

Effectiveness of Tactile Stimulation versus Auditory Stimulation on Neurobehavioral Development among Neonates in NICU in Selected Hospital

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Abstract: *Background:* Neonates are at risk for various health problems, even though they are born with average weight. The mortality and morbidity rates in newborns are high. The neonates react to both internal and external stimuli and manifest state related behavior. Infants in Neonatal Intensive Care Unit (NICU) are subject to a highly continuous stressful environment, high-intensity noise, bright light and a lack of the tactile stimulation that they would otherwise experience in the womb or in general mothering care (Vickers, et al., 2004). The fetal environment provides the fetus with multiple potential sources of rhythmic stimulation that are not present in the NICU. Maternal breathing, heartbeats, walking, dancing, running, speaking, singing, etc., all bathe the fetus in an environment of varied rhythmic stimuli: vestibular, somatosensory, tactile, and auditory. In contrast, the NICU environment does not offer the same proportion of rhythmic stimulation. After analyzing the NICU environment, the focus of the present study is to evaluate the effectiveness of tactile versus auditory stimulation on neuro behavioral development among neonates in NICU. *Aim:* The aim of the study is to evaluate the effectiveness of tactile stimulation versus auditory stimulation on Neurobehavioral development among neonates in NICU, in selected Hospital, at Nellore District. *Methods:* A Factorial design was adopted to evaluate the effectiveness of tactile stimulation and auditory stimulation simultaneously in two independent groups. The study was conducted in NICU of the selected hospital. A sample size of 100 neonates in NICU were selected and 50 Neonates were assigned to tactile stimulation group(Group-I)- 25 neonates in experimental group and 25 neonates in a control group. 50 neonates were assigned to auditory stimulation group(Group –II), Among 50, 25 neonates allocated to experimental group and 25 neonates to the control group by using probability stratified random sampling technique followed by simple random technique. Modified Brazelton's Neonatal Neuro Behavioral Assessment Scale (NNBAS) was used to assess the Neuro behavioral Development before and after providing tactile stimulation and the auditory stimulation. *Data analysis:* data was analyzed using descriptive statistics and inferential statistics according to the objectives and the hypothesis tested. *Results:* the results revealed that, that there is a significant improvement in the neuro behavioral development of neonates in NICU after providing tactile stimulation and auditory stimulation . It is evident from the findings of the study that auditory stimulation is more effective than the tactile stimulation in improving the neuro behavioral development among neonates. *Conclusion:* It is evident that there is significant improvement in neuro behavioral development on neonates after providing the auditory stimulation when compared to the neonates in tactile stimulation group.

Keywords: Neonates, NICU, Neuro behavioral development, Tactile stimulation

1. Introduction

Neonates are at risk for various health problems, even though they are born with average weight. The mortality and morbidity rates in newborns are high. The neonates react to both internal and external stimuli and manifest state related behavior. The healthy neonates born at term, between 38-42 weeks, cries immediately after birth, establishes independent rhythmic respiration, quickly adapts with the extra uterine environment, having an average birth weight and no congenital anomalies.¹

The preterm, very low birth weight infants are at high risk of developing neurodevelopmental delay despite little or no medical complications at the time of birth. The care and interventions of such infants have an impact on the pre-existing risk.²

Common causes of neonatal admissions are prematurity (30%), birth asphyxia (28%), and meconium aspiration syndrome (42%). The most common cause of death was prematurity followed by birth asphyxia. This is in accordance with the Indian national figures where

prematurity and birth asphyxia are the leading causes of death in neonates during hospitalization.³

2. Need for the Study

The World Health Organization (WHO) estimates that there are 15 million preterm births every year [2]. Ninety-seven percent of LBW babies are born in low and lower-middle income countries (LMIC) where estimates of gestational age are the most difficult to ascertain. Therefore, the WHO also estimates the number of babies born with LBW, currently 25 million babies annually. [2]4 (Rates and risk factors for preterm birth).

Infants in Neonatal Intensive Care Unit (NICU) are subject to a highly continuous stressful environment, high-intensity noise, bright light and a lack of the tactile stimulation that they would otherwise experience in the womb or in general mothering care (Vickers, et al., 2008).⁵

As many as 17 to 48 percent of preterm infants demonstrate neuro-motor abnormalities during infancy e.g., abnormal muscle tone or asymmetries (Allen and Capute, 1989; Khadilkar et al., 1993; Pallas Alonso et al., 2000; Vohr et al., 2005). Some of

these infants go on to develop significant neuro-motor abnormalities and motor delays that signify cerebral palsy, but AGA babies was lower in all the behavioral characteristics most do not. Although neuro-motor abnormalities tend to like orientation, habituation, motor development, and cry resolve or do not interfere with function, transient neuromotor quality. Alter behavioral state during inactivity correlated abnormalities are associated with an increased risk of later positively with motor development and motor activity school and behavioral problems (Drillien et al., 1980; Khadilkar (r=0.80) and with cry quality (r=0.51).¹² et al., 1993; Sommerfelt et al., 1996; Vohr et al., 2005). A thorough examination of a baby just after birth for early recognition of neurobehavioral developmental disorders and conditions leads to better outcome.⁶

In addition, exhaustion caused by compliance or stress can also lead to injury or damage to development. Moreover, somatosensory, tactile, and auditory. In contrast, the NICU stimulatory environment of the hospital and lack of social interaction experiences with mother and great interaction with stimulation. After analyzing the NICU environment, the others can add to the above risks. Many reasons are conceivable focus of the present study is to evaluate the effectiveness of that by itself or in interaction with other causes can lead to tactile versus auditory stimulation on neuro behavioral the problems related to the growth and development of premature infants. Often it is unclear how much premature infants are affected by these cases.⁷

Developmental care is a broad classification of interventions designed concerning improving developmental outcomes in premature infants admitted to the neonatal intensive care unit. Nellore.”

Multi-sensory stimulation is relatively a new intervention closely related to principles of evolutionary care.⁸

Different stimulation programs included auditory touch-motor or situational stimulation or visual stimulation (11).⁹

Tactile stimulation is considered a safe practice and there are no significant harmful effects if performed appropriately. It stimulates the production of certain ‘feel good’ hormones including endorphins and oxytocin. Endorphins released with tactile stimulation are natural source of pain relief for the body (Kulkarni, et al., 2010)¹⁰

The intrauterine environment is rhythmic, but such rhythm is completely absent for the preterm infant in the incubator. The NICU environment deprives infants of sensory stimulation Lahav and Skoe described the complex sound environment in the womb as rhythmic, periodic, organized, and predictable, while in the NICU, the sound environment is described as aperiodic (white noise), unorganized, and unpredictable (alarms). In the incubator, the child no longer hears the heartbeat or the breathing rhythm of its mother. Regarding rhythmic language stimulation, only 2% to 5% of the sounds reaching the ears of the preterm infant are language. The child remains mostly lying in a horizontal position and has no vestibular stimulation and even less vestibular rhythmic stimulation. Stationary confining incubators reduce the amount of vestibular information available to the infant¹¹

A study was conducted to evaluate the neurobehavioral development of term appropriate for gestational age and small for gestational age babies during the first 2 weeks of life in a tertiary care hospital in Pondicherry. 48 neonates were assessed using Brazelton’s Neonatal Neuro Behavioral Assessment Scale (NNBAS) on 3rd, 7th and 14th day of life. The behavior of AGA (adequate gestational age) babies is characterized by optimal performance in habituation, the range of state, regulation of state and autonomic stability.

Statement of the problem

“A study to evaluate the effectiveness of Tactile stimulation Versus Auditory stimulation on Neurobehavioral development among neonates in NICU in Hospital, Nellore.”

Objectives:

- 1) To assess the Neuro behavioral development among neonates in NICU before providing tactile stimulation and auditory stimulation.
- 2) To evaluate the effectiveness of tactile stimulation versus auditory stimulation on Neuro behavioral development among neonates in NICU.

Hypothesis

Null Hypothesis:

H₀: There is no statistically significant difference on neurobehavioral development before and after providing the tactile stimulation and the auditory stimulation among neonates in NICU.

3. Methodology

Research approach: Quantitative research approach

Research design:

Factorial design setting: The study was conducted in NICU, in the selected hospital in Nellore District.

Target population: Term and pre term babies, normal weight and low birth weight babies.

Accessible population: Neonates admitted in the NICU, Narayana Medical College Hospital at Nellore.

Sample: Term and preterm babies, normal birth weight and low birth weight babies admitted in NICU.

Sampling technique: Probability stratified random sampling technique by means of lottery method.

Sample size: comprise of 100 neonates, 50 were assigned to tactile stimulation group -25 neonates in an experimental group and 25 neonates in a control group. 50 neonates were assigned to auditory stimulation group, 25 neonates in the experimental group and 25 neonates in the control group.

Sampling criteria:

Inclusion criteria:

The study includes neonates who are

- 1) Preterm, term babies, normal birth weight and low birth weight babies.
- 2) Both boy and girl babies were included.

Exclusion criteria:

- 1) Babies of parents who are not willing to participate.
- 2) Acutely ill neonates, ventilated babies.
- 3) Extremely Low birth weight (< 1000 Gms) babies.

Variables:

Independent Variables:

Tactile stimulation and Auditory Stimulation.

Dependent variables: Neuro-behavioral development of the neonates.

Tools and Techniques: The tool consists of baseline data on socio demographic variables and birth history and a Modified Brazelton's Neonatal Neuro Behavioral Assessment Scale (NNBAS) to assess the neuro behavioural development of the neonates in NICU.

Part I: Consists of Socio Demographic data including Age in days, Gender, APGAR Score at birth, APGAR Score at 5th min of birth, Birth weight of the baby, Weeks of gestation, Vaccination at birth, Birth order of baby, Mode of delivery, and Parity.

Part II: Modified Brazelton's Neonatal Neuro Behavioral Assessment Scale (NNBAS). It includes Habituation, Social-Interactive, Motor system, Activity level, State of organization, State of regulation, Autonomic system, & Reflexes on neonates to evaluate the effectiveness of tactile stimulation and auditory stimulation among neonates.

Data analysis: data was analyzed by using descriptive and inferential statistics and discussed according to the objectives and hypothesis tested in the study.

4. Results

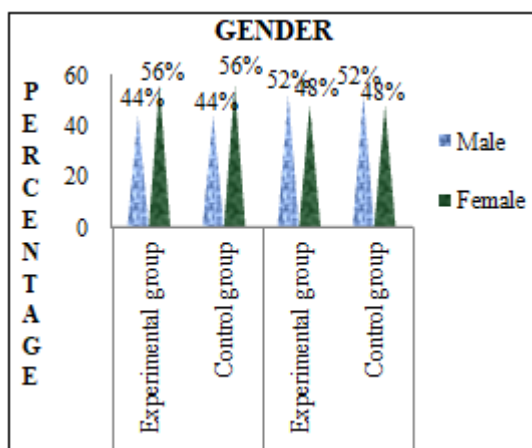


Figure 1: Percentage distribution of neonates based on gender in tactile and auditory stimulation group

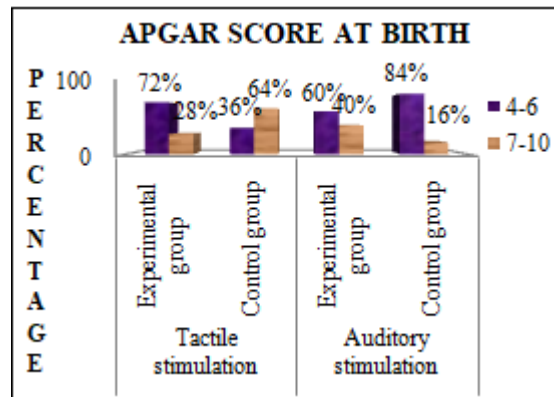


Figure 2: Percentage distribution of neonates based on APGAR score at birth in tactile and auditory stimulation group

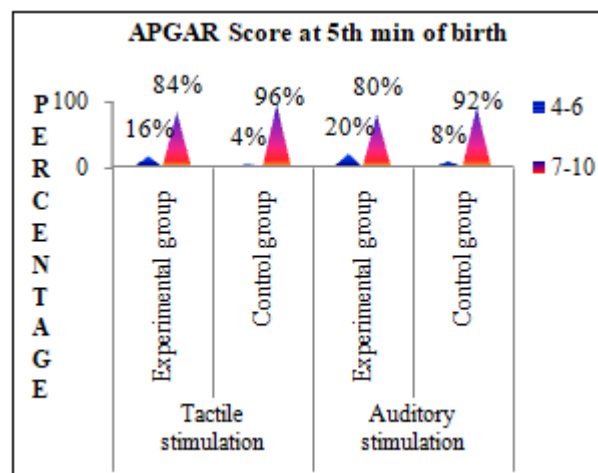


Figure 3: Percentage distribution of neonates based on APGAR score at 5th minute of birth in tactile and auditory stimulation group

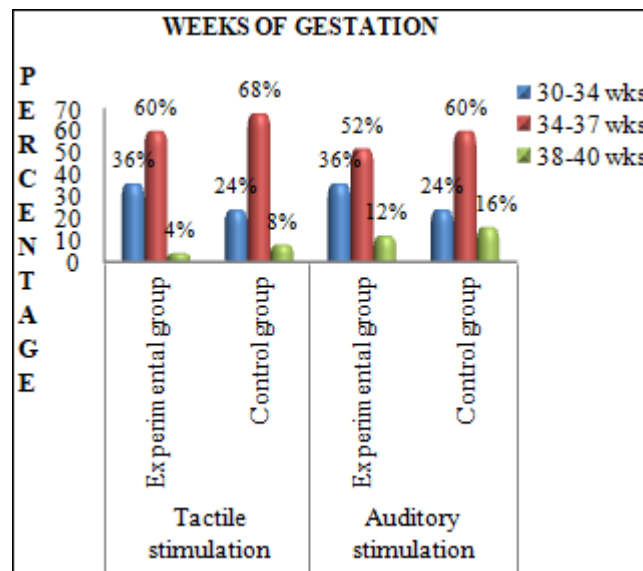


Figure 4: Percentage distribution of neonates based on weeks of gestation in tactile and auditory stimulation group

Table 1: Frequency and Percentage distribution of neonates based on age in tactile and auditory stimulation group.

(N=100)

AGE	Group – I (n= 50)				Group – II (n= 50)			
	E.G. n=25		C.G. n=25		E. n=25		C.G. n=25	
	f	%	f	%	f	%	f	%
a)< 7 Days	25	100	25	100	25	100	25	100
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 2: Frequency and Percentage distribution of neonates based on birth weight of the child in tactile and auditory stimulation group (N=100)

Birth weight of the baby	Group – I (n= 50)				Group – II (n= 50)			
	E.G. n=25		C.G. n=25		E. n=25		C.G. n=25	
	f	%	f	%	f	%	f	%
a) 1-1.5 kg	12	48	4	16	5	20	1	4
b) 1.5- 2 kg	4	16	8	32	12	48	8	32
c) 2- 2.5 kg	6	24	13	52	8	32	11	44
d) > 2.5 kg	3	12	-	-	-	-	5	20
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 3: Frequency and Percentage distribution of pre test and post test score of neurobehavioral development among neonates in Tactile Stimulation Group, (n= 100)

Neuro behavioral development	Group – I (n= 50)				Group – II (n= 50)			
	E.G. n=25		C.G. n=25		E. n=25		C.G. n=25	
	f	%	f	%	f	%	f	%
Delayed response (1-35)	21	84	19	76	15	60	18	72
Some response (36-70)	4	16	6	24	10	40	7	28
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 4: Frequency and Percentage distribution of pre test and post test score of neurobehavioral development among neonates in auditory stimulation group. (N= 100)

Neuro behavioral development	Group – I (n= 50)				Group – II (n= 50)			
	E.G. n=25		C.G. n=25		E. n=25		C.G. n=25	
	f	%	f	%	f	%	f	%
Delayed response (1-35)	22	88	20	80	14	56	16	64
Some response (36-70)	3	12	5	20	11	44	9	36
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 5: Frequency and percentage distribution of pre test and post test score of neurobehavioral development based on various components among neonates in tactile stimulation group. (n= 100)

Neuro behavioral development	GROUP – I Pre – test (n=50)				GROUP – I Post – test (n=50)			
	E.G n=25		C.G. n=25		E.G n=25		C.G. (n=25)	
	f	%	f	%	f	%	f	%
1 Habituation: No response (0-2)	-	-	3	12	1	4	2	8
Moderate response (3-5)	4	16	4	16	7	28	8	32
Good response (6-8)	21	84	18	72	17	68	15	60
Total	25	100	25	100	25	100	25	100
2.Social interaction Noreponse-0	14	56	11	44	14	56	11	44
Some response (1-4)	11	44	9	36	8	32	9	36
Moderate response (5-8)	-	-	5	20	3	12	5	20
Total	25	100	25	100	25	100	25	100
3.Motor system a)General tone: No response-0	19	76	13	52	21	84	17	68
Moderate response – 2	5	20	8	32	4	16	5	20
Total	1	4	4	16	-	-	3	12
Total	25	100	25	100	25	100	25	100
b)Power activity: No response-0-2	18	72	20	80	17	68	19	76
Moderate response – 3-5	7	28	5	20	8	32	6	24
Total	25	100	25	100	25	100	25	100
C)Motor maturity Noreponse-0	14	56	12	48	18	72	16	64
Delayed response (1-4)	9	36	9	36	6	24	6	24
Neuro behavioral development	GROUP-I Pre test (n=50)				GROUP-I Post test (n=50)			
	E.G (n=25)		C.G. (n=25)		E.G (n=25)		C.G. (n=25)	
	f	%	f	%	f	%	f	%
C).Motor maturity Some response (5-8)	2	8	4	16	1	4	3	12
Total	25	100	25	100	25	100	25	100

IV)Activity level No response-0	17	68	16	64	18	72	19	76
Some response -1	8	32	9	36	7	28	6	24
Total	25	100	25	100	25	100	25	100
V)State of organization No response-(0-2)	20	80	18	72	21	84	19	76
Moderate response – (3-5)	5	20	7	28	4	16	6	24
Total	25	100	25	100	25	100	25	100
VI)State regulation No response-(0-2)	21	84	16	64	19	76	17	68
Moderate response – (3-5)	4	16	9	36	6	24	8	32
Total	25	100	25	100	25	100	25	100
VII) Autonomic regulation No response-(0-2)	18	72	15	60	19	76	17	68
Moderate response – (3-5)	7	28	10	40	6	24	8	32
Total	25	100	25	100	25	100	25	100
VIII)Reflexes No response-(1-14)	20	80	11	44	19	76	12	48
Some response (15-28)	5	20	9	36	6	24	10	40
Moderate response (29-42)	-	-	5	20	-	-	3	12
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 6: Frequency and percentage distribution of pretest and post test score of neurobehavioral development based on various components among neonates in auditory stimulation. (N= 100)

Neuro behavioral development	Group – I Pre – test (n=50)				Group – I Post – test (n=50)			
	E.G (n=25)		C.G. (n=25)		E.G (n=25)		C.G. (n=25)	
	f	%	f	%	f	%	f	%
1) Habituation:								
No response (0-2)	-	-	3	12	1	4	2	8
Moderate response (3-5)	7	28	10	40	5	28	7	28
Good response (6-8)	18	72	12	48	19	76	16	64
Total	25	100	25	100	25	100	25	100
2) Social interaction								
Noresponse-0	12	48	9	36	14	56	11	44
Some response (1-4)	10	40	5	20	8	32	9	36
Moderate response (5-8)	3	12	11	44	3	12	5	20
Total	25	100	25	100	25	100	25	100
3) Motor system								
a)General tone:	19	76	17	68	20	80	19	76
No response-0	6	24	8	32	5	20	6	25
Total	25	100	25	100	25	100	25	100
b)Power activity:								
No response-0-2	16	64	18	72	18	72	17	68
Moderate response (3-5)	9	36	7	28	7	28	8	32
Total	25	100	25	100	25	100	25	100
C)Motor maturity								
Noresponse-0	15	60	12	48	19	76	15	60
Delayed response (1-4)	7	28	8	32	5	20	5	20
Neuro behavioral development	Group-I Pre test (n=50)				Group-I Post test (n=50)			
	E.G (n=25)		C.G. (n=25)		E.G (n=25)		C.G. (n=25)	
	f	%	f	%	f	%	f	%
C).Motor maturity								
Some response (5-8)	3	12	4	16	1	4	3	12
Moderate response (9-12)	-	-	1	4	-	-	2	8
Total	25	100	25	100	25	100	25	100
4) Activity level								
No response-0	16	64	12	48	18	72	15	60
Some response -1	9	36	10	40	7	28	9	36
Moderate response – 2	-	-	3	12	-	-	1	4

Total	25	100	25	100	25	100	25	100
5) State of organization								
No response-(0-2)	19	17	17	68	21	84	18	72
Moderate response (3-5)	6	24	8	32	4	16	7	28
Total	25	100	25	100	25	100	25	100
6) State regulation								
No response-(0-2)	21	84	16	64	18	72	17	68
Moderate response (3-5)	4	16	9	36	7	28	8	32
Total	25	100	25	100	25	100	25	100
7) Autonomic regulation								
No response-(0-2)	18	72	17	68	20	80	18	72
Moderate response (3-5)	7	28	8	32	5	20	7	28
Total	25	100	25	100	25	100	25	100
8) Reflexes								
No response-(1-14)	19	76	14	56	18	72	15	60
Some response (15-28)	5	20	8	32	7	28	9	36
Moderate response (29-42)	1	4	3	12	-	-	1	4
Total	25	100	25	100	25	100	25	100
T.C: Tactile stimulation								
A.C.: Auditory stimulation								
E.G.: Experimental group								
C.G.: Control group								

Table 7: Effectiveness of tactile stimulation and auditory stimulation on the neurobehavioral development of neonates between experimental and control group. (N=50)

Group	Experimental group (n=25)		Independent 't' test
	Mean	SD	
Tactile stimulation (Group-I)	20.5	3.9	Cal Value = 7.60 Tab Value = 3.74 S*** (p<0.001)
Auditory Stimulation (Group-II)	23.2	4.1	
S*** - Very highly Significant at (p<0.001), df _(n-1) =24			

5. Discussion

Major Findings of the Study

Description of socio-demographic variables of neonates in Tactile Stimulation

Among 50 neonates in Tactile stimulation (Group –I) with regard to age, both in the experimental and control group, 25 (100%) babies were less than 7 days. Regarding Gender, in experimental and control group, 11 (44%) were male babies and 14 (56%) were female babies respectively. With regard to APGAR score at birth, in experimental group, 18 (72%) babies had the score of 4-6, whereas in control group, 16 (64%) babies had a score of 7-10. Regarding the APGAR score at 5th min of birth, in the experimental group, 21 (84%) babies had the score of 7-10 whereas in control group, 24 (96%) babies had a score of 7-10. With regard to the birth weight of child, 12 (48%) were between 1-1.5 kg whereas in control group, 13 (52%) were between 2 – 2.5 kg at birth. With regard to weeks of gestation, in experimental group, 15 (60%) were born between 34-37 weeks, whereas in control group, 17 (68%) were born between 34-37 weeks of gestation.

Description of socio-demographic variables of neonates in auditory stimulation

Among 50 samples in Auditory Stimulation with regard to age in days, both in experimental and control group, 25 (100%) babies were less than 7 days. With regard to gender, in experimental and control group, 13 (52%) were male

babies and 12 (48%) are female babies respectively. With regard to APGAR score at birth, in experimental group, 15 (60%) babies had the score of 4-6, whereas in control group, 21 (84%) babies had the score of 4-6. With regard to APGAR score at 5th min of birth, in experimental group, 20 (80%) babies had the score of 7-10 and in a control group, 23 (92%) babies had the score of 7-10. With regard to the birth weight of the child, in experimental group, 12 (48%) are between 1.5 -2 kg, whereas in control group, 11 (44%) are between 2 – 2.5 kg at birth. Regarding the weeks of gestation, in experimental group, 13 (52%) were born between 34-37 weeks, whereas in control group, 15 (60%) were born between 34-37 weeks of gestation.

Effectiveness of Tactile stimulation versus auditory stimulation on Neuro behavioral development among neonates in NICU

The results of the study reveal that in group – I (tactile stimulation), during pretest, 21 (84%) had delayed response and 4 (16%) had some response in experimental group whereas in Control group, 19 (76%) had delayed response and 6 (24%) had some response. During Post test, 15 (60%) had delayed response and 10 (40%) had some response in experimental group whereas in Control group, 18 (72%) had delayed response and 7 (28%) had some response.

In group–II (Auditory Stimulation), with regard to neuro behavioral development among neonates, during pretest, 22 (88%) had delayed response and 3 (12%) had some response in experimental group whereas in control group, 20 (80%) had delayed response and 5 (20%) had some response. During Posttest, in experimental group, 14 (56%) had delayed response and 11 (44%) had some response. whereas in control group, 16 (64%) had delayed response and 9 (36%) had some response.

The findings reveal that both there is significant improvement in the post test mean score of neuro behavioral development among neonates in experimental groups of both tactile stimulation and auditory stimulation groups. This indicates that both tactile stimulation and

auditory stimulation are effective in improving the neuro behavioral developments of neonates when each stimulation administered separately.

The findings are consistent with results of A Randomized Clinical Trial which examined the Effect of Multi-sensory Stimulation on Neuromuscular Development of Premature Infants. The study concluded that there was a positive association between infant neurologic development and massage with human/social contact.¹⁴

Comparing the effectiveness of tactile stimulation versus auditory stimulation among neonates on neurobehavioral development in experimental and control group:

The results of the study reveals that in comparison of effectiveness of tactile stimulation versus auditory stimulation on neurobehavioral development among neonates ,In experimental group(tactile stimulation)-I, the mean score of neuro behavioral development is 20.5 with Std Deviation of 3.9 and in Group – II (Auditory Stimulation) ,the mean score of neuro behavioral development is 23.2 with Std Deviation of 4.1.The calculated value of Independent ‘t’ test is 7.60 which is greater than the table value of 3.74 at at the level of $p < 0.001$.it is statistically evident that the auditory stimulation is more effective than tactile stimulation in improving neurobehavioral development among neonates in NICU. The Null Hypothesis (H_{01}) is rejected as there is a significant difference between the post mean score of neuro behavioral development in tactile stimulation group and auditory stimulation group.

Findings of the study are consistent with the study conducted to examine the importance of Rhythmic Stimulation for Preterm Infants in the NICU which revealed that among all the interventions, the classic method of skin-to-skin contact offers the preterm infant the possibility of simultaneously receiving, in synchrony, all the maternal rhythmic signals. Coupled with maternal singing, skin-to-skin contact seems to better stabilize the physiological constants of the preterm infant and favors closeness in the mother–infant dyad. When the mother sings to her child in the kangaroo care, she offers the child a multitude of rhythms (respiratory, cardiac, singing). Skin-to-skin contact along with infant-directed singing generates a rhythmical synchronization between mother and infant, providing an envelope (tuning) of several rhythmic stimuli.¹⁵

The Limitations of this study were as follows:

- 1) The duration the current study was very short.
- 2) In this study the main effects of auditory stimulation and the tactile stimulation were examined and compared in the two independent groups. The study didn't examine the combined effects of both auditory stimulation as well as tactile stimulation.

6. Conclusion

It is evident that there is significant improvement in neuro behavioural development on neonates after providing the auditory stimulation and tactile stimulation. In comparison

of tactile versus auditory stimulation, the neonates in auditory stimulation group showed significant improvement than the tactile stimulation group.

7. Recommendations for Further Research

On the basis of findings of the study the following recommendations have been made:

- 1) A similar study can be replicated on large sample size, in different settings within a different population as the longitudinal study.
- 2) A study can be conducted to assess the combined effects of Multimodal Stimulation (Auditory, Visual and Tactile stimulation) on a neurobehavioral development and physiological parameters of Pre term neonates in NICU.
- 3) A Comparative study can be conducted to assess the effectiveness of tactile stimulation on neurobehavioral maturity among term, preterm and post term neonates.
- 4) A study can be conducted to examine the effectiveness of tactile stimulation on weight gain among pre term and low birth weight babies.
- 5) A Comparative study can be conducted on effectiveness of mother voice and stranger voice on neurobehavioral development among neonates.

Conflict of Interest: No Conflict of Interest

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