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Original Article

Environment in pediatric wards: light, sound, and temperature

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ABSTRACT

The mutual relationship between sleep and disease is well known, becoming more relevant whenever the disease leads to hospitalization. We intend to describe patterns of environmental factors of some pediatric wards, and to verify if these are in line with those recommended. As a secondary aim, we characterize sleep quality during hospitalization.

Methods: Five pediatric wards of a tertiary-level hospital were included. Light, sound, and temperature were measured and assessed through descriptive statistics. The following recommended values were considered: maximum light 100 Lux, maximum sound 45 dB, and optimal temperature 20–24 °C. A questionnaire was prepared to assess children's sleep, and it was completed by a caregiver.

Results: Light values were within the desirable limits for 86% of evaluated time. In all wards, the intensity of sound was much higher than desirable, being above 45 dB during 85% of evaluated time. The temperature was above 24 °C during 78% of total time.

Based on 34 answered questionnaires (out of 50 distributed), almost half of the respondents believe that sleep quality and restlessness are worse at the hospital. Most children slept for a longer time at home. Eighteen children awoke more times at the hospital, and those awakenings were mostly attributed to noise.

Conclusions: The sound and temperature were higher than recommended. The different values between these wards may be due to different levels of care, but this shows that there are no standard rules on this matter. A worse quality and shorter duration of sleep at hospital were reported. Comprehensive studies are necessary to evaluate the impact of environmental factors on disease recovery.

1. Introduction

Sleep is a complex and essential biological process that is required on a daily basis for all humans regardless of age, sex, or ethnic origin [1]. Learning, memory processing and consolidation, cellular repair, and brain development are among the most important functions of sleep [2–4]. Moreover, sleep quality affects health and neurodevelopment in several ways. In addition to maintaining normal brain functioning, sleep has important roles in controlling the functions of many other body systems, which become more evident in states of sleep deprivation [1]. The linkage of sleep to immune functioning and healing in patients is well known: compromised sleep can lead to a deregulated immune function with increased inflammatory markers and impaired neuroendocrine regulation, which can affect growth and healing [1,5]. People who are sleep deprived experience more depression [6], obesity [7], hypertension [8], dyslipedemia [8], and diabetes mellitus [9].

Sleep disturbances are prevalent in hospitalized patients [10]. Whenever disease leads to hospitalization, daily routines are modified, and there are several sleep disruptors that can lead to sleep deprivation, accentuating the relationship between sleep and health.

Among sleep disruptors during hospitalization, we have found those resulting from the underlying disease, such as pain and discomfort, and those resulting from hospital environment, including break in daily routines, strange environment, people talking in the hallway, vital sign checks, medical and nursing procedures, noise, light, and temperature. An observational study that assessed sleep in a pediatric intensive care unit, monitoring children while asleep, revealed that noise, light, and contact with caregivers were significant predictors of sleep [11]. It is therefore up to health professionals to provide an adequate nighttime care environment that promotes a restorative sleep. A disruptive nighttime care environment can compromise both sleep quantity and quality in acutely ill children [12–14].

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Sleep complaints during pediatric hospitalization are common; however, few studies have focused on sleep conditions in pediatric wards, in a non-intensive care setting. Some studies with different sleep assessment methods, focused on adults' nurseries [10], intensive care units [11], or hospitalized children with cancer [15], showed shortened sleep duration, increased night awakenings, shorter total sleep, and greater day fatigue. However, these are studies targeted at a limited age range, specific inpatient units, or single disease, and they cannot be generalized to all hospitalized pediatric population. Another study [16] based on a self-reported survey completed by parents focused on patient's and parents' sleep in a hospital, with a broad range of ages and units, and it showed that sleep patterns were significantly different during hospitalization, with younger children reporting a later bedtime, later wake time, more night awakenings, and shorter total sleep time, and older children reporting a significantly later wake time, more night awakenings, and longer total sleep time. In that study, 14% of 72 children took medication for sleep while hospitalized (against 2% at home).

Although based on different measures, studies investigating nighttime sound and light intensities in pediatric and adult critical care settings have identified a different environment from that recommended by the World Health Organization (WHO) for health-care settings [11,13,14,17–19]. These studies identified increased sound and light levels, as well as interactions with health-care providers, as significant predictors of fewer nighttime sleep minutes and increased sleep fragmentation [5,11,12]. Other potential source of disturbed sleep is temperature variation; a study [15] investigating temperature in a specific pediatric ward showed that the average nighttime temperature was close to the upper threshold for recommended room temperature for healthy sleep [20] but without significant fluctuations.

Extensive research and literature in the field of sleep medicine have been published; however, we still lack information on some aspects of sleep during hospitalization. According to different sources, desirable luminosity levels should be between 5 Lux at night and 100 Lux [21,22] during day; sound levels should be between 30 and 35 dB with acceptable peaks of 45 dB [23]; and temperature should be between 20 and 24 °C [20,24]. Adequate levels of sound, light, and temperature are essential to recovery.

To our knowledge, aside from the study based on hospitalized children with cancer [15], no other studies have investigated light, sound, and temperature levels in non-intensive pediatric general wards. We intend to verify if the hospital environment in specific non-intensive pediatric wards is in line with recommended ranges of light, sound, and temperature for hospital settings.

1.1. Aims

The first aim of this study is to describe nighttime and daytime patterns of environmental factors (light, sound, and temperature levels) at the bedside of hospitalized children and at the hallways of different pediatric wards, and to verify if these are in line with those recommended.

A secondary aim of the study is to characterize sleep quality of hospitalized children, in comparison with nighttime sleep at home, and to identify potential sleep disruptors.

2. Materials and methods

All five pediatric wards (including four medical and one surgical) of a tertiary-level hospital were included, each one identified by a letter (A–E). The surgical ward, with seven rooms, most of them being shared, accommodates children during the perioperative period for acute and elective surgeries and traumatic lesions. The medical wards are divided among different pathologies: general pediatrics, hematology, and neurology (nine rooms); infectious diseases and gastroenterology (10 rooms); nephrology (four rooms) and respiratory diseases (six rooms); non-invasive ventilated children are accommodated in the respiratory diseases ward. Most rooms are shared; some have private bathroom and all have at least one window. Only parents or relevant caregivers are allowed to stay with children in wards (two people from 8 am to midnight, and one during the night). In order to distinguish and characterize the different environments inside the ward, we assessed two different places – room and hallway. We excluded intensive care units (pediatric and neonatal) for their particular characteristics, regarding severity of disease and conditions of sleep.

We considered three periods of the day, according to different levels of disturbance at ward: daytime (7 am to 8 pm) – the busiest period, with more people within the ward; evening (8 pm to 11 pm) – a quieter period, but with dinner and therapeutics administration time; and nighttime (11 pm to 7 am) – the main rest period. The measured values were grouped within these three periods. The evaluation was made during working days.

Institutional review board approval was granted for this study. Parental consent was obtained for questionnaires.

2.1. Assessment of environmental variables

Measurement equipment was placed on one room per unit (randomly chosen, not single and without private bathroom inside) and on hallway (a general thoroughfare), kept out of reach or sight of children and adults. It was placed on the bedside of the patient inside the room, and it was hidden on the hallway in a corner up the suspended ceiling.

2.1.1. Light

Light was measured using a luxmeter Optronics Laboratories®, OL 730 CV. The measurements were obtained at 250-ms intervals, and they were stored in the internal memory of a personal computer. The values were regrouped in 5-min intervals, throughout each day (24 h) for 3 days. The data logger's light sensor measures light intensity with a range of 0–7000 Lux with a 0.01-Lux resolution and an accuracy better than 2%. The sensor dimensions are 37 mm diameter and 47 mm height. The device is traceable to international standards by Instituto de Soldadura e Qualidade (ISQ) – Laboratório de Metrologia Electro-Física, Portugal.

2.1.2. Sound

Sound was measured using an integrating sound level meter, 01 dB, model Symphonie®, with type approval. The equipment is periodically calibrated according to the plan, by an accredited laboratory. Sound measurements were obtained at 200-ms measuring rate intervals, in Leq mode, and they were stored directly in the computer to which Symphonie® was connected. The values were regrouped in 5-min intervals, throughout each day (24 h) for three days. The sound pressure level meter measures values on a range from 20 to 135 dB, at 0.1-dB resolution. The equipment complies with the requirements of International Electrotechnical Commission (IEC) 61672 for class 1 accuracy. This device is designed for the measurement of building acoustics, ambient and incommodity noise in residential, industrial, and commercial settings, and traceable to international standards by ISQ – Laboratório de Metrologia Electro-Física, Portugal.

2.1.3. Temperature

Temperature was measured using a data logger device, Ibutton®, DS1922l-F50, obtained at 30-s intervals, and it was stored in the internal memory and then downloaded to a computer. The values were regrouped in 5-min intervals, throughout each day (24 h) for three days. The data logger's temperature sensor measures from 0