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Effect of "quiet time" to reduce noise at the neonatal intensive care unit

Efeito do "horário do soninho" para redução de ruído na unidade de terapia intensiva neonatal

Efecto del "horario del sueño" para la reducción del ruido en la unidad de cuidados intensivos neonatal

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Abstract

Objective: To identify and compare the Sound Pressure Levels (SPL) inside the incubators at an NICU with and without the quiet-time intervention. **Methods:** Quantitative, descriptive research project conducted at the NICU of a university hospital. A Quest 400 noise dosimeter was used for data collection. The sample comprised 261 hours of registers. **Results:** The results show that at the times pre-established for the interventions, the highest average equivalent noise pressure level ($Leq_{average}$) were 58.5 dBA in room A and 53.1 dBA in room B. During other periods, a mean equivalent continuous noise level ($Leq_{average}$) of 79.7 and 74.3 dBA was measured in both rooms, respectively. **Conclusion:** During the intervention periods, the SPLs are in accordance with the levels recommended by regulatory agencies, which reinforces the efficacy of quiet time. However, results point to the need to improve the acoustic profile of the neonate's micro and macro environments, since these work as an interrelated system.

Keywords: Sleep; Humanization of care; Neonatal Nursing; Noise; Newborn.

Resumo

Objetivo: Identificar e comparar os Níveis de Pressão Sonora (NPS) no interior das incubadoras de UTIN com e sem a intervenção dos "horários do soninho". **Métodos:** Pesquisa quantitativa, descritiva realizada em UTIN de um hospital universitário. Utilizou-se dosímetro Quest 400 para a coleta de dados. A amostra constituiu-se de 261 horas de registros. **Resultados:** Os resultados indicam que nos horários determinados para a intervenção, os maiores níveis de pressão sonora equivalente médio ($Leq_{médio}$) foram 58,5 dBA na sala A e 53,1 dBA na B, fora desses períodos obteve-se um nível de ruído contínuo equivalente médio ($Leq_{médio}$) de 79,7 e 74,3 dBA, respectivamente. **Conclusão:** Nos períodos de intervenção os NPS estão em consonância ao recomendado pelos órgãos regulamentadores o que reforça a efetividade do "horário do soninho", porém os resultados demonstram a necessidade de melhorar o perfil acústico do micro e macro ambiente do neonato, visto que funcionam como um sistema interrelacionado.

Palavras-chave: Sono; Humanização da Assistência; Enfermagem Neonatal; Ruído; Recém-nascido.

Resumen

Objetivo: Identificar y comparar los Niveles de Presión Sonora (NPS) en el interior de las incubadoras de una Unidad de Cuidados Intensivos Neonatal con y sin la intervención de los "horarios del sueño". **Métodos:** Investigación cuantitativa, descriptiva, realizada en UCIN de un Hospital Universitario. Se utilizó el decibelímetro Quest 400 para la colecta de datos, con 261 horas de registros. **Resultados:** En los horarios determinados para las intervenciones, los mayores NPS equivalente promedio (Leq_{medio}) fueron 58,5 dBA en sala A y 53,1 dBA en la B, fuera de estos períodos obtuvieron un Leq_{medio} de 79,7 y 74,3 dBA, respectivamente. **Conclusión:** En los periodos de intervención, los NPS están en consonancia con el recomendado por los órganos reguladores, lo que refuerza la efectividad del "horario del sueño". Sin embargo, hay que mejorar el perfil acústico del micro y del macro ambientes del neonato, visto que funcionan como un sistema interrelacionado.

Palabras-clave: Sueño; Humanización de la Atención; Enfermería Neonatal; Ruido; Recién Nacido.

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INTRODUCTION

Neonatal intensive care units (NICU) started to appear in the mid-1980's, due to the need to increase the survival of infants who needed high-risk care[1]. Since then, the growing technological evolution substantially modified these units' ecology, transforming them into a chaotic environment with high sound pressure levels (SPL), uninterrupted luminosity and an intense work rhythm. This environmental situation significantly compromises the health of the patients and the work team[2].

In the NICU environment, the different noise sources sometimes reach such high SPL that they can also negatively affect the newborns' development[2].

For the infants, especially when premature, the prolonged exposure to high noise levels is potentially dangerous, as it can injure the cochlea, cause hearing loss and predispose to intraventricular hemorrhage. In addition, increased oxygen consumption and heart frequency are observed, which result in a greater demand for energy and delayed weight gain, consequently extending the hospitalization period. On the other hand, the infants' long stay in a very noisy environment can trigger bradycardia and apnea[2]. Noise can also act as one of the most disturbing components of infants' sleep and rest rhythm at NICU. High SPL at the NICU interfere in the deep sleep, which plays a fundamental role in the maturing of the infants' brain functions. In addition, sleep disorders can cause changes in the thermoregulation, in the production and release of some hormones, and compromise the infants' immunity. Sleep and rest disorders can provoke agitation, irritability, crying and a consequent increase in intracranial pressure[2].

Departing from the confirmation of the adverse effects if high noise levels associated with the NICU environment on the hospitalized infants and to improve the care for infants, interventions have been implemented, including architectonic changes, use of less noisy equipment, luminosity control, minimal handling of the infants and educative programs for the family and the multiprofessional team[3,4].

The developmental care focus was introduced in the 1980's, as a strategy to change the NICU's environmental conditions, aiming for the infants' wellbeing and safety, with the following central objectives: respecting the infant's rhythm, controlling the handling by the caregivers and modulating or mitigating the infant's responses to care[5]. Hence, the quiet time was implemented at the NICU as a strategy that involves: reduced luminosity and noise and minimal handling of the infant during certain periods of the day, so as to provide better environmental conditions for the infants' rest[6,7].

This strategy is developed at the NICU of a university hospital where the researchers are active, where it is called "nap time". Based on the neonatal routine care demands, the unit determined four one-hour periods throughout the day as "quiet time". During these times, the central lights in the room are turned off, using only natural light during the day and the corridor light at night. The nursing team groups the care before the start of the intervention and, during this period, any elective procedures are avoided. The professionals and family attempt to remain silent and minimize any actions that cause noise. In view of the above and considering the results of SPL measures at the NICU[8] and inside the service's incubators[9] and the implementation of the "quiet time", the following question is raised: how does this intervention contribute to an acoustically more appropriate environment for the infants? The objective in this study was to analyze the effect of the "quiet time" intervention on the noise pressure levels (SPL) inside the incubators of a neonatal intensive care unit.

METHOD

A descriptive study was undertaken inside the incubators of two rooms (A and B) at a Neonatal Intensive Care Unit of a university hospital in São Paulo - SP (Brazil), with tertiary and quaternary hospital care levels and considered a referral institution by the Brazilian Ministry of Health. Inside the incubators in both rooms, critically ill full-term and preterm infants are hospitalized, who demand intensive care. Each of these rooms can hold four beds, but sometimes this number is exceeded due to the high demand. The floor inside the rooms is made of vinyl, with brick walls, concrete roof, glass windows that are kept permanently open, exposing the environment to intense noise from public roads. The room doors are made of wood, without a buffer for closing; they tend to remain closed during "quiet time". Each room has two sinks without anti-noise coverage material, located near the beds. The service has no preventive maintenance of the incubators and other equipment at the unit, and the two environments are not climate-controlled. The model of all incubators is Fanem® C186T S, with single walls and an average 15 years of use. It is highlighted that, while the infant stays inside the incubator, part of the acrylic dome remains covered with dark-colored cotton tissue.

Four daily "quiet times" are established in each room: morning from 10h till 11h, afternoon from 16h till 17h, night from 22h30h till 23h30h and from 4h till 5h, totaling 28 hours per week among the three shifts. The service set these times in accordance with the demands of routine care delivery to the infants. On some occasions, compliance was impossible though, due to the need for emergency care to an infant. In compensation, when the infants' conditions permit this, the quiet period is expanded. The start and end of the "quiet time" was registered during the data collection.

The SPL registered were obtained with the help of a Quest 400 dosimeter. The researchers were previously trained to change the batteries, transfer data to the computer and calibrate the device. The dosimeter battery was change daily. The device was calibrated three times per day, at the start of each shift, using the QC-10 calibrator. During the collection period, the data were transferred from the dosimeter to the computer

each day. Before introducing the microphone inside the incubator, it was disinfected and then introduced inside the acrylic dome through an entry hole. The microphone was fixed at 20 centimeters from the infant's ear[8]. The dosimeter was configured in the compensation scale A and slow response. In that configuration, the SPL register is similar to the perception of the human ear and appropriate to monitor continuous sounds[10], which is indicated to measure continuous noise in the equivalent noise pressure level (Leq)[11]. The instrument was also programmed to operate within SPL intervals between 40 and 140 decibels (dB).

The research variables were: SPL during the shifts (morning, afternoon and night), during "quiet time" (intervention being assessed) as well as in other periods and on different weekdays.

To initially decide which incubator the dosimeter would be placed in, among the newborns in each room, the infant with the highest Score for Neonatal Acute Physiology Version II (SNAP II) was identified. This criterion was adopted because this score assesses the risk of neonatal mortality[12]. Thus, the SPL registers were obtained inside incubators with severe premature infants who were using different neonatal devices 24 hours per day. It is highlighted that the SPL registers were measured first in room A and later in room B. After getting authorization from the hospital board and the Research Ethics Committee at *Universidade Federal de São Paulo*, São Paulo - SP Brazil under Nº. 0391/07, the data collected was started, between January 12th and 25th 2009.

To reduce the estrangement and avoid any change in the professionals' behavior, which could distort the reality, before the start of the data collection, the device remained disconnected inside the incubator for four days[13].

At each room, the SPL was registered inside the incubator selected for the study during one week, sequentially, across all weekdays and work shift, so as to apprehend the variation in SPL according to the different daily routines.

In the data collection strategy, the device was expected to remain connected inside the incubator for 24 hours at each NICU room, during two consecutive weeks. The total number of hours of SPL registers was 336, 75 hours of which were discarded because of a technical measuring problem with the dosimeter, the needed to interrupt the collection because of the newborn's leave from the nursery for procedures, the child's transfer to another bed type and 30 minutes that were discarded at the start and end of each shift, in view of the possibility of provoking noise while handling the device for battery change and calibration. Therefore, the sample consisted of 261 hours of registers.

Among this total number of hours registered, 43 refers to the intervention periods analyzed as "quiet time", 21 hours in the incubators in room A and 22 hours in room B.

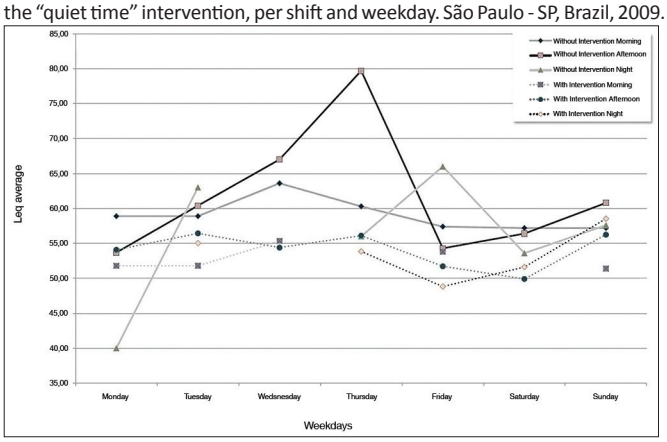
For the data analysis, the software Quest Suite for Windows was used to obtain the continuous SPL, Leq and their maxima and minima. Based on these data, the average Leq ($Leq_{average}$) were calculated for the incubators in rooms A and B, identifying the "quiet time" in comparison with the $Leq_{average}$ for the periods measured per workday and shift. The data analysis considered the differences obtained between the mean Leq during the "quiet time" and the total level for the period measured.

For the sake of analysis of the SPL, values below 58.0 dBA were adopted inside the incubator, according to the recommendation of the American Academy of Pediatrics (AAP).

RESULTS

At the incubator in room A, the highest $Leq_{average}$ registered was 79.7 dBA during the afternoon shift on Thursday, and the lowest was 53.6 dBA during the night shift on Saturday (Figure 1), showing a difference of 26.1 dBA.

Figure 1. $Leq_{average}$ dBA inside the incubators in NICU room A with and without the "quiet time" intervention, per shift and weekday. São Paulo - SP, Brazil, 2009.



During the "quiet time" intervention analyzed, however, the highest $Leq_{average}$ was 58.5 dBA on Sunday and the lowest 48.8 dBA on Friday, both during the night shift (Figure 1). The $Leq_{average}$ in this environment varied by 9.7 dBA.

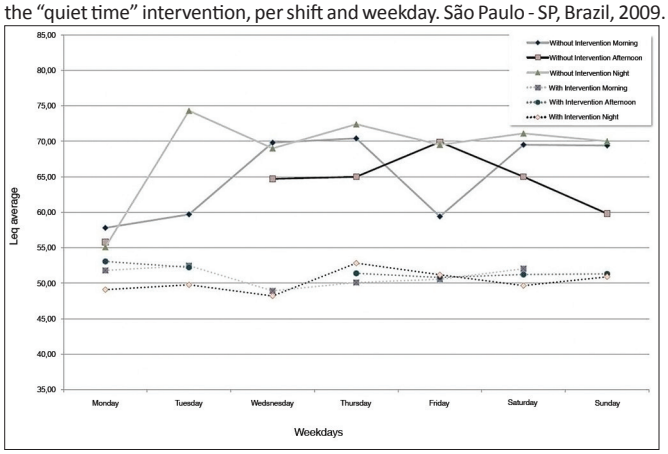
At the incubators in NICU room B, high $Leq_{average}$ were also verified. Throughout the entire SPL measuring period inside the incubator in that room, the highest $Leq_{average}$ was 74.3 dBA and the lowest 55.1 dBA, both measured during the night shift on Tuesday and Monday, respectively. The variation corresponded to 19.2 dBA (Figure 2).

Lower SPL were predominant during the "quiet time" at room B. As to the SPL measured inside the incubators during these periods, it was verified that the highest $Leq_{average}$ was 53.1 dBA on Monday afternoon and the lowest 48.2 dBA on Wednesday night (Figure 2). The variation in the $Leq_{average}$ at room B corresponded to 4.9 dBA.

DISCUSSION

The $Leq_{average}$ levels demonstrate that the "quiet time" effectively contributes to reduce the noise inside the incubators. Considering the highest $Leq_{average}$, a reduction by 21.2 dBA was found in

Figure 2. $Leq_{average}$ dBA inside the incubators in NICU room B with and without the "quiet time" intervention, per shift and weekday. São Paulo - SP, Brazil, 2009.



the SPL measured inside the incubators at room A and room B during the "quiet time". When comparing the lowest $Leq_{average}$, the reduction at room A corresponded to 4.8 dBA, against 6.9 dBA at room B. The importance of these results is highlighted as, on the logarithmic noise measuring scale in decibels, an increase or decrease by 3 dB means a rise or reduction by about 50% in the SPL. Thus, the quiet time favors greater acoustic comfort for the infant inside the incubator.

During the "quiet time" at rooms A and B, the SPL obtained inside the incubators are in accordance with the limits recommended by the Brazilian Association of Technical Standards (ABNT), which sets Leq levels below 60.0 dBA[14] for the interior of this equipment. On the other hand, when considering the American Academy of Pediatrics' (AAP) recommendation to maintain the SPL below 58.0 dBA as the maximum level permitted inside the incubator[15], at room A, the $Leq_{average}$ exceeded this limit (58.5 dBA) only once, on Sunday night.

In one study[16], in France, developed at an NICU, SPL levels were identified inside the incubator, involving extremely premature infants in environmental air, corresponding to 50.1 dBA; $Leq_{average}$ corresponding to 50.4 dBA for infants on mechanical ventilation; and $Leq_{average}$ of 59.3 dBA for infants receiving continuous positive airway pressure. When comparing these data with the present study, it was identified that the SPL registered are similar during the "quiet-time" intervention periods, but higher without the intervention.

It is known that the interaction among different stimuli provokes a cascade effect that enhances the SPL, that is, the higher the noise, the more the professionals tend to raise their voice. At the same time, the presence of luminosity at the NICU outside the "quiet time" can cause an increase in the SPL, due to the professionals' behavior of talking louder, performing the procedures in a less careful way, making the infants become more agitated and whining. A study found that the infant's agitation can increase the SPL inside the incubator by up to 20 dBA[17].

When considering the infant's wellbeing, however, it is important to highlight that the "quiet time" amounts to only four hours per day. Hence, they are exposed to high SPL about 20 hours per day. In this environmental condition, the habituation, which is defined as the infant's ability to reduce his/her behavioral response to repetitive stimuli, is compromised, which can make them respond to the very strong and continuing environmental stimuli until they are exhausted, causing greater energy spending and difficulty to remain sleeping[2].

In addition, although the incubator partially serves as a barrier against the penetration of environmental sounds, the sounds produced by its functioning and by the care applied to the child reverberate against the hard wall of the dome, amplifying the noise that reaches the infant[18]. The acoustic profile of the SPL inside the incubators could be more appropriate, however, if the length of use of the investigated incubators were smaller and if the service received preventive maintenance. A study[18] that measured the noise inside this equipment found a reduction by up to 4 dBA in the SPL of newer when compared to older incubators.

These study results reveal the daily profile of the acoustic ecology inside the incubators of the investigated NICU, considering that the sample included the three shifts on all weekdays during 14 days.

The high SPL inside the incubators detected in this research are also associated with the high noise levels found at the NICU where the study data were collected[8], as the environmental noise partially crosses the Plexiglas walls of the incubator domes.

CONCLUSION

During the "quiet time", the SPL are within the limits recommended by the Brazilian and international laws for the inside of incubators, which are the infants' microenvironment. Outside the "quiet time", however, the noise levels remain far from the recommended ideal. Therefore, the obtained results indicate the efficacy of the "quiet time" to reduce the SPL and the need for further interventions to improve the acoustic profile of the microenvironment. The implementation of educative programs for the professionals is suggested, as well as the elaboration and implementation of guidelines and the use of ear protectors for the infants. In addition, research should be developed at the NICU to measure the SPL during the intervention hours, correlating them with the noise sources, which represents a limitation in this research. At the same time, the sleeping patterns of hospitalized infants could be assessed.

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