a major component of health care. Florence Nightingale argued this in the late 1800s (Nightingale, 1992). The health care systems are undergoing constant change, partly because of increasing demand for efficiency and a desire to shorten the duration of care (Castledine, 2010).

Patients need care on a 24-hour basis, also during the night (Fąfara et al., 2018). Nursing interventions during the night require light, physically manipulation of patients or even talk to them, which can interfere with their sleep (Grossman et al., 2017). These interventions may adversely affect a patient's ability to rest and sleep. It is the nurses' responsibility and authority to promote health through nursing care which includes caring for the patient's sleep (Redeker & McEnany, 2011).

Several studies on patients with various pathologies have pointed out that hospitalization has negative impacts on patient's sleep quality and pattern (De Rui et al., 2015; Dwiastani & Gayatri, 2021; Manian & Manian, 2015; Yilmaz et al., 2012). These negative effects can prejudice various organ systems (Chang 2019), and leads to higher risk on multiple complications such as delirium (Pisani & D'Ambrosio, 2020), hyperglycaemia and impaired fasting glucose (DePietro et al., 2017), cardiovascular disease (Meier-Ewert 2004), or pneumonia (Patel et al., 2012). Several factors can affect a patient's sleep duration, quality, and experience during hospitalization in different wards (Ding et al., 2017; Dogan et al., 2005; Lei et al., 2009). Three categories of factors can be distinguished: environmental factors, physical and pathophysiological factors, and psychological factors (Zhang et al., 2013). As viewed from the patient's perspective, bed comfort, as well as the

room and nurse/medical care during nighttime, are considered environmental factors (Lane & East, 2008; Yilmaz et al., 2012). In a study conducted in Spain, nursing care and activity was identified as statistically significant factor influencing sleep quality (Bernat Adell et al., 2021). Additionally, sounds and lights may also interfere with sleep (Ding et al., 2017; Zhang et al., 2013). Several factors can affect physical and pathophysiological experiences, such as pain and undermanaged pain (Ding et al., 2017; Lane & East, 2008; Yilmaz et al., 2012). In addition, losing one or two hours of sleep can increase heart rate and blood pressure. Improved sleep may result in improved outcomes, shorter hospital stays, lower medication burdens, enhanced immunity, decreased infection rates, as well as improved wound healing (Davis et al., 2021). Psychological factors include anxiety, worries, previous experiences of safety, and fears about missing family members (Lee et al., 2007; Yilmaz et al., 2012).

Nursing assessments of patients' sleep quality and recommendations for nursing intervention are necessary to promote patients' quality of sleep on hospital wards (Ritmala-Castren et al., 2022). A systematic review (Bellon et al., 2021) found several nursing interventions to be effective in helping patients to sleep more soundly. Among these interventions are environmental, physical, and behavioral strategies including aromatherapy, massage, music, eye masks, and earplugs as well as educational and psychological interventions. There is a lack of evidence investigating the current situation of sleep quality in hospitalized patients in Spain (Bernat Adell et al., 2021; Jorge-Samitier et al., 2020). In most studies investigating sleep quality, a quantitative approach is employed (Bernat Adell et al., 2021; Davis et al., 2021; Dogan et al., 2005; Jorge-Samitier et al., 2020; Ritmala-Castren et al., 2022; Zhang et al., 2013). By establishing agreements with patients and nurses, a patient-centered approach can be implemented to reduce disruptions and improve sleeping conditions (Gellerstedt et al., 2020). Therefore, it may be vital to conduct a qualitative study to investigate the perception and the factors affecting sleep quality based on the accounts of patients and nurses in Spain may be deemed as important for bridging this research gap and contribute evidence for policymakers to improve these factors.

Conceptual Framework: Roy's Adaptation Model

This study will employ Roy's Adaptation Model (Roy, 1988; Roy & Zhan, 2006) to examine the relationship between the environment and the individual as a framework. According to this model, humans are considered to be biopsychosocial adaptive systems that respond to environmental change by adapting to it (Polit & Beck, 2004). Considering Roy's model, a nurse's role is to assist clients with adapting to changes and regulating the stimuli that affect them (Polit & Beck, 2004). In Roy's theory, there are two major types of coping mechanisms: regulators and cognators (Roy, 1988; Roy & Zhan, 2006)Click or tap here to enter text.. As part of the regulator subsystem, chemicals, neural systems, and endocrine systems all play a part in coping. The cognator subsystem is responsible for cognitive and emotional processes. In the cognator subsystem, there are four cognitive-emotive channels: perception and information processing, learning, judging, and emotion processing. These two processes determine an individual's response to stimuli. When an individual is exposed to a stimulus, cognitive and regulatory processes collaborate to produce a behavior (Roy, 1988; Roy & Zhan, 2006).

Roy's model identifies four adaptation modes associated with four main processes of coping: physiological, interdependence, role function, and self-concept/group identity. The role of nursing is to meet the needs of individuals in these modes of adaptation. On the basis of Roy's model, the person can be viewed as an adaptive system, which includes their adaptive processes, modes, and health adaptations (Roy & Zhan, 2006).

Roy›s Adaptation Model (Roy, 1988; Roy & Zhan, 2006)is an innovative approach to investigate sleep quality and factors influencing it, such as noise and nurses' work-related activities that disrupt sleep in patients, such as blood sampling, vital sign measurement, and medication administration and strategies to adapt.

Aim

The purpose of this study is to explore patients' perceived sleep quality, and factors disturbing their sleep within a medical unit in a public hospital in Lleida, Spain, and contrast this with the perception of nightshift nurses on their patients' sleep quality.

Methodology

Study design

This study will employ a descriptive exploratory generic design. The qualitative descriptive methodology provides more insights into a phenomenon and clarifies who, what, and where it occurs (Sandelowski, 2000). The study will employ semi-structured interviews as a method for gathering nuanced and rich descriptions of patient and nurse experiences. The methodology employed emphasizes understanding and exploring from the perspective of the individual (Peters & Halcomb, 2015). This study will follow the Standards for Reporting Qualitative Research (SRQR) (O'Brien et al., 2014).

Study setting and study participants

The study will take place at an internal medicine unit at the University Hospital Arnau de Vilanova, a public, tertiary care hospital in the west of the autonomous community of Catalonia, Spain. The researchers will coordinate with the hospital management as well as the nursing supervisor responsible for the unit in order to obtain permission to conduct this study.

- The following inclusion and exclusion criteria for study participant will be applied *Inclusion criteria:*
- Nurses who work night shifts or rotating shifts and provide direct patient care.

Adult patients hospitalized at the internal medicine unit with a stay for at least three consecutive nights, emotionally and cognitively able to communicate in Spanish, Catalan or English.

Exclusion criteria:

- Patients refusing to participle in the study.
- Participants with mild or severe cognitive impairment, psychiatric or neurological conditions (including delirium) that hinder verbal communication.
- Participants with before diagnosed sleeping disorders.
- Patients highly agitated or violent.

Data collection and sampling

The interviews will be carried out based on a semi-structured interview guide developed by the research team (Supplementary file1) that includes questions or topics that will be explored by the researcher, and will be recorded by audio recorder. Interviews will be conducted between September and November 2022. The interviewer will be a novice qualitative researcher who received education about qualitative research. Interviews will be held in a private room at the unit between only researchers and participant. Before the interview is scheduled, participants will receive information given by the researchers' team and an information sheet (Supplementary file 2) will be handed over. If the participant agrees to participate, he will sign the informed consent form (Supplementary file 3), and consent to record, as well will be given the opportunity to ask questions. The researcher will remind the participants of their right to withdraw from the study before recording. All interviews will be performed voluntarily, and no compensation is provided. Figure 1 illustrates the study process from recruitment of subjects to conducting interviews. We expect interviews to have a duration of approximately 45 minutes. The researcher will introduce himself as a nurse with several years of clinical experience, not working in the hospital, in order to avoid possible imbalances in the power relation between interviewer and interviewee. Based on the responses of the participants, the interviewer would ask follow-up questions in order to ensure that all study objectives are addressed and to collect the maximum amount of data for analysis (Bryman, 2016). Due to the nature of this qualitative study, we will use a convenience sampling method as the sample is demographically and geographically local (Robinson, 2014). Based on the principle of information power, we estimated to conduct between 15 and 20 patient-interviews and between 5 and 10 nightshift nurses to include in our analysis. The model of information power states that the more relevant information the sample holds; less sample is required. They suggest that a narrow study aim, a strong dialogue, participant selection, use of an established theory and the use of an analysis strategy can decrease the number of the needed sample (Malterud et al., 2016).

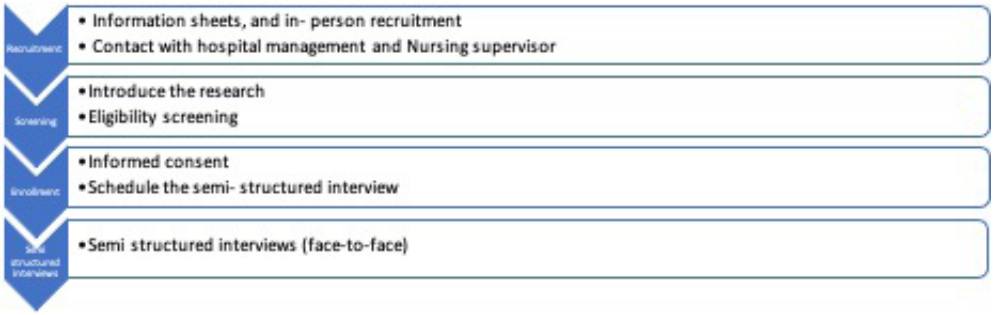

Figure 1. Study procedure.

Data analysis

Interviews will be digitally recorded and transcribed verbatim. To obtain transcription of the interview data we will use the ATLAS-ti qualitative software (ATLAS.ti Scientific Software Development GmbH, 2022). De-identified transcripts will be analyzed using Braun and Clarke's thematic analysis method (Braun & Clarke, 2006) and the Roy's adaptation framework will be used to structure the categories. Two researchers will read all transcripts, obtained data will be categorized, and differences will be discussed until an agreement is reached. As a result of the codes, the research team will be able to creates themes and subthemes and produces the results of the qualitative study. Results will be presented by the use of quotes from the participants and the basic collected demographic characteristics.

Pilot study

A pilot study will be conducted to test the recruitment and sampling processes, as well as the data collection methods, and where necessary, refine these. The researcher will gain experience with recording equipment, recruitment procedures, consent procedures, and will be able to be mindful of his position as an interviewer by conducting this pilot study.

Besides providing the opportunity to test and modify the semi-structured interview topic guides, if necessary, this process will also follow the guidelines already established. The pilot study will include two to three interviews.

Rigour

The validity and trustworthiness of this study will be ensured by adhering to the scientific principles of descriptive phenomenology (Sundler et al., 2019; van Wijngaarden et al., 2017).

Therefore, to avoid bias, researchers need to be aware of their preexisting understanding of the world and of their relationship with those around them, as well as the risk of giving voice to themselves rather than the participants. For maintaining scientific rigor during the collection of data, analysis, and presentation of results, the researchers will rely on the closely related methodological principles of emphasizing openness, challenging pre-understanding, and adopting a reflective attitude during the process (Sundler et al., 2019). Throughout the research process, all researchers engage in critical discussions, challenging their preconceived notions and theoretical knowledge to minimize bias among researchers. None of the researchers will be familiar with the participants covered by the research.

To preserve openness to the study goal, a search for the unknown is necessary, along with maintaining a reflective attitude towards the expressed experiences (van Wijngaarden et al., 2017). By presenting how sub-themes and themes are abstracted and interpreted, the ability of the reader to assess the validity and trustworthiness of the study will be enhanced, and findings will be supported by quotations from all interviews in the original transcripts (Sundler et al., 2019).

Ethical considerations

The study adheres to the principles of the Helsinki Declaration in its design and execution. Approval by the ethics committee of the Arnau de Vilanova University hospital has been obtained (CEIC-2140). The researchers will develop detailed information sheets and consent forms in Spanish, Catalan, and if necessary, in English. Participants will be informed that participation in the study is voluntary and that all responses will remain confidential. All participants will be aware of the possibility of withdrawing from the study at any time without prejudice on their health care service. Interviewer and interviewee can suspend the interview if there is a perception of negative affection on the interviewee's emotional condition.

Discussion

The findings of this study may contribute to a better understanding of nurses' and patients' perceptions of factors that influence sleep quality, strategies for improving sleep, and the experiences of patients in a provincial hospital in Lleida, Spain. Furthermore, it could emphasize the vital position nurses and patients play in improving sleep quality. Nursing can play a crucial role in identifying sleep deprivation and sleep disturbance and advocating for sleep quality improvement using tailored interventions for individual patients (Gellerstedt et al., 2019).

Semi-structured interviews are the most common method of collecting qualitative data. During a semi-structured interview, the researcher and participant engage in a dialogue guided by an interview protocol, which is supplemented with follow-up questions, probes, comments (DeJonckheere & Vaughn, 2019; Magaldi & Berler, 2020).

During the process of collecting open ended data, this method can allow participants to reveal their thoughts, feelings, and beliefs regarding a specific topic as well as dive into deeply personal and sometimes sensitive matters. In addition, it is a powerful tool that can be employed by researchers to gain an understanding of patients' motivations, beliefs, and experiences (DeJonckheere & Vaughn, 2019; Magaldi & Berler, 2020). This study will contribute in tending the current knowledge gap and could offer helpful evidence for program managers and policy planners to improve sleep disturbing factors in the pandemic recovery phase we are currently in.

Limitations

Patients who speak Spanish, Catalan or English are the subjects of the study. There is a possibility that some patients will not meet this inclusion criterion, in which case they will be excluded. In a multi-cultural country such as Spain this could exclude individuals who don't speak the languages.

The study will take place in a single hospital in Catalonia. Although the results may not be generalizable, qualitative research aims to provide in-depth perspectives of a limited number of subjects.

Conclusion

This study protocol will present the perspectives of patients and nurses on sleep quality in hospitalized patients in Lleida, Spain. Due to the lack of evidence in this context, this study will provide a more in-depth understanding that will aid in developing recommendations for future research and nursing interventions intended to reduce sleep disturbances and improve sleep among hospitalized patients.

Conflict of interest

No conflict of interest has been declared by the authors

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SUPPLEMENTARY FILE 1 : INTERVIEW GUIDE

Nurses:

Question	Theme
1. Could you describe what good sleep quality is? - How important do you think sleep is? How does it influence the recovery of patients/ impact on patients? 2. What is your perception of the quality of sleep of the patients in your unit during a regular night?	Importance of sleep
3. Could you describe a typical night at your unit? 4. What factors do you think influence the sleep of your patients? – How do you think nurses influence on patients' sleep? 5. What share do you think nurses have in the sleep patrons of their patients?	Factors influencing
6. Do you have active protocols to improve sleep quality of patients? If yes, could you describe these 7. Are other nursing interventions carried out to improve sleep quality? 8. Could you explain us how you assess patients' sleep in your unit?	Nursing interventions to improve sleep
9. Do you think improvements in nursing care could be implemented in order to better the sleep of patients? Do you think timing of care is important for your patient, are there improvements to be made in this aspect? How can we help patients to sleep better? 10. What changes could be carried out in your unit to improve patients' sleep?	Solutions

Nurses' characteristics:

Sex/gender:

Age:

Working shift:

Education/ specialty:

Years working:

Time working at ward:

Patients:

Question	Theme
How would you describe a good night of sleep? Could you describe how important sleep is for you? How do you feel after a night of bad sleep?	Importance of sleep
How could you describe your regular habits before going to sleep? How different are these at the hospital? What do you do when you can't fall asleep?	Patients' sleep habits
Do you feel satisfied with your sleep at the unit? Could you explain why?	Perception of sleep during hospitalization.
What kind of care activities were carried out in your room during the nights of your hospitalization? What factors in the hospital do you think influence on sleep habits of patients? Could you describe a situation where your sleep was disturbed during your hospitalization?	Disturbing factors
How do you think sleep could be improved in the hospital? Are there interventions nurses could perform to make you feel safer/ calmer / less anxious / improve sleep	Solution

Patients' characteristics:

Sex:

Age:

Education:

Prior sleep problems:

Main reason for hospitalization:

Time in hospital:

Type of room:

Living with partner/children:

Having company in hospital at night:

Supplementary file 2: An information sheet for participants: semi-structured interviews

Project title: Patients' and nurses' perspectives on the sleep quality of hospitalized patients in Lleida, Spain

Introduction

We would like to invite you to take part in a research study. The following information should be read carefully and discussed with others, if you wish. It is essential to understand the purpose of the research and what it entails before making a decision. Do not hesitate to contact us if you have any questions. If you decide to participate in this study, you will be asked to sign a consent form. Participants may withdraw at any time without giving a reason and without this withdrawal effects their care during hospitalization.

What are the objectives of the study?

The purpose of this study is to find out how nurses and patients perceive factors that affect sleep quality at a public hospital in Lleida, Spain. Additionally, the study has the following objectives, which are to explore and describe patients' experiences of sleeping in hospitals and nurses' perspectives on patients sleeping in hospitals. The project will also identify factors that affect patients' sleep quality and strategies to improve sleep among patients in the hospital, based on what nurses and patients perceive. Finally, we sought to identify the similarities and differences among nurses, patients' perceptions about hospital sleep, and factors that affect hospital sleep.

Do I have to participate?

Participation is entirely voluntary. There is no obligation for you to participate. There will be no impact on the kind of care you receive in the hospital if you do not participate.

If I participate, what will happen to me?

If you choose to participate, you will be invited to attend an interview with a member of our research team. You will not be required to discuss anything that makes you uncomfortable. The meeting is scheduled to last approximately 40 to 60 minutes. The meeting will be recorded on audiotape, and the interviewer may take some written notes.

Is my participation in this study confidential?

This study follows the Declaration of Helsinki and has been approved by the ethics committee of The University hospital Arnau de Vilanova. All information you provide to us, along with your participation in this study, will be treated with strict confidentiality. We will remove your name and contact information from any information we maintain, and you will only be able to be identified by an ID number. The recording will be transcribed by a member of the research team after the interview. The University of Lleida will maintain all electronic information in password-protected files. Only members of the research team will have access to this data.

What are the advantages and disadvantages of participating?

You will have the opportunity to discuss your experiences with sleep quality in the hospital during this study. During the interview, you will have the opportunity to discuss what you consider relevant and what you believe needs to be improved.

Some individuals may find some of the topics discussed difficult or upsetting. You may withdraw from the meeting at any time, and you are not obligated to discuss any subject you feel uncomfortable discussing. According to academic research standards, participants in the study are not financially compensated.

What will happen to the research study's results?

The results of this study will be published in academic journals as well as presented at relevant national and international conferences and seminars. As previously indicated, your identity will not be revealed in any of these publications. The results will be available to all participants.

Contact details

Supplementary file 3: Informed consent for patients and nurses

I am willing to take part in the study entitled "Patients' and nurses' perspectives on hospitalized sleep quality in Lleida, Spain.". I will participate in an interview as part of my participation. I understand that participation in the study is completely voluntary, and I may withdraw at any time during the study.

I have read this information. There have been opportunities to ask questions about it. All my questions have been satisfactorily answered. Interested in participating in this study, I voluntarily consent.

Name of Participant _____

Signature of Participant _____

Date _____

Day/month/year