

# Effect of Noise Level On Selected Physiological Parameters Among Neonates Admitted In NICU

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**Abstract** - Infants in the neonatal intensive care unit (NICU) are subjected to stress, including the sound of high intensity. The sound environment in the NICU is louder than most home or office environments and contains disturbing noises of short duration and at irregular intervals. There are competing auditory signals that frequently challenge preterm infants, staff, and parents. The sound levels in NICUs often exceed the maximum acceptable level of 45 decibels (dB), recommended by the American Academy of Pediatrics. Hearing impairment is diagnosed in 2% to 10% of preterm infants versus 0.1% of the general pediatric population. Noise may cause apnoea, hypoxemia, alternation in oxygen saturation, and increased oxygen consumption secondary to elevated heart and respiratory rates and may, therefore, decrease the number of calories available for growth. Very few studies have explored the physiologic responses of term and premature infants to noise in the NICU. In order to reduce sound levels, they should first be measured. A study was performed to “Assess the effect of noise level on selected physiological parameters among neonates admitted in NICU of Bharati Hospital, Pune”.

**Keywords** - Noise, sound, decibel, Heart rate, Respiratory rate, oxygen saturation, Neonate, NICU,

## I. INTRODUCTION

There is increasing acceptance that noise on the neonatal unit can have detrimental effects on neonates and staff. In this article, we try to explain the physical properties of sound and extrapolate these into the clinical setting, including recommendations to minimize the noise in the NICU. Recently, there has been considered that the intensive care environment may play a part in causing detriment to the neonate, and this has been reflected by the increasing body of work supporting developmental care practices on the neonatal unit. These spectra of interventions and care packages aim to improve the stability of the neonate with the aim of improving long-term outcomes, based on the hypothesis that brain development can be adversely affected by the environment. One particular focus of developmental

care has been the effect of noise on the infant. Not only are there concerns about the potential damage to hearing that may be caused to preterm infants, but it is recognized that noise can influence the short-term physiological stability of neonates and also the working practices of staff on the neonatal intensive care unit (NICU). NICU that is required by the preterm infants for their continued existence and which actually helps them to survive may end up being an inappropriate milieu; given the presence of overwhelming stimuli, most potent among them is the continuous presence of noise, caused by the sophisticated machinery and gadgets that may adversely affect the physiological stability, recovery, growth as well as the development of the preterm infants.

The American Academy of Pediatrics (AAP) and the Joint Committee on Infant Hearing (JCIH) have introduced noise as a major physical factor causing pollution in NICUs. They thus suggested that the admittance of infants to these wards might be associated with deafness. Sound levels are reported as A-weighted decibels (dBA). A-weighted sound level measurements are numerically adjusted to reflect the frequency-dependent nature of human hearing at low sound levels. AAP (2007) recommended the standard values of equivalent continuous sound level (Leq), the sound level that is exceeded for only 10% of any specific hour (L10), and maximum sound level during data collection (Lmax) as 45, 50, 65 dBA, respectively. According to AAP, lack of compliance to these values would result in the risk of negative effects on the health of premature infants. The first step in establishing standard sound levels is measurement. Owing to suitable modern technology and equipment, it is currently possible to measure sound levels. In some NICUs in the United States of America, sound levels are measured annually. In Iran, however, little attention is paid to the measurement of sound levels in NICUs. In fact, no study has been conducted on measuring sound levels in NICUs. Comparing the measured sound levels in NICUs with standard levels would facilitate the identification of sources of noise and their effects on sound levels. New policies can accordingly be designed to eliminate or mitigate



sources of noise and hence reduce sound levels. Reducing sound levels in NICUs will, in turn, shorten the NICU stay of premature infants and support their growth and development. The aim of the current study was to assess sound levels and to determine sources of noise and their effects on sound levels in the NICU

American Academy of pediatrics had Recommendations 1. Pediatricians should encourage research to determine the health effects of noise exposure on pregnant women and their fetuses and infants. 2. Pediatricians are encouraged to consider screening for noise-induced hearing loss in those infants who were exposed to excessive noise in the uterus or as a newborn. Occupational sources of such noise include jobs in which women are required to wear protective hearing devices. Environmental sources of such noise include rock concerts, boom boxes in cars, and airport jet traffic. 3. Pediatricians are encouraged to monitor sound in the NICU and within incubators. A noise level of 45 dB is of concern. Ideally, as proposed by the US Environmental Protection Agency, a noise level exceeding 45 dB is best avoided. NICU personnel should devise simple strategies to reduce noise in the nursery (no tapping or writing on the tops of incubators and hoods, careful closing of incubator doors, soft shoes). If such simple, inexpensive strategies fail to reduce monitored noise levels, more technical strategies need to be considered (incubator covers, use of less noisy equipment). When purchasing new equipment or renovating facilities, sound control should be considered. 4. Pediatricians should encourage manufacturers to reduce noise from medical equipment. 5. The National Institute of Occupational Safety and Health should consider further research on noise exposure during pregnancy. 6. The Occupational Safety and Health Administration should consider pregnancy in setting their occupational noise standards.

#### **A. NICU Environment — A Need for Change by T.S. Raghu Raman**

Noise is perceived differently by different professionals. The physicist perceives it as sound whose character can be defined and whose properties can be measured with the same equipment that measures other sounds. However, the psychologist perceives it as an undesired sound as contrasted to speech and music, which are usually desired sounds. Man-made technological advances have led to the installation of a broad spectrum of machines, and as a result, the work environment is now threatened with undesired sounds resulting in noise pollution. Its effects are insidious and often go undetected. British safety standards require that the mean noise level inside the incubator should not exceed 60 dB (A). Noise is one of the most important factors having an adverse effect on a neonate in intensive care. Preterm infants staying longer are exposed to moderate noise

levels for weeks and months. The usual source of noise is the staff talking and laughing, telephone ring, placing of bowls and other equipment on the incubator, oxygen cylinder changing, and squeaking door hinges. The mean noise levels outside the incubator are in the range of 55-75 dB (A), which resembles the noise pollution recorded in a busy office environment. The incubator alarm records a noise level of 85 db. It has been observed that tape recordings from inside the incubator pick up human speech, but it is muffled and indistinct.

The hazards of modern-day intensive care are numerous and not very obvious to the casual observer. It is the moral duty of the staff of such intensive care unit to prevent and correct such practices that may affect the patient. The aim of neonatal intensive care is no longer merely survival or avoidance of severe disability but rather the preservation of normal brain function.

The present study is composed of the following objective:

1. To determine the noise level and sources at a level and sources at a selected time in the NICU.
2. To measure the effect of noise level on selected physiological parameters among neonates.
3. To correlate the effect of noise level on selected physiological parameters among neonates.

**Research Methodology: Research Approach:** Exploratory approach,

**Research design:** Non-experimental, co-relational descriptive design.

**The setting of the study:** The proposed study was conducted in the Neonatal intensive care unit (NICU) of Bharati Hospital and research center, Pune.

**The population is** comprised of Pre-term and Full-term neonates.

**Sample size:** 60 samples.

**Sampling technique:** Non-probability, purposive sampling approach sampling.

**Sampling criteria:** Neonates admitted in NICU were inclusive criteria, and exclusive criteria were critical ill neonates and neonates on ventilator

**Data collection technique Tools:** An observation checklist was prepared to assess and record the noise level. The tool consists of: *Section I:* - Demographic data *Section II:* - Measurement of sources and their sound level by using the sound level meter. *Section III:* - Record of the minimum and maximum sound level and measurement of the selected physiological parameters among the neonates.

**The conceptual framework** utilized in the study was based on the "Inactive theory of infant development". The conceptual framework provides for understanding the behavior of premature infants, especially while they are still in NICU.

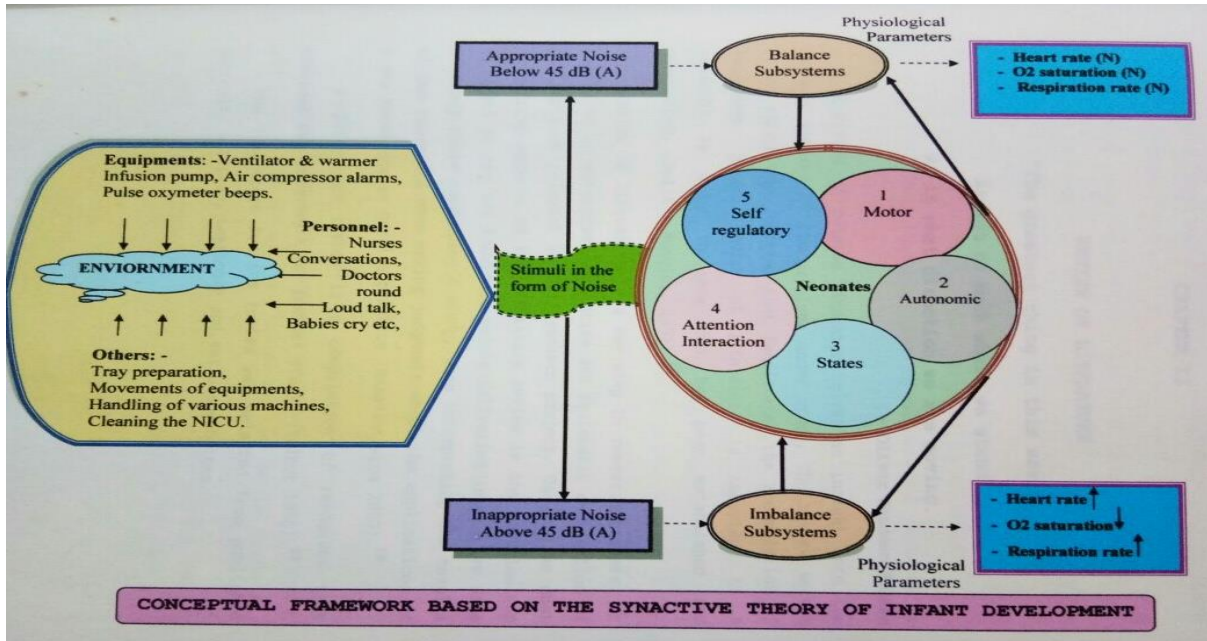


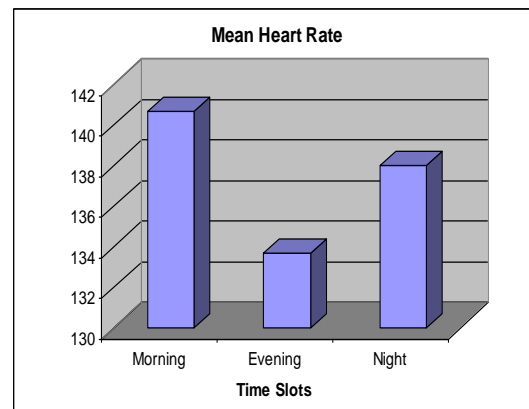
Fig 1: A Conceptual Framework Based On The Synactive Theory Of Infant Development

The conceptual framework explains the effect of environmental noise in NICU, which consists of stimuli from the personal, equipment, and other sources which range from below or above 45 db (A) and can have an effect on the neonate system. The basic concept underlying this approach is that the neonate will defend him/herself against stimulation if it is inappropriately timed or is inappropriate in complexity or intensity. If an inappropriate stimulus persists, the infant will no longer be able to maintain a stable balance of subsystems (e.g., increases in heart rate, decrease in oxygen saturation or increase in respiration rate may be observed or skin color may change, or muscle tone decreases). If properly timed and appropriate in complexity and intensity, stimulation will cause the infant to search and move toward the stimuli while maintaining him/her in a stable balance (e.g., appropriate color, even heart and respiratory rate, and/or good muscle tone). Thus due to environmental stimuli in NICU could either cause subsystems of the baby to get balance or imbalances and, in turn, is evaluated by the responses recorded through physiological parameters like neonates heart rate, oxygen saturation, and respiration rate.

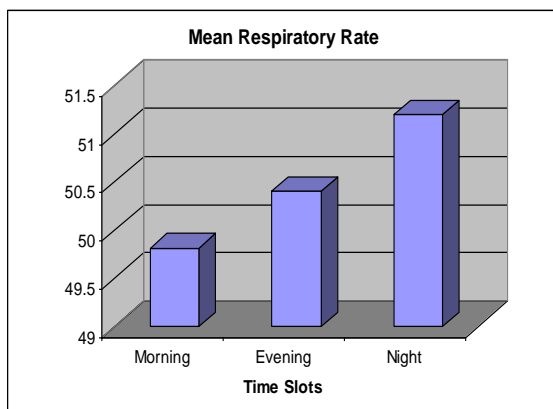
## II. RESULT

It was found that out of 60 samples, 43 (72 %) were male, and 19 (28 %) were female infants. The majority (88%) of the neonates were admitted for less than 5 days, (62%) of the neonates were delivered through FTND. The APGAR score noted among the neonates was 88 % score between 8-10 at 5 minutes. Most of the child was admitted for Hyperbilirubinaemia, LBW, MAS, and hypoglycemia. The sound level was measured at the

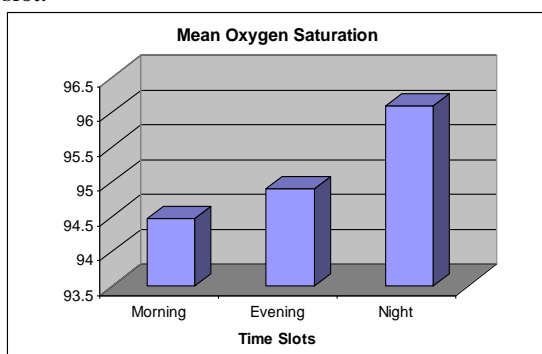
minimum and maximum level, and it was compared with values of sound level prescribed by 'American Academy of Paediatrics'. The levels were: quiet zone falls between 40-60 dB level, Moderate: 60-80dB, and Loud: 80-100dB to be considered in NICU. It was observed that during the morning shift, the sound intensity was high at the level of moderate, falls between 60-80dB level as compared to evening and night shift at the of quiet, falls between 40-60 dB level.



It was observed there was a highly significant difference in the mean score of Heart rate compared to noise produce by personnel, equipment, and other sources in all the time slots, i.e., morning, evening, and night as the P-value was < 0.01 and since z-calculated was more than the table value. It also concludes that the mean score of heart rate, i.e., 140.66 at morning time, was significantly higher than the heart rate of 133.67 and 138.00 at evening and night time slot, respectively.



It was observed there was a significant difference in the mean score of Respiratory rate compared to noise produce by personnel, equipment, and other sources in all the time slots, i.e., morning, evening, and night as the P-value was < 0.01 and since z-calculated was more than the table value. It also concludes that the mean score of respiratory rate, i.e., 49.81 at morning time, was significantly less than the respiratory rate of 51.19 at the night time slot.



It was observed there was no significant difference in the mean score of O<sub>2</sub> saturation compared to noise produce by personnel, equipment, and other sources in morning and evening and between evening and night time slot but it was observed that between the time slot between morning and night time slots as the P-value was < 0.01 and since z-calculated was more than the table value. It also concludes that the mean score of O<sub>2</sub> saturation, i.e., 94.46 at morning time, was significantly higher than 96.09 when compared to the night time slot.

### III. IMPLICATIONS OF THE STUDY

**A. Neonate nursing practices:** Nurses working in the NICU setup can be benefited from such researches, as it will provide more insight regarding the preventive, promotive, and curative aspects of neonate health nursing. Update the knowledge periodically among nurses. They should be motivated and encouraged to practices to minimize the sound levels are based mainly on behavioral modifications of those present in the NICU. However, it has been shown that changes to the physical environment of the unit are more effective

than behavioral modification and staff/visitor education.

### B. Nursing service:

- Light music can be played in NICU as it has a soothing effect, which in turn would act as a pacifier.
- Telephone rings should be replaced by blinking lights.
- Mobiles should be kept on 'vibrator' mode or should be switched off in the NICU.
- Quickly anticipate activation of alarms of ventilators and respond to them promptly.
- Communication should be very gentle near the NICU unit.
- Learn the art of speaking softly, walking quietly and gracefully in the NICU.
- The fridge door should be padded or must be closed gently.

### C. Nursing education:

Planned teaching during the orientation program should be provided as to how to minimize noise and anticipate the changes in physiological and behavioral changes, which occur due to noise.

### D. Nursing Administration:

- Sound insulation should be done for walls to make them soundproof (Acoustical structures).
- Ceilings and walls can be provided with noise-absorbing materials.
- Doors and drawers should be padded.
- Legislations for NICU regarding noise control should be well displayed.
- A beeper should be provided to all NICU personnel to control the noise level.

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## V. CONCLUSION

Health professionals are increasingly aware that the acoustic environment in the neonatal intensive care unit (NICU) may affect infants' well-being. Where unpredictable noise adversely affects sleep and physiologic stability, meaningful auditory stimulation. A major problem in the NICUs is a large number of alarms, Sounds created by health professionals, Phone ring tones, etc., used which produce a high level of noise. There are reports that exposure to high levels of noise in newborns, particularly when premature, can have potentially

negative effects on their stability and their future neurodevelopment. The measured values were higher than standard levels of NICU. Every NICU requires a sound level assessment system in order to achieve environmental noise limiting guidelines and to get closer to the standard sound levels. By evaluating sound levels, the sources of noise can be identified, and their effects on sound levels can be studied. Moreover, the staff, especially nurses, can decrease sound levels by implementing new policies. Infants will thus be faced with fewer sound stimuli, and a safe care environment would be created. The results of this study can also be used to create a protocol to reduce sound levels.

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