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Participatory action research intervention for improving sleep in inpatients with cancer

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Abstract

Aim: To design and implement a plan to improve oncohaematological patients' sleep.

Background: The hospital environment can compromise inpatients' sleep, negatively impacting on health outcomes and patient satisfaction.

Design and Method: The improvement plan was designed in collaboration with 18 professionals, 3 patients and 3 accompanying relatives. The study designed followed the SQUIRE 2.0 guidelines. Outcome variables were self-reported patient satisfaction regarding sleep, measured using a 30-item, ad hoc questionnaire and a 10-point visual analogue scale, completed by 318 oncohaematological inpatients (pre-intervention $n = 120$, post-intervention, $n = 198$) in a comprehensive cancer centre in Spain from 2017 to 2019.

Results: Overall, 61.5% ($n = 190$) of the inpatients reported sleep alterations, and 92.6% reported interruptions in their nightly sleep. Half slept less than 6 h/night, but

58.0% said they felt rested upon waking, despite the interruptions. These outcomes were similar before and after the intervention. The improvement plan identified four domains for work (professionals, care procedures, instruments/environment and patients/relatives), 10 areas for improvement and 35 actions for implementation. However, overall sleep worsened significantly, from 6.73 to 6.06 on the 10-point scale. The intervention significantly improved variables related to professionals' behaviour, including noise during the shift change, conversations at the control desk and the use of corridor lights. Sleep disturbances were mainly caused by pain/discomfort and infuser alarms, and collectively they decreased significantly after the intervention ($p = .008$). However, overall sleep worsened significantly, from 6.73 to 6.06 on the 10-point scale.

Conclusions: Pain, clinical devices and noise made by professionals are the main causes of sleep disturbances. Involving professionals in decision-making to improve patients' sleep have a positive impact on noise levels.

Relevance to clinical practice: This study proposes new strategies for improving sleep by increasing staff awareness and changing attitudes towards patients' sleep. Nurses should be involved in addressing sleep disturbances during hospitalization.

KEYWORDS

cancer, decision-making, health care quality, hospital care, intervention, noise in hospitals, patient participation, sleep disturbance

1 | INTRODUCTION

Cancer is an important public health problem and one of the main causes of morbidity and mortality worldwide; approximately 19.3 million new cases were recorded in 2020 (GLOBLOCAN). By 2040, population estimates indicate that annual incidence will increase to 29.5 million globally (SEOM, 2021; WHO, 2021).

One of the most frequent alterations in cancer patients is sleep disturbances, which can seriously affect physical and physiological health (Cheung et al., 2021; Lin et al., 2013). Anywhere from 30% to 93.1% of cancer patients suffer from sleep disorders, compared with 9% to 33% of the general population (Doi et al., 2000; Santoso et al., 2019; Slade et al., 2020; Stubbs et al., 2018).

Population studies have reported significant associations between short sleeping periods and higher mortality (Dew et al., 2003; Ferrie et al., 2007), concluding that persistent alterations in sleep quality negatively affect health status and are closely related to long-term overall survival (Palesh et al., 2014).

The factors associated with sleep disturbances in cancer patients still need to be elucidated. Previous studies have pointed to age, higher body mass index (BMI), cancer-related fatigue, depression and anxiety as being associated with poor sleep quality in this population (Kahan, 2017). Depending on the person, sleep patterns can be conditioned by age, sex, health status and environmental and personal changes (Berger et al., 2019; Cilingir et al., 2016). Noise can also modify the functioning of the neuro-vegetative system, accelerating the respiratory heart rate, increasing blood pressure and salivary secretion and altering muscle tone. It can also influence the psychic and immune systems, impeding concentration and producing discomfort, fear, anguish and distress. In many cases, the secondary cognitive state can cause patients to fall, putting safety at risk during hospitalization (Miaskowski et al., 2011). The initiation of cancer therapy and the presence of pain have also been shown to be conditioning factors for sleep (Sharma et al., 2012; Wang et al., 2021). Moreover, the therapies used above all in the haematological field can induce cognitive problems even in the long-term (Mogavero et al., 2020).

Hospitalization is associated with less sleep and rest. Studies carried out in hospitalization areas show that environmental factors have an important effect on patient recovery. Noises made by people, the medical devices used (infusion pumps, monitors and ventilation systems), lights or even the dynamics of the unit itself can destabilize patients' recovery, lengthening their stay, causing an impact on their health and ultimately affecting the economic cost

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

- This study takes a new methodological approach to changing health professionals' behaviour, based on participatory action research.
- The shared decisions and responsibilities in decision-making have an impact on patient care and their sleep, helping to reduce the environmental disturbances perceived by the inpatient.

(Dobing et al., 2016; Fillary et al., 2015; Hu et al., 2015; Huang et al., 2015; Kamdar et al., 2013).

The World Health Organization (WHO) and the U.S. Environmental Protection Agency (EPA) suggest that the nocturnal noise level in hospitals should not exceed 35–40 dB (Achury et al., 2013; Kamdar et al., 2012). The recommended noise levels in hospitals should average 45 dB during the day and about 35 dB at night. Hospitals are considered to have a quiet environment when overall noise levels range from 40 db to 50 db, a moderate environment at 50 db to 60 db, and a loud environment at 60 db to 70 db. Despite the limits proposed by the WHO in settings such as the intensive care unit (ICU), it is almost impossible to respect these values due to the existing high technology (Fillary et al., 2015). The continuous exposure to light is another factor that can diminish the patient's sleep; light plays a very important role in the synchronization of the circadian rhythm and can directly impact on the structure of sleep at levels of 40 lux. Research shows that in the ICU, mean nocturnal light levels are typically 128 lux to 1445 lux—enough to interrupt the suppression of melatonin and affect sleep and its rhythm (Vilchez-Dagostino et al., 2012).

Sleep problems in hospitals are usually addressed pharmacologically, but this approach can produce side effects. Benzodiazepines, for example can lead the patient into a state of delirium, requiring new pharmacological adjustments to reverse the presence of these episodes (Elliott, & McKinley, 2014; Huang et al., 2015; Kamdar et al., 2013). Numerous studies have advocated for the use of non-pharmacological measures to improve sleep in critical or complex care units, despite the fact that only moderate improvements have been achieved thus far (Huang et al., 2015; Elliott & McKinley, 2014; Farokhnezhad-Afshar et al., 2016; Vincensi et al., 2016).

Oncohaematological patients are fragile, and they undergo highly complex treatments. This population is at high risk of delirium due to their frequent comorbidities, the pharmacological treatment associated with the cancer care process and the treatment frequently administered for pain control. A stressful situation such as hospitalization, accompanied by environmental overstimulation, can trigger delirium, which is a sign of poor prognosis in cancer patients.

In this context, the health professionals in these units, and especially the nurses—who serve a caregiving role throughout the care process—can contribute to promoting the patient's sleep: protecting them from unnecessary noise, identifying the sources of noise, minimizing them, trying to make their own behaviour quieter, reducing or eliminating unnecessary conversations in patient rooms and assessing the need to perform activities that may interrupt the patient's sleep. These considerations motivated the present study, which took place in the oncohaematological hospital wards of the Catalan Institute of Oncology to identify factors that disturb sleep, implement an improvement plan and evaluate its impact through participatory action.

This study aimed to identify areas for improving the sleep of oncohaematological patients and to implement and evaluate noise reduction strategies in the hospitalization areas through participatory action research methods.

We hypothesized that the implementation of an improvement plan based on participatory methods would reduce environmental noise and improve self-reported quantity and quality of sleep and increase satisfaction among patients admitted to the oncohaematological hospitalization unit.

2 | METHODS

2.1 | Setting and study design

The study took place in the oncohaematology and palliative care unit of a comprehensive cancer centre in Badalona (Spain) from 2017 to 2019. It employed a pre-/post-intervention design with non-equivalent groups, based on the participative planning and implementation of an improvement intervention. The study has followed the stands for SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence).

2.2 | Recruitment and sample

The centre serves approximately 1655 hospitalized patients annually. We calculated the sample size, estimating a difference of 17 percentage points between the pre- and post-group (α: 5%; $\beta = 20\%$, baseline (pre) prevalence of sleep alterations: 50%, final (post) prevalence: 33%, total = 131 participants per group), without considering losses, for a study period of 28 months (GRANMO software version 7.12 April 2012).

Inclusion criteria were inpatient in the oncohaematology unit with a stay of more than 72 h, any age and sex and signed informed consent. We excluded patients with cognitive impairments, delirium or an end-of-life situation that made it impossible to fill out the questionnaire independently.

Stratified random probability sampling using an admission constant of 5. In each ward, inpatients were randomly selected from an admission list. The randomization system for selecting participants was based on multiples of 5; so, we selected every fifth patient from the list for inclusion; if the selected patient name corresponded to an empty bed, the patient was out (for instance, undergoing a test), or they declined to participate, we invited the next patient on the list who fulfilled the selection criteria.

2.3 | Instruments and data collection

2.3.1 | Variables and data collection

The outcome variables were overall self-perceived quality of sleep and causes of sleep disturbances, as perceived by the hospitalized patient and measured using an ad hoc questionnaire. Secondary explanatory variables were the patients' sociodemographic characteristics: age, sex, length of hospital stay and responsible oncology service.

The baseline assessment of patient-reported sleep was performed January 2017, and the post-intervention impact was from January to February 2019. Eligible patients, selected using the sampling strategy described above, provided their subjective assessment of the degree of comfort in the environment and the presence of noise. The assessment tool was an ad hoc questionnaire with 30 questions, 7 items measured the quality and quantity of perception patients' sleep last night and 23 items probed the causes of sleep disturbance on a visual analogue scale from 0 (no disturbance) to 10 (maximum disturbance). The main variables were (1) noise generated from various sources (professionals, service professionals outside the unit and medical devices) and (2) disturbing environmental aspects (temperature, light and others). Participants were also invited to propose suggestions for improvements through an open question. To assess patients' sleep, the design of the study questionnaire took the Spanish versions of the Richards-Campbell Sleep Questionnaire (RCSQ) (Nicolás et al., 2002) and the Pittsburg Sleep Quality Questionnaire (Macías & Royuela, 1996) as guides. Before the start of the study, the questionnaire was piloted in 31 patients who were not part of the final sample. In all cases, the questionnaires were self-administered.

2.3.2 | Intervention

The study intervention, or the noise reduction and environmental improvement plan, was designed using participatory action research methodology. This approach was based on the socio-critical paradigm framed by Lewin, within Checkland's theoretical context (Flood, 1990). In total, 18 professionals were invited to participate: 6 nurses representing all shifts, 4 nursing assistants, 2 social workers, a patient services professional, the head of inpatient care, the centre's care manager, the centre's nurse manager and the medical coordinators of the oncology and haematological hospitalization units. Professionals with less than one year of experience in the unit were excluded. In addition, three adult inpatients admitted for any reason for at least 72 h, plus three adult family members accompanying the patient, were invited to volunteer. In our country, patients are permitted to be accompanied throughout their hospital stay by a family member, who frequently spends the night next to the patient in their room; thus, we considered that their perspective on causes of sleep alterations were also valuable. We excluded patients with cognitive impairments, delirium, or an end-of-life situation that made it impossible contribute to the discussions. All participants were volunteers and gave informed consent.

Purposive sampling was used to select professionals working in various shifts and areas of responsibility within the study unit, while convenience sampling was used to recruit patients and relatives of patients hospitalized when the second discussion group was being created.

Scope

The content areas explored were the hospital environment, noise and sleep, whereas descriptive variables were age, sex, shift, unit and professional experience.

Instruments and data collection

Peter Checkland's framework was used to collect data using a qualitative technique for non-structural systems in seven phases: (1) description and assessment of the situation; (2) identification of the areas involved; (3) definition of desirable changes; (4) analysis of the model of desirable change for the current situation; (5) prioritization of desirable and feasible change strategies; (6) implementation of the proposed actions and continuous monitoring and (7) reflections or reassessment of the change caused and redefinition of follow-up strategies.

The participatory development of the improvement plan proceeded through two discussion groups from January and March 2017. The first session lasted about two hours and involved 18 health professionals. The group followed the Metaplan technique, a qualitative method for moderated group problem-solving, based on structured brainstorming, shared decision-making and agreement on the action plan. Data were collected using coloured cards, which were grouped by thematic areas and ranked in order of importance by the working group. Participants were led by two expert researchers, a moderator and an observer, with the aim of guiding the organization of ideas and decision-making. During the session, the emerging thematic categories were articulated through 'clouds' that were labelled and prioritized. All the meetings were recorded and transcribed to complete the interpretation of the categorization work, always with the informed consent of the participants. In the second meeting, six professionals, three patients and three family members participated, reproducing the methodology, with the aim of bringing out new thematic areas from the patient's point of view and planning feasible actions that professionals could implement in line with the patient's vision.

Every two months for 12 months following the development of the improvement plan, meetings were held with the five professional delegates for sleep-in the discussion group's unit, representing all shifts. The purpose of the meetings was to work in collaboration with the centre's management to facilitate the implementation and monitoring of the corrective measures. During the planning phase, a triangulation process was applied with documentary review in the study area. Throughout the teamwork process, the field journal/minutes was used to support and contextualize the sessions.

Data analysis

Content analysis was performed in pairs by coding and categorizing the emerging themes with the support of the field journal/minutes and bibliographic triangulation.

2.4 | Ethics

The centre's management office and the cognizant ethics committee approved the study (PI-17–106). Its performance complied with the rules of good clinical practice and the General Data Protection Regulation (EU) 2016/679. All participants gave voluntary informed consent to take part.

2.5 | Data analysis

Scores were transferred to an SPSS database (IBM Statistical Package to the Social Science, version 20). A descriptive and inferential analysis was carried out. Quantitative variables were expressed by means (standard deviation, SD) and qualitative variables as absolute and relative frequencies. Leven's test was used to assess the homogeneity of the sample; contingency tables and the Chi-square test, to compare qualitative variables; the student's *t* test, to compare means; and Spearman's rho test, to assess bilateral correlation. For the analysis and interpretation of the results, an alpha error of 5% was assumed.

3 | RESULTS

The final sample was 318 oncohaematological patients. Of the 130 hospitalized patients recruited for the baseline assessment of self-perceived sleep, 10 patients were excluded because they were discharged within 72 h. The improvement plan identified four domains of work (professionals, healthcare procedures, instruments/environment and patients/family members), 10 areas for improvement and 35 improvement interventions (Table 1). The patients consulted in the pre-intervention period assessed these areas through an ad hoc survey, identifying 18 aspects to improve (Table 2). Subsequently, the corrective actions were implemented for 12 months over 2018, and the post-intervention impact was evaluated with the participation of 198 patients.

Thus, a total of 318 patients were included: 120 in the pre-intervention phase and 198 in the post-intervention phase. Table 3 presents their sociodemographic characteristics; no significant differences were observed between groups by sex or age, but patients in the pre-intervention phase had a significantly longer stay (pre: 14.8 days, SD 13.6 vs. post: 11.6 days, SD 11.2; $p = .029$).

3.1 | Characteristics of patient sleep

Overall, 61.5% ($n = 190$) of the patients reported sleep alterations during their admission, with 92.6% ($n = 288$) reporting interruptions in their nightly sleep. The existence of interruptions was not associated with age, sex, length of stay or hospitalization area. About half (51.3%, $n = 161$) slept less than 6 h a night, but 58.0% ($n = 181$) said they felt rested upon waking, despite the interruptions. Most (60.32%, $n = 190$) were taking sleep-inducing medication. Table 4 shows the characteristics of participants' sleep according to the study period; there were no statistically significant differences by age, sex, length of stay or hospitalization area.

3.2 | Changes in the perception of aspects that disturbed sleep

Following implementation of the corrective measures, patients' perception of noises that could disturb their sleep improved for all the variables evaluated. Using the 10-point VAS, patients reported that the primary reasons for sleep alterations after the intervention were pain or discomfort (mean 3.96, SD 3.16), infuser alarms (mean 3.48, SD 3.29), room temperature (mean 2.21, SD 2.67) and the corridor light (mean 1.56, SD 2.56), all yielding moderate scores of less than 4 on average. The variables related to professionals' behaviour showed improvement, including the noise generated during the shift change (mean 1.33, SD 2.20; $p = .001$), the conversations at the control desk (mean 1.04, SD 2.09; $p = .003$) or use of light in the corridor (mean 1.56, SD 2.56; $p = .001$). No improvements were observed in the noise generated by roommate, relatives or pain (Table 5).

In the correlation study between the perception of overall sleep and that of the variables generating sleep disturbances, there was a significant and inverse correlation for pain, fear, noise generated by professionals and relatives, light and noise from the TVs in the rooms ($p < .001$, Table 6).

When the difference in noise perception was analysed according to shift and intervention period, statistically significant differences were found in favour of the study intervention ($p = .001$). The morning shift was rated as the loudest despite the decrease in score across all shifts.

The intervention did not lead to a higher overall score for self-perceived sleep; indeed, the mean score actually decreased from 6.73 (SD 1.74) in the pre-intervention period to 6.06 (SD 2.25) after implementation of the plan ($p = .005$). This assessment did not show significant differences by age ($p = .22$), sex ($p = .72$), hospitalization area ($p = .29$) or length of stay ($p = .34$). Regardless of taking sleep medication or not, overall score for self-perceived sleep worsened in both periods ($p = .086$). The patients taking medication for sleep had a poorer overall score for self-perceived sleep (Table 4). But it did significantly decrease sleep disturbances during admission ($p = .008$).

4 | DISCUSSION

We observed a high incidence of sleep disturbances in oncohaematological inpatients, affecting more than 60% of people during their hospital stay, in line with other published studies (Lei et al., 2009). However, few studies have focused specifically on sleep in patients in long-term care units or with cancer; most have taken place in critical care units with high technology (Lee et al., 2007). Our study shows that a participatory action research-based intervention can reduce the noise generated by professionals which disturbs patients' sleep; however, there are additional disruptive agents that require other interventions.

Our results highlight the multifactorial nature of sleep alterations in oncohaematological inpatients. The presence of pain or clinical devices is some of the main causes of impaired sleep, as reported

TABLE 1 Areas for improvement and interventions implemented

Area for improvement	Corrective measure
Domain 1: professionals	
Noise during the shift change	Review and adherence to briefing spaces in 4 different areas Limitation on information-sharing in corridors
Noise among professionals	Promote a noise-free environment by engaging staff leaders and raising awareness of the new project: delegated sleep teams Review and reach consensus on staff rest hours and capacity to facilitate coverage Monitor the use of alerts among professionals in corridors by delegated team Closed office doors during professional rest periods Use of professional locator in the patient's room. Review and improve practices related to presence
Cleaning staff	Include cleaning staff in the project. Modify the space for preparing buckets and cleaning material
Noise in the work room for residents	Integrate noise reduction in the project
Domain 2: care procedures	
Scheduling of care procedures	Review treatment schedules if necessary Take vital signs at least once every 24 hours, according to the patient's profile. Avoid systematization Review intervals for receiving laboratory samples and customize if necessary. Systematic review of serial tests Use of flashlights and adjustment of head lights
Domain 3: instruments/environment	
Poor door closing Poor weather	Corrective actions for maintenance or substitution Use of rubber rather than metal gaskets on the floor
Infusion pumps with frequent acoustic alerts	Infuser model change with volume control for acoustic signalling and light. Request for remote monitoring on PC Implementation of systematic surveillance rounds to check infusers along with other healthcare dynamics
Acoustic signal bells at control desk	Substitution of public address system with open switchboard for a switchboard with an individualized telephone terminal for each professional Implementation of the bathroom call bell at nursing control desk Installation of glass partitions at nursing control desk Establishment of staggered shift changes and monitoring of call bells by nurse assistants Incorporation of a light signal in the office and control desk to reduce the volume of the bells at night. Intercom in bathroom Accompaniment during bathroom visits
Use of clinical tools, dressing carts, and clothing	Modification of the clothing reception schedule in the unit from 6:00 AM to 7:30 PM Change of staff linen trolleys with revision and provision per shift at fixed location, allowing free access Promote tool-free spaces
Domain 4: patients and family members	
Noise from interaction between patient and families	TV volume. Facilitate the use of headphones, acquisition by the hospital Regulate visitor policies: change in the regulations to limit visits to one companion per patient and establish visiting hours. Personalization in special cases Reformulation of the welcome sheet to include new tips for preserving the environment and reducing noise Educate visitors to keep the environment noise-free: use of posters in the unit and rooms. Monitoring by delegated sleep team Avoid mobile phone use and ringtones in corridors: include guideline on welcome sheet and posters. Monitoring by delegated team In welcoming the patient and family, present the unit as being committed to comfort and sleep Indicate/agree with the accompanying relative on the time that the professionals will visit the patient; so that they can go to the waiting room or cafeteria Redirect companions to the waiting room during patient examination Do not share information in hallways. Establish information room and hours for interviews with families

previously by Ritmala-Castren et al. (2021), who concluded that there was a correlation between the presence of pain and the decline in patient sleep, based on data similar to ours.

Pain is one of the most prevalent symptoms in cancer patients, affecting around 70% of patients; so, its optimal management is essential and will have a direct impact on the patient's sleep (Neufeld et al., 2017). This source of sleep disruption is closely linked to the characteristics of hospitalized patients and secondary to the exacerbations or discomfort present. Future studies must consider this important factor of discomfort and involve pain management specialists as part of the comprehensive care offered during hospitalization.

In addition, medical devices are another key factor disturbing the sleep of oncohaematological patients. The high frailty of cancer patients, who are usually on high-risk treatments such as opiates or chemotherapy, which must be administered using infusers, presents a barrier that is difficult to overcome. The impact of technology on patient sleep has been widely reported in settings such as the ICU (Dobing et al., 2016; Fillary et al., 2015; Hu et al., 2015; Huang et al., 2015; Kamdar et al., 2013) but less so in oncological settings like ours. The implementation of improvements in the critical care environment has had a low impact, in consonance with our results. It is necessary to develop new remote alert mechanisms outside the patient's room to reduce the impact of these disturbances, with a signal directed specifically to the professional in charge in order to enable rapid clinical intervention.

TABLE 2 Areas for improvement identified by patients in pre-intervention phase

Areas for improvement
Avoid the presence of children in the unit, especially their playing in corridors
Maintain TV schedule established out of respect for the roommate
Improve heating and air conditioning
Reduce noise from infusion pumps and monitors
Turn off hallway lights to improve sleep
Close unit and room door at night
Reduce noise during the afternoon
Reduce noise from carts and other furniture
Isolate ventilation noise from the transfer area
Avoid forming groups of staff next to the rooms
Regulate the number of visitors and their ages
Reduce the volume of professional conversations at night when taking the elevator
Reduce the number of family members and the presence of children
Reduce noise during shift changes
Reduce the volume of the voices of professionals at night
Avoid collisions with carts
Modify the light intensity at the head of the bed
Find a space for medical information other than the corridor

Our results showed that a high percentage of oncohaematological inpatients were prescribed sleeping pills. Recent systematic reviews have supported the effectiveness of these drugs compared with other types of therapies for managing insomnia in cancer patients (Cheng et al., 2021; Yang et al., 2021), which is consistent with our findings. This result may be related to the scarcity of existing evidence on non-pharmacological measures, such as relaxation techniques, music therapy and exercise for improving sleep quality (Liu et al., 2019; Natale et al., 2019; Samuel et al., 2021). Studies have actually been conducted on the non-pharmacological treatment of sleep disorders in cancer patients (although few), which have shown how cognitive-behavioural therapy of sleep disorders (CBT) can improve the therapeutic response anti-cancer, reduce comorbidities and improve the quality of life of patients and caregivers (Melton, 2018).

Finally, our study illustrates the benefits of participatory action research for planning improvements in clinical practice. Despite some promising results, follow-up is needed to assess the long-term impact. To improve the dynamics of hospitalization units, healthcare administrators must reflect on the need to integrate systems for greater professional participation in decision-making into current management models (Reeves et al., 2017). Likewise, efforts to improve patient sleep must include a comprehensive approach to pain management, including pharmacological treatments and other strategies proven to increase comfort and reduce pain or anxiety—factors that our study shows can directly impact the patient's sleep (Bradt et al., 2016).

5 | LIMITATIONS

This study is not without limitations. First, the main outcome variable is a subjective, patient-reported measure. However, it was based on two validated sleep scales, and the main variables

TABLE 3 Sociodemographic characteristics of participants, by study period

Variables	Pre-intervention N = 120	Post-intervention N = 198	p value
Age in years, mean ± SD	62.8 ± 13.6	62.5 ± 13.8	.57
Length of stay in days, mean ± SD	14.8 ± 13.6	11.6 ± 11.2	.029*
Gender[†], *n* (%)			.80
Men	68 (58.11%)	118 (59.59%)	
Women	49 (41.89%)	80 (40.41%)	
Hospitalization area[†], *n* (%)			.89
Oncology-palliative care	72 (60.50%)	117 (59.69%)	
Haematology	47 (39.49%)	79 (40.31%)	

Note: Chi^2 and *t*-student test, significant at the 0.05* level.
Abbreviation: SD, standard deviation.
[†]*N* = 315.

TABLE 4 Sleep-related characteristics in participants, by study period

Variables	Pre-intervention	Post-intervention	p value
Alterations during their admission	81 (71.1%)	109 (55.9%)	.008*
Woke during the night, n (%) (N = 311)			.80
Yes	108 (93.1%)	180 (92.3%)	
No	8 (6.9%)	15 (7.7%)	
Times they woke up during night, mean ± SD (N = 318)	3.4 ± 1.8	3.4 ± 2.4	.89
Hours of nightly sleep, n (%) (N = 314)			.94
> 8	17 (14.7%)	27 (13.6%)	
6 to 8	39 (33.6%)	70 (35.4%)	
< 6	60 (51.7%)	101 (51.0%)	
Felt rested upon waking, n (%) (N = 311)			.66
Yes	69 (60.0%)	112 (57.1%)	
No	46 (40.0%)	84 (42.9%)	
Took sleeping pills during admission, n (%) (N = 315)			.088
Yes	64 (54.2%)	126 (64.0%)	
No	54 (45.8%)	71 (36.0%)	
Overall self-perceived quality of sleep (0–10), mean ± SD (N = 295)	6.73 ± 1.74	6.06 ± 2.25	.007*
Yes sleeping pills	6.40 ± 1.42	5.98 ± 2.61	.171
No sleeping pills	7.10 ± 1.98	6.20 ± 2.38	.031*

Note: Application of Chi-sqaured and t-student test. Significant at the 0.05* level.
Abbreviation: SD, standard deviation

TABLE 5 Main causes of self-reported sleep disturbances before and after implementation of improvement plan

Cause of disturbance, range 0 (no disturbance) to 10 (great disturbance)	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p value
Domain 1: professionals			
Noise generated by shift			<.001*
Morning	4.11 ± 2.72	3.01 ± 2.62	
Afternoon	3.99 ± 2.87	2.72 ± 2.43	
Night	2.76 ± 2.75	1.52 ± 2.02	
Professional conversations in the corridor	2.06 ± 2.67	1.55 ± 2.38	.092
Noise made by cleaning staff	1.42 ± 2.12	1.35 ± 2.82	.77
Shift changes	2.41 ± 2.97	1.33 ± 2.20	.001*
Noise made by kitchen staff	1.21 ± 2.05	1.04 ± 2.09	.48
Professional conversations at control desk	1.90 ± 2.69	1.04 ± 2.09	.003*
Domain 2: care procedures			
Infuser alarm	4.29 ± 3.41	3.48 ± 3.29	.035*
Professional interruptions	2.60 ± 2.51	1.61 ± 2.25	.001*
Medication carts	1.72 ± 2.30	1.13 ± 1.97	.022*
Domain 3: instruments/environment			
Temperature	2.92 ± 2.99	2.21 ± 2.67	.034*
Comfort of bed	2.46 ± 2.72	1.99 ± 2.55	.13
Call bells	2.39 ± 2.70	1.74 ± 2.58	0.037*
Corridor light	2.70 ± 2.93	1.56 ± 2.56	.001*
Heating or air conditioner devices	2.16 ± 2.64	1.49 ± 2.58	.028*
Room light	2.35 ± 3.02	1.41 ± 2.13	.004*
Cleaning carts	1.70 ± 2.27	1.11 ± 1.95	.021*

TABLE 5 (Continues)

Cause of disturbance, range 0 (no disturbance) to 10 (great disturbance)	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p value
TV in the room	1.54 ± 2.38	1.01 ± 2.04	.050*
Linen carts	1.59 ± 2.35	0.93 ± 2.07	.015*
Domain 4: patients and family members			
Pain or discomfort	4.36 ± 3.10	3.96 ± 3.16	.29
Visitors in the corridor	2.81 ± 2.80	2.55 ± 3.17	.48
Anxiety-fear	2.50 ± 2.82	1.69 ± 2.56	.013*
Roommate	1.79 ± 2.59	1.51 ± 2.31	.34
Noise made by roommate's relatives	1.96 ± 2.59	1.47 ± 2.30	.091
Noise made by own relatives	1.06 ± 2.01	1.08 ± 1.98	.94

Note: Application of t-student test. Significant at the 0.05* level.
Abbreviation: SD, standard deviation.

TABLE 6 Correlation study between variables affecting sleep and overall self-perceived sleep following implementation of improvement plan

Variables	Correlation with self-perceived sleep	95% CI for ρ	p value
Domain 1: professionals			
Professional conversations in the corridor	−0.237*	(−0.335, −0.128)	<.001*
Professional conversations at control desk	−0.202*	(−0.311, −0.094)	<.001*
Noise made by cleaning staff	−0.201*	(−0.307, −0.096)	<.001*
Shift changes	−0.133*	(−0.248, −0.013)	.021*
Noise made by kitchen staff	−0.077	(−0.193, 0.030)	.19
Domain 2: care procedures			
Infuser alarm	−0.162*	(−0.273, −0.052)	.005*
Medication carts	−0.150*	(−0.247, −0.044)	.010*
Professional interruptions	−0.135*	(−0.236, −0.022)	.020*
Domain 3: instruments/environment			
Corridor light	−0.294*	(−0.287, −0.061)	.002*
TV in the room	−0.279*	(−0.382, −0.166)	<.001*
Room light	−0.179*	(−0.395, −0.192)	<.001*
Temperature	−0.103	(−0.226, −0.005)	.074
Linen carts	−0.102	(−0.210, 0.006)	.082
Cleaning carts	−0.093	(−0.203, 0.011)	.11
Call bells	−0.072	(−0.184, 0.036)	.22
Heating or air conditioner devices	0.011	(−0.109, 0.128)	.85
Domain 4: patients and family members			
N times woke during the night	−0.447*	(−0.557, −0.341)	<.001*
Pain or discomfort	−0.404*	(−0.501, −0.295)	<.001*
Anxiety-fear	−0.229*	(−0.335, −0.117)	<.001*
Noise made by own relatives	−0.219*	(−0.320, −0.109)	<.001*
Noise made by roommate's relatives	−0.208*	(−0.315, −0.100)	<.001*
Roommate	−0.189*	(−0.300, −0.076)	.001*
Visitors in the corridor	−0.165*	(−0.285, −0.055)	.005*
Length of hospital stay	−0.126*	(−0.248, 0.003)	.034*
Age	0.053	(−0.624, 0.176)	.36

Note: Test Spearman's rho Correlations. Correlation is significant at the 0.05 * level.
Abbreviation: CI, confidence interval.

described in the literature were included in the questionnaire. In addition, it was not possible to measure the intensity of different sources of noise objectively, for example through decibel measurements (with a sound level meter) since it was impossible to distinguish between different acoustic measurement areas in the unit without interfering with the dynamics of care. The study did not carry out an assessment of sleep disorders with a sleep expert who could have evaluated other common sleep disorders in patients with haematological tumours, such as sleep movement disorders, which among other things are very disabling, if not treated properly, for the quality of life of patients. Another limitation was the study's single-centre design; however, for the purpose of the study, it made no sense to include other centres, since the measures applied would surely have varied by centre.

On the contrary, strengths of the study include its pioneering nature at the international level in terms of its setting in oncohaematology wards. The study is represented by the large case history in a long follow-up period. Moreover, it develops a line of research that can be applied in the future to other units and patient profiles with sleep alterations during their admission.

6 | CONCLUSION

Sleep disorders in hospitalized patients are multifactorial, with pain and clinical devices, together with the noise made by professionals, standing out as the main causes of altered sleep patterns. The noise reduction approach requires multiple strategies, both in technological development through remote and direct monitoring of the professionals responsible for care, as well as the involvement of professionals in decision-making and regulation of care behaviours. Given the incidence of impaired sleep-in hospitalized patients, it would be necessary in the future to implement multidisciplinary teams that deal with the correct management of sleep disorders.

Engaging professionals and patients in planning improvement actions to make the environment less noisy and more comfortable are relevant and help reduce environmental disturbances (noise and light).

7 | RELEVANCE TO CLINICAL PRACTICE

There are few studies on sleep alterations in oncohaematological patients, despite the increasing incidence of cancer worldwide. The oncohaematological patient is a highly complex patient, both due to their physical and emotional frailty, as well as the symptomatology and therapy associated with the disease, an aspect that may determine future interventions to improve sleep.

This study clearly identifies the areas causing the greatest sleep disturbance and offers new strategies for modifying clinical practice. Staff awareness of patient sleep is essential for a healthy, noise-free environment. The PAR methodology has proven to be an effective method of attitudinal change. However, a multidisciplinary and comprehensive approach is required that encourages sleep for the patient and reduces other disturbing sources that are difficult to manage, such as pain.

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CONFLICT OF INTEREST

No conflict of interest of the authors.

AUTHOR CONTRIBUTIONS

Sandra Cabrera-Jaime and Laura Cabrera-Jaime involved in conceptualization, methodology, formal analysis and writing original draft. Ana Belén Manrique Palles, Verónica Gonzalo Bachiller, Nuria Zarza Arnau, Luis Martin, Inmaculada Artiga Sarrion, Noelia Tierno Sanchez, Joaquim Julià Torras and Juan Manuel SANCHO involved in investigation of the study. Cristina Martinez-Martinez involved in writing—review.

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