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NOISE SOURCES AND ITS LEVELS DURING MORNING AND AFTERNOON SHIFT IN THE NEONATAL INTENSIVE CARE UNITS

Eman Ali Moselhi Mater

Pediatric Nursing Department, Faculty of Nursing, Cairo University, Egypt

Corresponding Author's Email: moselhibasmala11@yahoo.com

ABSTRACT

Noisy environment is considered one important stress factors for newborn infants and nurses in the Neonatal Intensive Care Unit (NICU). It may be harmful to full term and preterm infants. The aim of this study is to compare noise sources and its levels during morning and afternoon shift in NICU. The study was a comparative descriptive design, was done on a convenient sample of 100 new born infants attending the NICU of El Manial University Hospital (Kasr Al Ainy) and Pediatric University Hospital (Al Monira). Neonatal assessment sheet and noise sources and its levels sheet were utilized for data collection. Sound level meter was used to measure the level of noise during morning and afternoon shift. Results of the study revealed statistically significant differences between morning and afternoon shift regarding noise sources and its levels. The mean of noise level during morning and afternoon shift were 71.61±5.14 decibels and 60.12±9.21 decibels respectively. Devices alarm in NICU was a higher source of noise in the afternoon shift (54%) and conversation/talking were recorded only in the morning shift (21%). The study concluded that noise levels were above the standard of AAP recommendations in NICU during morning and afternoon shift and devices alarm in NICU was a higher source of noise. The study recommended that noise sources and its levels in NICU should be evaluated routinely in different days of the week and an educational program is needed to raise awareness among nurses and other professionals about the resources of noise.

Keywords: Noise, Newborn Infants, NICU

INTRODUCTION

Noise is an unwanted sound judged to be unpleasant, loud or disruptive to hearing (Elert, 2010). Newborn infants in NICU are frequently exposed to adverse environmental conditions like loud noise (Almadhoob & Ohlsson, 2015; Wachman & Lahav, 2010).The committee of environmental health of the American Academy of Pediatrics, (1997) recommended that noise intensity in NICU should remain below 45 dB. This recommendation is based on findings of hearing loss in newborn infants who were cared in NICU (Synnes *et al.*, 2012). Noisy events are numerous which altered the neonates' physiological stability (Byers, Waugh & Lowman, 2006). If the noise reaches very high levels, it can cause stress and low performance (Hassanein, Raggal & Shalaby, 2013).

The NICU ambient noise is higher than in most homes or offices, and with newborns in contact with disturbing noises of short duration and at irregular intervals, it could cause increasing environmental stress (Almadhoob & Ohlsson, 2015). Also, the NICU is often characterized by loud, unpredictable noise from extraneous sources that comes from various sources such as life support equipment (mechanical ventilator and CPAP), radiant warmer, infusion pumps, voices/talking, alarms, phones, movement of people in the unit and careless handling when locking cabinets, drawers, trash lid and door (Cardoso *et al.*, 2015).

Every new born infant has a right to rest and sleep deeply (Tavares, 2011). The maximum sound from the respiratory device is more than 80 dB and the infusion pump is more than 65 dB (Duran *et al.*, 2012).

Paying attention to eradicate environmental noise can help high risk neonates in NICU. Providing a suitable environment for development in the NICU is important because many infants admitted here are born prematurely. Noise level in the NICU plays an important role in staff communication, family interactions, and infant development (Hassanein, Raggal & Shalaby, 2013; Abdeyazdan, Ghassemi & Marofi, 2014). So, the aim of this study is to assess noise sources and its levels in NICU during morning and afternoon shift.

RESEARCH METHODOLOGY

Research design

A Comparative descriptive study design was utilized to accomplish the purpose of the study. It is used when two distinct groups are described and compared in terms of respective variables. The purpose of comparative descriptive research is to describe and explain a phenomenon.

Sample and sample size

Convenient sample of 100 newborn infants was selected according to the criteria of inclusion such as newborn infants with any gestational age, conscious and both sexes. The exclusion criteria included newborn infants with neonatal sepsis and congenital anomalies.

To determine a sample size, a power analysis was conducted using 0.05 as the level of significance, 0.95 as the power and effect size of 0.25. The minimum required sample size obtained was 110 new born infants. About 10 new born infants were discharged before the second measure in the afternoon shift.

Setting

The study was conducted in the NICUs at El Manial University Hospital (Kasr Al Ainy) and Pediatric University Hospital (Al Monira).

Instruments

1- Neonatal assessment sheet was developed by the researcher to collect data about new born infant's characteristics such as birth weight, gestational age, Apgar score etc. and factors affecting noise levels such as numbers of patients and personnel in NICU, hospital stay, number of ventilators etc.

2- Noise resources and its levels sheet were developed by researcher to record sound level and its resource during morning shift then repeated for the same patient in the afternoon shift. It included conversation/talking, respiratory setting, infusion pump, devices alarm, phone ringing and opening and closing of doors and mixed resources (more than two resources).

3- Sound level meter was used to measure the level of noise in NICU environment. It is a professional tool solutions since 1991, model MT-4618, resolution 0.1 decibels, measuring range is from 30 to 130 dB, can record minimum and maximum value with auto range and good anti interference performance, ISO 9001, PROKIT's industries co., LTD and certified.

It is better for louder sound levels. Noise level was measured at different times of days (during morning and afternoon shift), beside the head of the newborn infants outside the incubators.

Data analysis

The Statistical Package for the Social Science (SPSS) version 20 (IBM: Armonk, New York, United State) was utilized for statistical analysis. Descriptive statistics were computed to summarize the newborn infant's characteristics and noise level and its resources. Mann Whitney test was used to compare means, and Chi-square was used to compare categorical variables. A Spearman correlation statistical test was performed to investigate the relationship between noise level and newborn infant's characteristics and other variable that influenced noise levels.

Pilot study

A pilot study was conducted before starting the main study collection on 10 new born infants to assess the feasibility, the applicability of the tool and to estimate the sample size. The results of the pilot study confirmed that the study was feasible.

Validity and reliability

The tool was submitted to a panel of five experts in the field of high risk neonates to examine content validity (covering, clarity, wording, length, format and overall appearance). The reliability of the tool was tested by using Cronbach's α coefficient which is a model of internal consistency, based on the average inter-item correlation (0.74).

Ethical consideration

Prior to data collection, permission was obtained from the research scientific board of hospital, the head of NICUs and faculty of nursing, Cairo University. The parents of newborn infants gave informed verbal consent prior to their newborn infants' participation in the study.

RESULTS

New born infants' characteristics are summarized in table 1 and figure (1), the mean of gestational age was 31.9±7.31 weeks ranged from 30-38 weeks, around half of newborn infants were female (53%), the mean of birth weight was 2040±2393 gram, Apgar score at 10 minutes was 8.73±1.46, three quarter of them stayed in incubator (75%) and a higher percentage of them suffered from respiratory distress (80%).

Table 1: Newborn infant's characteristics (n= 100)

Characteristics	%	Mean ±SD
Gender		
Male	47	
Female	53	
Diagnosis		
Respiratory distress	80	
Hyperbilirubinaemia	12	
Low birth weight	8	
Gestational age		
30 -32	51	
33 -35	26	31.9±7.31
36 -38	23	
Birth weight		2040±2393
Weight at observation		2393±31.9
Apgar score at		
1 min		3.49±2.04
5 min		6.50±2.03
10 min		8.73±1.46

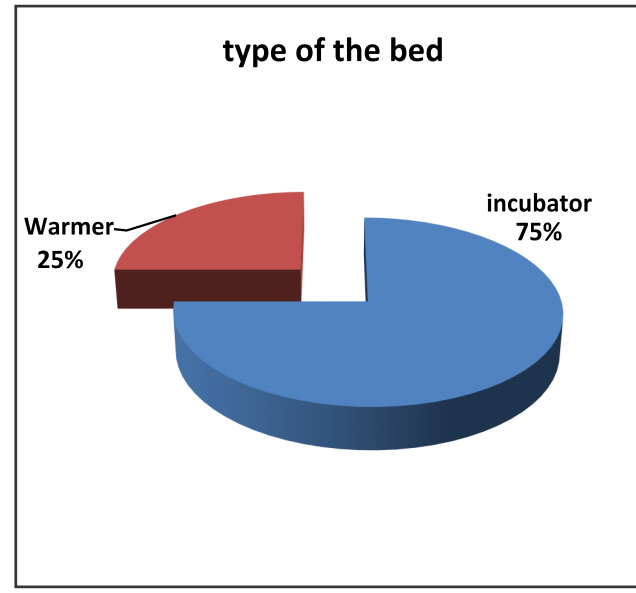

Figure 1: Type of the bed in percentage distribution (n=100)

Table 2 illustrates the mean of noise level during morning and afternoon shift were 71.61±5.14 decibels and 60.12±9.21 decibels respectively and the maximum levels in the morning and afternoon shift were 78 and 69 decibels respectively. The values were significantly above the AAP standard recommendation (P <0.02).

Table 2: Levels of noise in the morning and afternoon shift (n=100)

Levels of sound	Morning shift	Afternoon shift
Mean	71.61± 5.14 dB	60.12 ± 9.21 dB
Median	73 dB	60 dB
Minimum	56 dB	40 dB
Maximum	78 dB	69 dB
Variance	26.44 dB	91.62 dB
T-test	0.226	
P- value	0.02	

The results revealed statistically significant differences between morning and afternoon shift regarding sources of noise (p<0.001). Alarm devices in NICU were a higher sources of noise in the morning and afternoon shift, (23% & 54% respectively), mechanical ventilator (10% & 11% respectively), mixed sources (18% & 25% respectively) and conversation/talking were recorded only in the morning shift (21%) (table 3).

Table 3: Sources of noise in the morning and afternoon shift (n=100)

Sources of noise	Morning shift	Afternoon shift
	%	%
1- Conversation/talking	21	-
2- Respiratory setting	11	10
3- Infusion pump	6	11
4- Devices alarm	23	54
5- Phone ringing	12	-
6- Open and close door	9	-
7- Mixed (more than two resources)	18	25
X	57.293	
P-value	0.001	

Table 4 represents the mean of environmental factors that influenced the noise levels, such as the mean of the number of persons in the room was 17.02±13.28, the mean of patients' number in the room was 11.26±2.003 and the mean of hospital stay was 12.13±8.5.

Table 4: The mean of the environmental factors that influenced noise levels

The environmental factors	Mean ±SD
numbers of person in the room during morning shift	17.02±3.28
numbers of person in the room during afternoon shift	5.39±1.23
patients' number in the room	11.26±2.003
hospital stay	12.13±8.51

A Spearman correlation statistical test was performed to investigate the relationship between levels of noise and newborn infant's characteristics and the environmental factors (table 5). There was statistically significant differences were notes with Apgar score at 1 ,5 and 10 min, number of person inside NICU (p<0.000) and hospital stay, number of mechanical ventilator and gestational age (p< 0.003) but there wasn't statistically significant differences regarding number of patient in NICU p< 0.692).

Table 5: The correlation between noise level and newborn infants' characteristics and environmental factors

Variable	*r*-value	*p* - value
1- Apgar score at 1 min	-0.415	0.00
2- Apgar score at 5 min	-0.484	0.00
3- Apgar score at 10 min	-0.316	0.00
4- Birth weight	0.198	0.00
5- Weight at test	0.134	0.18
6- Hospital stay	-0.213	0.03
7- Number of persons in NICU	-0.424	0.00
8- Number of patients in NICU	-0.040	0.692
9- Gestational age	0.275	0.00
10- Number of mechanical ventilators	0.295	0.00

DISCUSSION

Noise levels above the standard AAP recommendations in NICU have previously been identified in several studies (Carvalhais *et al.*, 2017; Cardoso *et al.*, 2015; Abdeyazdan, Ghassemi & Marofi, 2014; Lasky & Williams, 2009). This study provided further evidence that the mean of noise level was found above AAP recommendations by nearly 26 decibels in the morning shift and 15 decibels in the afternoon shift. These finding are consistent with Pinda *et al.* (2017) who stated that average sound levels in NICU were 58.9±3.6 decibels with an average peak level of 86.9±1.4 decibels. Also, a study performed in NICUdone by Zamberlan *et al.*, (2012) to decrease the noise level, reported that even in significantly reduced noise levels, the remaining noise was still more intense than AAP recommendations.

According to the resources of noise, alarm devices in NICU was a higher source of noise especially in the afternoon shift (54%) and conversation/talking was recorded only in the morning shift (21%). Noise produced by the operation of multiple devices combined with the conversations between professionals and the unexpected noise from procedures of this place (Santos *et al.*, 2018).

In agreement with Pinheiro *et al.* (2011) the study reported that alarm devices enhances noise inside the unit even more and different stimuli can enhance the sound pressure level, that is, the higher the equipment noise, the higher the professionals raise their voice and the longer they take to respond to alarms. Aly & Ahmed (2016) recorded that the mean of noise level from monitor alarm was 62.67±5.51decibels and from doctors and nurses was 69.33±4.51decibels. Also, Altuncu *et al.* (2009) stated that changing caregiver behaviors is always the initial steps in the reduction of noise level, like asking staffs to speak softly and rapid response to alarms.

As regards to the relationship between noise level and new born infants' characteristics and environmental factors, gestational age was significantly influenced by noise level p<0.00. In agreement with Parra *et al.* (2017) the study mentioned that preterm infants, born less than 32 weeks of post conception age, were exposed to higher sound levels inside the room than newborn infants above 32 weeks. Birth weight was associated with high level of noise. These findings are convenience with Pinheiro et al.

(2011) reported that the lower the infant's weight, the higher the sound pressure level. Newborns that have very low birth weight and therefore very small body surface, absorb less noise and enhance reverberation and increase sound.

Also, there was a positive correlation between level of noise and number of mechanical ventilator. This result is consistent with Pinda *et al.* (2017) who found that medical equipment such as mechanical ventilator was associated with more noise exposure. Kazemizadeh, Black & Sidman (2015) mentioned that the noise traveling on ventilation tubing and in the air column within the tubing deserves careful consideration. Also, Shimizu & Matsuo (2016) stated that the caregiver should closely assess for adverse effects of higher sound level generated by different modes of respiratory support. Preventive maintenance of equipment is one of the noise reduction strategies (Tsunemi, Kakehashi & Pinheiro, 2012).

This finding showed that there was no significant difference between level of noise and number of patient. It is contradictory to the study by Manuel *et al.* (2018) who reported that there is a remarkable correlation between the increase of existing sound levels in the NICU and the increase in the number of occupied incubators. The obtained values are influenced by other noise sources, the various alarms being the major contributors.

Limitation

Interpretation of the results should acknowledge some limitation. We need to measure noise levels not only inside the NICU but also inside the incubators and measure it at night shift like morning and afternoon shift. There is a lack of nursing studies in this field.

CONCLUSION

The current study had shown that noise levels were above the standard AAP recommendations in NICU during morning and afternoon shift.

Devices alarm in NICU was a higher source of noise especially in the afternoon shift (54%) and conversation/talking was recorded only in the morning shift (21%).

Gestational age, birth weight and respiratory setting were significantly influenced by noise level $p<0.00$.

RECOMMENDATION

Based on the study results, the following recommendations are proposed:

1- Noise level and its resources in NICU should be evaluated routinely in different days of the week.

2- Further studies are essential to eliminate and manage the resources of noise.

3- The educational program is needed to raise awareness among nurses and other professionals about the resources of noise such as equipment noise and behavioral noise.

Notes

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