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*Original Research Article*

# A Study to Assess the Impact of Earmuffs on Physiological Parameters in Neonates in Neonatal Intensive Care Unit

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## ABSTRACT

**Objectives:** To determine the impact of earmuffs on physiological parameters in neonates in neonatal intensive care unit, Krishna Hospital, Karad and to associate the demographic variables with selected physiological parameters.
**Methods:** Evaluative Research Approach was used for the study and conducted in neonatal intensive care unit, Krishna Hospital, Karad, Maharashtra, India, using control and experimental group design. Non probability purposive sampling technique was used for 50 selected neonates. Every 2-2 hourly total 3 readings measured on same neonate before and after application of earmuffs. An earmuff was used for assessing the physiological parameters (temperature, heart rate, respiratory rate, oxygen saturation and sleep pattern) of the neonates. The data collected, tabulated and analyzed in terms of objective of the study using descriptive and inferential statistics (ANOVA).
**Results:** Repeated measure ANOVA showed significant difference in the mean of temperature, heart rate, respiration, sleep pattern (P=0.001) and there was no significant difference showed those babies were on oxygen.
**Conclusion:** The study concluded that wearing earmuffs can protect the infants averse to noise and maintain the physiological parameters of neonates .Also NICU nurses showed interest in using this simple and economic, easy to sterilize earmuffs for infants and agree to use earmuffs routinely in future for infants.

***Keywords:*** Earmuffs, Noise, Newborn, NICU, Physiological Parameters.

## INTRODUCTION

Neonatal units like specialize in the care of babies born early, with low weight (less than 5.5 pounds) or who have a medical condition that requires specialized treatment. Babies with medical conditions such as heart problems, infections, or birth defects are also cared for in the NICU. The NICU combines advanced technology and trained health care professionals to provide specialized care for the tiniest patients. [(1)]

Neonatal admission generally refers to the admission of newborns under 29 days old into a health facility for medical care. Neonatal infections may begin in-utero, early in labour or postpartum. Infections caused by bacteria, viruses and fungi, contracted either during delivery, at health care facilities or at homes, have been reported as common aetiologies in neonatal morbidity. [(2)]

An estimated 6.3 million under-five deaths occurred in 2013, and 44 percent, which translates into approximately 2.8 million of these deaths, were neonates. [(2)] A quarter of global neonatal deaths happen in India where nearly 600,000 newborns die within 28 days of their birth every year, according to a new UNICEF study. Of the 184 countries, which the report covers,

India's 31 rank with 25.4 neonatal mortality rate (per 1,000 live births) kept the world's seventh largest economy below 153 countries who have better survival rates for their newborns. [(3)]

In 2013, as many as 22 million newborns an estimated 16% of babies born globally had LBW, according to the UNICEF. South Asia had the highest incidence of LBW, with 28 % newborns weighing less than 2.5 kg. India had the third highest percentage of LBW newborns. [(4)]

India's high neonatal mortality (32/1000 live births) contributes substantially to its infant mortality (47/1000 live births). Approximately one-third of neonates born in India have a low birth weight, and neonatal mortality in India is 30% higher in neonates with mild growth retardation and 183% higher in neonates with severe growth retardation. [(5)]

Infancy is the period of rapid psychomotor, cognitive, and social development. A premature infant is one which is born before 37 weeks of gestational age. Prevalence of premature births has increased by 21% from 1990 in developed countries. [(6)]

Preterm birth (premature birth) is a significant public health problem across the world because of associated neonatal (first 28 days of life) mortality and short- and long-term morbidity and disability in later life. According to WHO, every year about 15 million babies are born prematurely around the world and that is more than one in 10 of all babies born globally. Almost 1 million children die each year due to complications of preterm birth (2013). Preterm birth is the world's number one cause of newborn deaths, and the second leading cause of all child deaths under five, after pneumonia. Many of the preterm babies who survive suffer from various disabilities like cerebral palsy, sensory deficits, learning disabilities and respiratory illnesses. [(7)]

Newborn babies who need intensive medical attention are often admitted into a special area of the hospital called the Neonatal Intensive Care Unit (NICU). [(11)] The neonatal intensive care unit (NICU) serves as home to preterm infants for a range of weeks to months after birth. According to the CDC, within the last 5 years in the United States (US), one in every ten neonates born was preterm. Preterm infants in the NICU are at an increased risk for overstimulation due to the abundant amount of activity and noise produced during daily activities. Sensory overstimulation, specifically auditory overstimulation, can create a negative impact on the overall growth and development of the neonate, and can damage the immature neurologic system in preterm populations. [(8)]

Noise in NICUs results from different sources, including equipment, such as heart monitors, ventilators, oxymeters, infusion pumps, aspiration systems and incubators. Medical, nursing and other professional teams' conversations and parental visits are also directly related to increased noise levels. [(8)] In addition, some parts of neonatal auditory system develop shortly after birth. In fact, environment influences fetal and neonatal development through various senses such as visual, auditory, tactile, olfactory, and taste sensation. An imbalance between sensory stimuli and brain development stage leads to an injury in the neonates. [(9)] Newborns exposed to noise may have high blood pressure, increased heart rate, hearing loss, apnea, bradycardia, hypoxia, sleeping disorders and consequent fatigue, agitation, crying and irritability. In addition, noise may affect weight gain by increasing oxygen consumption and heart rate, thereby leading to increased use of energy. [(1)]

Noise pollution is accompanied by increasing the risk of hearing loss in infants, in addition it can act as a stressor leading to an increase in heart rate, respiratory rate, auditory, nervous system, metabolism, and energy needs as well as a reduction in the energy storage, needed for neonatal growth and development. Stress results in secretion of hormones that contribute to more fat and

protein catabolism in the body. Thus, the neonates, tolerating stress, may have slower weight gaining leading to prolonged time to be discharged from NICU. [9,8]

In 1997, the American Academy of Pediatrics determined that safe sound levels in the NICU should not exceed an hourly level of 45 decibels on an A-weighted scale (dBA). Preterm infants have decreased autonomic and self-regulatory abilities, and are vulnerable to high noise levels due to their inability to filter and process noxious stimuli. By 26–28 weeks gestational age (GA), the preterm infant's auditory system is sufficiently mature for loud noise to produce physiological changes in heart rate, blood pressure, respiration and oxygenation. Therefore, maintaining a stable physiological state is crucial, especially this critical time for development of the central nervous system (CNS) when the most rapid neural formation is taking place. [11]

The Brazilian Technical Rules Association rules number 10152/1987 establishes hospital noise levels of 35 and 45 dB as desirable and acceptable, respectively. In Brazil, Aurélio measured the noise levels in the NICU-HUSM, which ranged from 43.3 to 114.9 dB (A) (mean 60 to 65 dB). These levels are excessive and negative effects on infants according to Brazilian and international rules. [8]

**Problem statement**

"A study to assess the impact of earmuffs on physiological parameters in neonates admitted in neonatal intensive care unit at Krishna Hospital, Karad."

**Objectives**

1. To assess the physiological parameters before & after using earmuffs in neonates.
2. To determine the impact of ear muffs in reduction of noise intensity on physiological parameters in neonates.
3. To associate the demographic variables with selected physiological parameters.

**Hypothesis**

Ho (Null Hypothesis) - There is no significant difference between reduction of noise intensity on physiological parameters in neonates before and after using earmuffs in neonates at, Krishna Hospital Karad.

H1 (Research Hypothesis) - There is significant difference between reduction of noise intensity on physiological parameters in neonates before and after using earmuffs in neonates.

## METHODS

In view of the nature of the problem selected for the study and objectives to be accomplished an evaluative research approach was considered. The research design adapted for the study was control (before) and experimental (after) group. Independent variable of the study was Earmuffs and dependent variable refers to Physiological Parameters (Temperature, Heart Rate, Respiration, Oxygen Saturation and Sleep State). The study was conducted in neonatal intensive care unit Krishna Hospital, Karad, Maharashtra, India. Non probability purposive sampling technique was used for 50 selected neonates as a sample of the study. After an extensive review of literature and with the help of experts structured knowledge questionnaire was prepared to assess the impact of earmuffs on physiological parameters in neonates.

Technique and tools in this study was:

SECTION I: Demographic variable of neonate- age, gender, weight, gestation in week, causes of admission in the hospital, baby on phototherapy, baby on kangaroo mother care.

SECTION II: Standard observation checklist for physiological parameters assessment.

**Methods of data collection**

To conduct the research study in Krishna Hospital, Karad, after availing ethical permission from Ethical Committee and other concerned authorities, before data collection. Data collection was held at from 09/12/2017 to 31/12/2017. On the day of data collection, at the very beginning, the infant's parents' were explained the purpose of the study and informed written consent

was obtained from each infants' parents. At Every 2 hourly physiological parameters were assessed. Then autoclave earmuffs were used for assessing the physiological parameters of neonates. Applied to neonates & again every 2 hourly physiological parameters measured on same infant total six times a day. Physiological parameter of neonates is assessed by using the standard observation checklist.

**Plan for data analysis**

The data obtained was analyzed in terms of the objective of the study using descriptive and inferential statistics. The plan of data analysis was developed under the excellent direction of experts in the field of nursing and statistics.

The plan of data analysis was as follows:

1. Organize the data in master sheet/computer.
2. Descriptive analysis used to calculate frequency, percentage, mean, median, standard deviation and independent 't' test.
3. Inferential analysis used to evaluate effectiveness of earmuffs by repeated measure ANOVA and Tukey-Kramer multiple comparison test.

## RESULTS

**Section I: Distribution of neonates according to Demographic variables.**

The data presented in table 1 shows that maximum numbers of 31 (62%) neonates were in the age group 1-5 days of age, 28 (56%) of them were male, 26 (52%) of them had weight between 1.0 kg-1.999kg and 24 (48%) of them had weight between 2.000-3.000kg and 32 (64%) of them had 28-37 weeks of gestational age and 18 (36%) of them had 38-40 weeks. The majority of 18 (36%) neonates were admitted to the hospital due to preterm deliveries, 12 (24%) neonates admitted due to mild neonatal jaundice, 7(14%) neonates were admitted due to mild neonatal respiratory distress, 7 (14%) neonates were with I.U.G.R. and 6 (12%) neonates were admitted in the hospital with other condition and only 12 (24%) neonates were under the phototherapy and received Kangaroo Mother Care.

**Table 1: Distribution of neonates according to Demographic variables (n=50)**

| Sr. No. | Socio Demographic Variables | Frequency | % |
|---|---|---|---|
| 1. | **Age of neonate** | | |
| | 1-5 days | 31 | 62 |
| | 6-30days | 19 | 38 |
| 2. | **Gender of neonate** | | |
| | Males | 28 | 56 |
| | Females | 22 | 44 |
| 3. | **Weight of neonate** | | |
| | 1000-1999 gm | 26 | 52 |
| | 2000-3000 gm | 24 | 48 |
| 4. | **Gestational (in weeks)** | | |
| | 28-37 | 32 | 64 |
| | 38-40 | 18 | 36 |
| 5. | **Causes of admission in hospital** | | |
| | Preterm care | 18 | 36 |
| | Mild neonatal jaundice | 12 | 24 |
| | Mild neonatal respiratory distress | 07 | 14 |
| | Intra uterine growth retardation | 07 | 14 |
| | Others | 06 | 12 |
| 6. | **Baby on phototherapy** | | |
| | Yes | 12 | 24 |
| | No | 38 | 76 |
| 7. | **Baby on K.M.C.** | | |
| | Yes | 12 | 24 |
| | No | 38 | 76 |

**Section II: Testing of hypothesis $H_1$ evaluation of effectiveness of earmuffs before and after application**

Mean and Standard deviation of neonates' physiological parameters are shown in Table 2. Table 2 shows Comparison of physiological parameters between before and after on subsequent two hours six times a day.

Tukey-Kramer multiple comparison tests showed, there was significant difference in reading of temperature, heart rate, respiration, oxygen saturation and sleep state before and after application of earmuffs at different times.

Repeated measure ANOVA was highly significant increase in readings of temperature and oxygen saturation at different times after application of earmuffs ($p<0.001$).

Repeated measure ANOVA was highly significant reduction in reading of heart rate and respiration at different times after application of earmuffs ($p<0.001$). Thus due to earmuffs, there is reduction in noise intensity.

Repeated measure ANOVA was highly significant increase in readings of oxygen saturation at different times after application of earmuffs ($p<0.001$). Thus, due to earmuffs increasing time of quiet sleep.

Repeated measure ANOVA showed, there was no significant difference in score of on oxygen at different times after application of earmuffs ($p<0.05$).

**Table No. 2: Evaluation of effectiveness before and after application of earmuffs on physiological parameters among neonates**

| Time | | Temp. (ċ) | | HR (b/min) | | RR (b/min) | | $SPO_2$ (%) | | SLEEP STATE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | SD | M | SD | M | SD | M | SD | M | SD |
| BEFORE APPLICATION OF EARMUFFS | 8 am | 36.43 | 0.32 | 139.10 | 16.23 | 55.44 | 4.93 | 95.160 | 3.184 | 3.64 | 1.71 |
| | 10 am | 36.48 | 0.22 | 138.48 | 17.13 | 55.48 | 4.87 | 95.540 | 2.991 | 3.48 | 1.66 |
| | 12 pm | 36.43 | 0.23 | 139.28 | 15.86 | 56.20 | 5.83 | 94.900 | 4.210 | 3.72 | 1.60 |
| AFTER APPLICATION OF EARMUFFS | 2 pm | 36.53 | 0.24 | 127.70 | 13.38 | 47.36 | 4.92 | 96.880 | 3.008 | 1.62 | 1.34 |
| | 4 pm | 36.57 | 0.14 | 125.40 | 12.32 | 47.24 | 4.93 | 96.740 | 2.601 | 1.98 | 1.62 |
| | 6 pm | 36.59 | 0.17 | 124.24 | 12.26 | 46.60 | 4.80 | 97.220 | 2.053 | 1.54 | 0.89 |
| P | | <0.0001* | | <0.0001* | | <0.0001* | | <0.0001* | | < 0.0001* | |
| F Statistics | | 5.26 | | 40.27 | | 77.49 | | 10.096 | | 10.096 | |

**Section III: Association of the demographic variables with selected physiological parameters.**

Repeated measure ANOVA was used to check effect of demographic variables wise at different times, before and after application of earmuffs. Reading was taken on subsequent every two hourly, six times a day. It revealed that, there was highly significant difference in reading of temperature, heart-rate, respiration, and sleep state at different times for the neonates having age, gender, weight, gestational age, baby on phototherapy and baby on KMC. Also selected demographic variables wise independent 't' test was indicated that, there was significant difference with the physiological parameters at different time.

## DISCUSSION

The study was conducted to assess the impact of earmuffs on physiological parameters in neonates. It was aimed to assess the impact of earmuffs and to improve the sleep pattern and maintain vital parameters.

Present study revealed that, there was highly significant increase in reading of temperature and oxygen saturation at different times after application of earmuffs ($p<0.001$) whereas, heart rate and respiratory rate also revealed that, there was highly significant reduction at different times after application of earmuffs ($p<0.001$). Tukey-Kramer multiple comparison test showed that, there was significant difference in reading of temperature, heart rate, respiration, oxygen saturation and sleep sate in comparison before and after application of earmuffs. Independent 't' test indicated that significant difference between the demographic variables and parameters.

Zahra Abdeyazdan el al (2014) conducted a clinical trial study in Iran to evaluate the effects of earmuffs use on the physiologic and motor responses in 64 premature infants hospitalized selected by randomly, in neonatal intensive care unit.

Results showed when infants wore the earmuffs, they had significant higher mean arterial oxygen saturation, the less frequent motor response and a decrease in their pulse and respiratory rate. However the mean of sound intensity was at least 65.4dB and at the most 89.8 dB. Mean of sound intensity in the morning hours and afternoon hours were 75.9 and 73.2 dB, respectively. This result of the study support the noise exposure in preterm infants were reduced by wearing earmuffs and the results showed improvement in physiologic and motor responses. Hence, wearing earmuffs can protect the infants' averse to noise and maintain physiological parameters of neonates. [(6)]

Rawia Abujarir el al (2012) conducted a similar Quasi-Randomized prospective controlled study in Qatar to evaluate the impact of earmuffs on vital sign in 100 infants completed 72-hours period inside NICU, with 50 infants in each group. Results showed that earmuffs were clearly demonstrated to have a beneficial effect on several important vital sign, heart-rate, respiratory rate, oxygen saturation and days of oxygen requirement. However there were statistically significant difference between the gender proportions and birth-weight between groups, but not in gestational age. The study concludes that positive effect of wearing earmuffs in 4 common vital signs of sick newborn infants inside the NICU, as well, application of earmuffs was not associated with any skin problems. [(10)]

Duran R et al (2012), was conducted A comparative prospective study to evaluate the effectiveness of the earmuffs on physiologic and behavioral responses in very low birth weight preterm infants in 20 infants. Results showed preterm infants with earmuffs (87.5%) were more frequently observed in a quiet sleep state of ABSS compared with those without earmuffs (29.4%). However, the ABSS scores of group 1 and 2 were 3.07 ±1.1 and 1.34 ± 0.3, respectively, statistically significant difference was notes between the means of ABSS scores ($p<0.001$). The study concluded that noise reduction in preterm infants with earmuffs is helpful by improving sleep efficiency and increasing time of quiet sleep. [(12)]

Zahr and Traversay (1995), was conducted a premature infant responses to noise reduction by earmuffs: effects on behavioral and physiologic measures in infants. Results showed that, when infants wore the earmuffs, they had significantly higher mean oxygen saturation levels and spent more time in the quiet sleep state. [(13)]

## CONCLUSION

The study concluded that wearing earmuffs can protect the infants averse to noise and maintain the physiological parameters of neonates .Also NICU nurses showed interest in using this simple and economic, easy to sterilize earmuffs for infants and agree to use earmuffs routinely in future for infants.

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