

Original Paper

Noise Level at Neonatal Care Unit of Al-Sader Teaching Hospital in Misan Province, Iraq

Hussein Fadhil Musa Aljawadi^{1*}, Esraa Abd Al-Muhsen Ali ¹, Malik Hadi Mahmood²

¹Pediatrics Department, College of Medicine, Misan University, Misan, Iraq.

²Physiology Department, College of Medicine, Misan University, Misan, Iraq.

Abstract

Background: Preterm infants exposed to prolonged excessive noise are also at increased risk for hearing loss, abnormal brain and sensory development, and speech and language problems.

Aim of study: to determine noise levels in the neonatal care unit.

Materials and methods: A descriptive cross sectional study was conducted at neonatal care unit of Al-Sader Teaching Hospital in Misan Province, South East of Iraq during October/2015. A portable sound pressure level meter (sound level meter model SL-4010) was used to record sound level.

Results: The records of mean, maximum and minimum sound levels were high and mainly during day time at 10:00 a.m. ranging between 65.13 to 71.68, 78 to 83 and 47 to 61 decibel respectively which exceed the American Academy of Pediatric recommendations.

Conclusion: The noise level in the Neonatal Care Unit of Al-Sader Teaching Hospital was obviously high and did not meet the American Academy of Pediatric recommendation. A real effort is required to establish guidelines for noise reduction.

Key words: sound level, noise, decibel, neonate.

Introduction

Noise is an unwanted or objectionable sound. Generally, the acoustic signals that produce a pleasant sense (music, bells) are recognized as “sound” and the unpleasant sounds as “noise” (for example: produced by a machine) ⁽¹⁾. Physically, there is no difference between sound and noise. Sound is a sensory perception and noise corresponds to undesired sound ⁽²⁾. By extension, noise is any unwarranted disturbance within a useful frequency band ⁽³⁾. Sound is measured based on the amplitude and frequency of a sound wave. Decibel (dB) unit is used to measure sound pressure levels on a logarithmic scale ⁽²⁾. During last 2 decade there were an improvement in neonatal care especially premature infants and there are dramatic decline in neonatal mortality rate with advance of surfactant, ventilator support

and total parenteral nutrition as well as high standard of nursing care ⁽⁴⁾.

In addition to sophisticated medical and nursing care, there is importance of environment at neonatal care unit (NCU) in regard of noise level as one of essential factor influence in morbidity of premature or full term neonates that need admission long period of time at NCU ⁽⁵⁾. It is well known that sound levels in the neonatal intensive care unit (NICU) are a major source of environmental stress for premature infants ⁽⁶⁾. Excessive auditory stimulation creates negative physiologic responses such as apnea and fluctuations in heart rate, blood pressure, and oxygen saturation ^(7, 8). Preterm infants exposed to prolonged excessive noise are also at increased risk for hearing loss, abnormal brain and sensory development, and speech and language problems ^(9, 10). Fetuses born after 24 weeks have nearly complete cochlea and sensory organs, and

*For correspondence E-mail: drhussein1969@gmail.com

when born prematurely they are thrust out of the quiet atmosphere of the uterus into the noisy environment of the NICU ⁽¹¹⁾. The American Academy of Pediatrics (AAP) has recommended 45 dB as the maximum noise in the neonatal intensive care units (NICUs) and less than 35 dB is desired for sleep ⁽¹²⁾.

These levels, however, are frequently exceeded because "thousands of nurseries built during the 1970's or with 1970 era-designs and materials continue in use worldwide without modification to improve noise levels" ⁽¹³⁾. Studies from USA have shown that infants in NICU are continuously exposed to sounds of 50–105 dB ^(14, 15).

Sources of sound within the NICU are typically classified into two categories:

1. Operational sounds are those generated by the staff or equipment in the NICU, and
2. Structural sounds are those generated by the building as for example, sounds generated by ventilation, air conditioning systems, and doors ^(13, 14, 16).

Many policies have been designed to eliminate sources of noise and hence reduce sound levels; through educational program ^(15, 17) and behavioral modification for staff ^(18, 19), structural modification and reconstruction of NICU ⁽¹⁴⁾.

Reducing noise levels and ensuring greater quiet time for premature infants have been shown to increase their overall development and weight gain and reduce the length of their hospital stay ^(20, 21).

The purpose of this study is to determine the noise level at the NCU to have an idea about how this issue is concerned in daily practice.

Materials and methods

A descriptive cross sectional study was conducted at NCU of Al-Sader Teaching Hospital in Misan Province, South East of Iraq during October /2015. The study protocol was reviewed; approval and official permission were obtained from the Ministry of Higher Education, Misan

directorates of health and Al-Sader Teaching Hospital to conduct the present study.

Description of NCU at Al-Sader Teaching Hospital: This hospital was established in 1986 in last century. The average number of neonates in the NCU at a given point of time is 10 (range 8-12).

The NCU which is just beside the labour room consists of 3 nursery rooms and a hall:

- Room No.1: is large one contains; seven incubators with monitors as well as two ventilators and two continuous positive airway pressure (CPAP).
- Room No.2: contains five incubators, two CPAP and one resuscitator.
- Room No.3: is resuscitating room which receives newborns infant before shifting to incubators and it also contains three resuscitators, drug cabinet and three suction machines.
- Finally, a hall (nursing station) which is in front of the three rooms and consist of table, chairs, telephone and sink as well as there is a side room beside nursing station for the staff . As shown in figure 1.

Instrument and procedure: A portable sound pressure level meter (sound level meter model SL-4010) was used to record sound level. This device records a sound range of 35-135 dB ⁽²²⁾ as shown in figure2.

The following steps were carried out to measure noise level:

- The noise level measurements were performed by the researchers.
- Recording sound level at different time of the day by choosing a three periods of one reading each time (10:00am, 5:00pm, 10:00pm) including a total of one month duration (October 2015).
- These measurements did not interfere with the work of the nursing staff so the usual procedures, activities and behavior were involved in this study.

Data analysis: The observations were obtained at three different timing for four areas (room1, room2, room3, and nursing station). Then the mean of sound level,

maximal and minimal values were calculated for each time in each station along with their standard deviation (SD) to summarize the data. All results were reported as dB (logarithmic scale). The mean of sound levels were compared to the current 45 dB recommendation by AAP⁽¹²⁾.

The analysis of data was carried out using the available Statistical Packages for Social Science, version 18.0 (SPSS-18.0). Data were presented in form of table of numbers and some figures by using Microsoft Excel 2010.

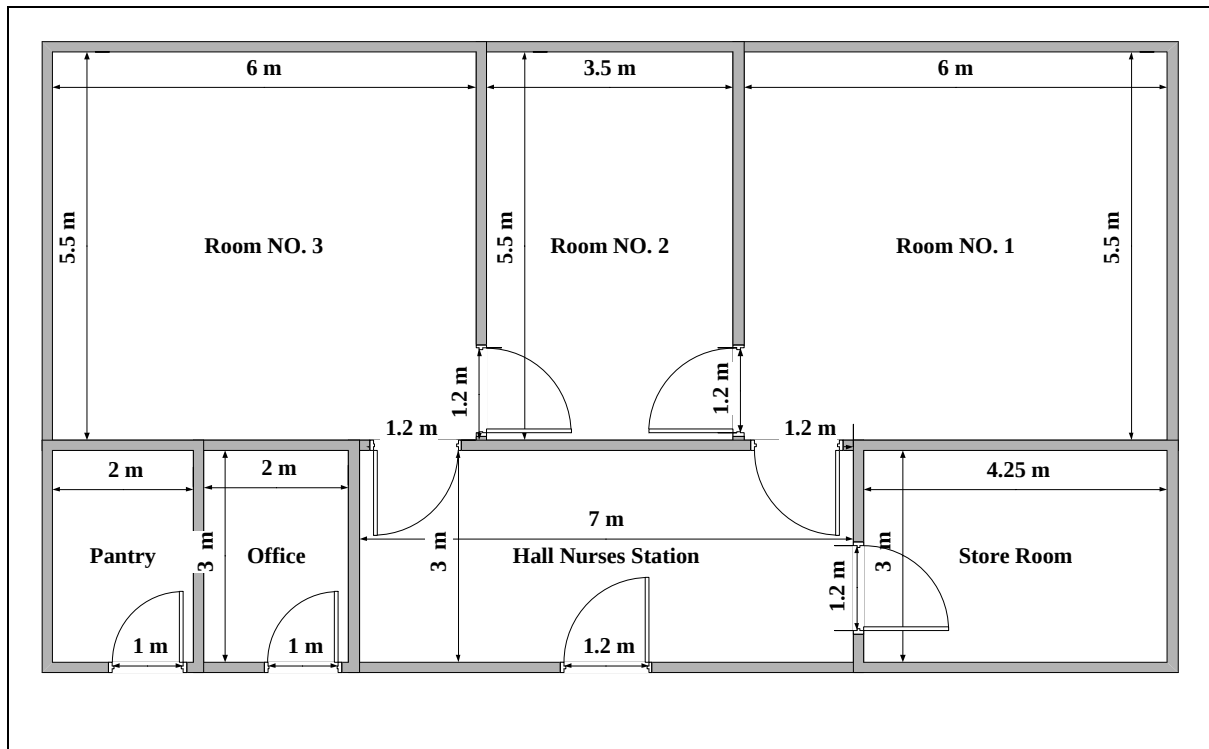


Figure 1. Map of Neonatal Care Unit of Al-Sader Teaching Hospital.

Model : SL-4010



Figure 2. Sound level meter (SL- 4010).

Results

Mean sound levels in different time (10.00 a.m., 5:00 p.m. and 10.00 p.m.) with their standard deviation were recorded in all four areas of NCU as shown in **table 1**.

Recording sound levels revealed that the hall station had the maximum readings in the three occasional time as follow; 83, 66 and 61 dB respectively. While the minimum sound levels were the same in all four areas at time of 10:00 p.m. which was 38dB, as shown in **table 2**. Generally mean sound level records showed higher reading at 10:00 a.m. followed by 5:00 p.m. and 10:00 p.m. timing in all four areas. The hall station had the highest records as shown in **figure 3**.

Discussion

Infants in the NICU are subjected to stress; including sound of high intensity ^(6, 23).

Surprisingly, it was found that the noise levels often had been exceeding the maximum acceptable level of 45 dB recommended by the AAP. Although the source of noise was not studied specifically, but the study gave an overall estimation of noise level in four areas of the NCU at different time.

The records of mean, maximum and minimum sound levels were high and mainly during day time at 10:00 a.m. ranging between 65.13 to 71.68, 78 to 83 and 47 to 61 dB respectively which reflect not only noise produced by equipment but also the impact of persons and increased activity as important source of noise including; medical morning round, presence of students, staff's conversation, rings of telephone or personal cell-phone. The study of Laudert et al. showed that the highest volume of sound in NICU was made during the rounds ⁽²⁴⁾.

Table1. Mean sound levels with standard deviation for all stations.

	Mean sound level for each time in dB			Standard deviation of reading for each time		
Station No.	10:00AM	5:00PM	10:00PM	10:00AM	5:00PM	10:00PM
Room 1	68.03	52.03	45.52	10.78	4.83	4.75
Room 2	65.13	49.32	43.19	5.51	6.42	4.42
Room 3	70.03	53.87	43.84	5.83	6.48	4.31
Hall	71.68	52.39	46.77	8.01	7.57	6.05

Table 2. Sound levels (maximum and minimum) for all stations.

	Maximum value for each time in dB			Minimum value for each time in dB		
Station No.	10:00AM	5:00PM	10:00PM	10:00AM	5:00PM	10:00PM
Room 1	80	62	59	47	40	38
Room 2	78	64	55	57	39	38
Room 3	82	65	53	61	43	38
Hall	83	66	61	55	40	38

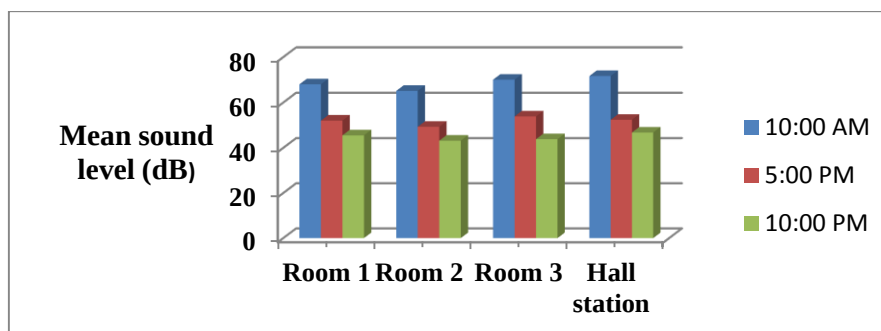


Figure 3. Comparison between mean sound levels in all stations of the neonatal care unit through different timing.

This time of the day usually have a lot of admission and a lot of medical staff in comparison with afternoon and night shift of work as well as the parents' visit and discussion with the doctor is usually at morning. In addition the laboratory investigations or procedures are usually done at this time.

These finding were less than results of a study in Iran done by Valizadeh S et al., 2013 showed that the volume measured during the day is a minimum of 65.4 dB and a maximum of 89.8 dB due to the large number of infants admitted to NICUs and the presence of staff and parents in the same unit ⁽²⁵⁾.

The mean sound levels were much higher than NICU results in Turkey which were ranging between 50 to 60 dB ⁽²⁶⁾ and approximately the same results if comparing with results of India ⁽¹⁸⁾.

On the other hands, the mean sound levels in this study were higher than many studies' results had been done in more advanced NICU in USA ^(14, 15, and 19). Unfortunately noise was excessive in these studies with variable levels and all exceeded the AAP recommendation.

At current time there is no study of noise level in NCU in Iraq nevertheless there was one study in Mosul, North of Iraq at 2012 determined the noise level at different parts of many hospitals belonging to Nineveh health directorate which showed high levels of noise at different part of hospitals but unfortunately, the NCU was not included in this study ⁽²⁷⁾.

Also it was noticed that there was a remarkable difference in noise levels in different days during October; the measurements of sound levels in holidays were much less than working days, by which may consider nurses to have an important effect on noise levels, as shown by Krueger et.al.2007 ⁽¹⁴⁾.

At afternoon (5:00 p.m.), the measurement of mean, maximum and minimum sound levels were less than morning time (but still exceeding 45 dB) due to nurses' shift change as well as time for family visit.

While at evening (10:00 p.m.), measurements were markedly less than results of day time and surprisingly the minimum sound levels in all areas were reaching 38 dB but still exceeding the desired level for sleep <35 dB by AAP recommendation ⁽¹²⁾.

In this study, the measurement of sound level was undertaken in different areas of the NCU;

The hall station was on the top of these four areas in recording high readings of mean and maximum sound levels which can be again due to the effect of noise mediated by the staff with increased activity.

While room No.3 recorded the second highest readings for the mean and maximum sound levels especially at morning time which can be explained by noise induced by staff while doing routine care for many newborns delivered by cesarean section at this time (a lot of elective cesarean section were usually done at morning time).

Although there were a lot of incubators, monitors, ventilators and CPAP in room No.1 and less equipment in room No.2, the measurements of mean sound levels especially at day time were under taken the third and fourth sequence respectively after hall station and room No.3 which gave an idea that the persons have an important effect on noise levels as well as machine.

Many recent studies used a sound level meter with computing and data storage capabilities (dosimeter), so sound levels can be monitored and electronically recorded for long periods of time ^(13, 14, 28).

In this method, a portable sound pressure level meter was used to record sound level at specific time, with one record at each time. It was difficult to measure sound levels for more extended long period or through the whole day so further computerized study will be required in future.

Premature infants spend most of their first months of life in the NICUs and are

exposed to constant, sudden, and loud noise of 57-97 dB and maximum intensity of 120 dB ⁽²⁹⁾. Therefore, improvement of quality of life of premature infants with the focus on NICU environment has become one of the research goals ⁽³⁰⁾. In this research, now we have got an idea that the noise was excessive on the neonatal unit which furthermore is essential to implement changes that enable controlling and reducing noise. Also it is important to evaluate how to maintain safe sound levels within the NCU. Further researches for these issues will be required in the future.

Conclusion

The noise level in the Neonatal Care Unit of Al-Sader Teaching Hospital was obviously high and did not meet the American Academy of Pediatrics recommendation. A real effort is required to establish guidelines for noise reduction.

Recommendation

- Implementation of noise reduction protocols as a standard of care in the NICU.
- Educational programs increase the awareness among the staff about the harmful effects of sound and noise on neonates.
- Training programs to increase the knowledge of staff in order to reduce sound levels.
- Audition of sound levels in the unit and aim to improve on these for the benefits of staff and babies.
- Hearing screening: all neonates in the NICU should be screened for hearing impairment before hospital discharge or latest at the first follow up visit to the hospital.

Interest of Conflict: There is no interest of conflict with any organization and this research is not funded.

Acknowledgment

I would like to thank all the persons that they have great efforts to complete this work especially the medical staff of neonatal care unit and Dr. Hmoud Madhi Hassan (FICMS/ CM).

References

1. World Health Organization (WHO) Training Package for the Health Sector. CHILDREN AND NOISE: Children's Health and the Environment. World Health Organization. Updated: December 2009. Available at: www.who.int/ceh.
2. Barrientos MC, Lendrum DC, Steenland K. Occupational noise: assessing the burden of disease from work-related hearing impairment at national and local levels. Geneva, World Health Organization, 2004. (WHO Environmental Burden of Disease Series, No. 9).
3. NIOSH. Noise-induced loss of hearing. Cincinnati, OH, National Institute for Occupational Safety and Health. 1991.
4. Hill K, Choi Y. Neonatal mortality in the developing world. *J Demographic research*. 2006; 14(18): 429-52.
5. Altimer LB. Management of the NICU Environment. In C. Kenner & J Wright Lott (3rd ed.). *Comprehensive Neonatal Nursing*. 2003; 229-37. Philadelphia: Saunders.
6. Peng N, Bachman J, Jenkins R, Chen C, Chang Y, Chang Y, et al. Relationships between environmental stressors and stress biobehavioral responses of preterm infants in nicu. *Journal Perinatal & Neonatal Nursing*. 2009; 23: 363-71.
7. Bremmer P, Byers J, Keihl E. Noise and the premature infant: Physiological effects and practical implications. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 2003; 32:447-54.
8. Wachman EM, Lahav A. The effects of noise on preterm infants in the NICU. *Arch Dis Child Fetal Neonatal Ed* 2010; 10:1-5.
9. Brown G. NICU noise and the preterm infant. *Arch Dis Child Fetal Neonatal Ed*. 2011; 96:F305-9.
10. McMahon E, Wintermark P, Lahav A. Auditory brain development in premature infants: The importance of early experience. *Ann N Y Acad Sci*. 2012; 1525:17-24.
11. Abrams R, & Gerhardt K. The acoustic environment and physiological responses of the fetus. *Journal of Perinatology*. 2000; 20(8 Pt 2): S31-36ER.
12. American Academy of Pediatrics Committee on Environmental Health. Noise: A hazard for

- the fetus and newborn. *Pediatrics*. 1997; 100:724-27.
13. Philbin MK, Gray L. Changing levels of quiet in an intensive care nursery. *Journal of Perinatology*. 2002; 22:455-60.
 14. Krueger C, Schue S, Parker L. Neonatal intensive care unit sound levels before and after structural reconstruction. *MCN Am J Matern Child Nurs*. 2007; 32:358-62.
 15. Berg LA, Chavez TC, Serpanos CY. Monitoring noise levels in a Tertiary Neonatal Intensive Care Unit. *Contemp Issues Commun Sci Disord*. 2010; 37:69-72.
 16. Evans J & Philbin MK. Facility and operations planning for quiet hospital nurseries. *Journal of Perinatology*. 2000; 20(8 Pt 2):S105-112.
 17. Milette I. Decreasing noise level in our NICU: the impact of a noise awareness educational program. *Adv Neonatal Care*. 2010; 10:343-51.
 18. Ramesh A, Suman Rao PN, Sandeep G, Nagapoornima M, Srilakshmi V, Dominic M, et al. Efficacy of a low cost protocol in reducing noise levels in the neonatal intensive care unit. *Indian J Pediatr*. 2009; 76:475-8.
 19. Knutson AJ. Acceptable noise level for neonates in the neonatal intensive care unit. Independent studies and Capstones. 2013; paper 463. Program in Audiology and Communication Sciences, Washington University School of Medicine.
 20. Philbin MK. The influence of auditory experience on the behavior of preterm newborns. *Journal of Perinatology*. 2000; 20: S76-S87.
 21. Vahidi R. Noise pollution. Iran: National Program Health Mangment Center. 2004; (Persian).
 22. Lutron electronic enterprise cn.Lmtd.
 23. Lotas MJ. Effects of light and sound in the neonatal intensive care unit environment on the low-birth-weight infants. *NAAACOG's Clinical Issues in Perinatal and Women Health Nursing*. 1992; 3:34-44.
 24. Laudert S, Liu WF, Blackington S, Perkins B, Martin E, MacMillan-York E, et al. Implementing potentially better practices to support the neurodevelopment of infants in the NICU. *J Perinatol*. 2007; 27(Suppl 2):S75-93.
 25. Valizadeh S, Bagher Hosseini M, Alavi N, Asadollahi M, Kashefimehr S. Assessment of sound levels in a neonatal intensive care unit in Tabriz, Iran. *J Caring Sci*. 2013; 2:19-26.
 26. Altuncu E, Akman A, Kulekci S, Akdas F, Bilgen H, Ozek E. Noise levels in neonatal intensive care unit and use of sound absorbing panel in the isolette. *Int J Pediatr Otorhinolaryngol*. 2009; 73: 951-53.
 27. Al-Zubeera HG, Al-Jawadia AA & Al-Joomard RA. Noise Pollution in Mosul Medical City Center Teaching Hospitals. *Ann Coll Med Mosul*. 2013; 39: 32-37.
 28. Byers JF, Waugh WR, Lowman LB. Sound level exposure of high-risk infants in different environmental conditions. *Neonat Netw*. 2006; 25:25-32.
 29. Bremmer P, Byers JF, Kiehl E. Noise and the premature infant: physiological effects and practice implications. *J Obstet Gynecol Neonatal Nurs*. 2003; 32:447-54.
 30. Brown G. NICU noise and the preterm infant. *Neonatal Netw*. 2009; 28:165-73.