

## EFFICACY OF MUSIC THERAPY IN IMPROVEMENT OF NEUROMOTOR DEVELOPMENT IN PRETERM INFANTS

### EFICIENȚA TERAPIEI PRIN MUZICĂ ÎN ÎMBUNĂȚĂȚIREA DEZVOLTĂRII NEUROMOTORII, LA SUGARII PREMaturi

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**Keywords:** preterm, music therapy, developmental program      **Cuvinte cheie:** prematuri, meloterapie, program de dezvoltare

#### Abstract:

**Background.** Preterm birth is associated with an increased prevalence of major and minor neurodevelopmental disability. Infants born before 37 weeks of gestational age are considered preterm infants, and very preterm infants are those who are born before 32 weeks' gestational age. Infants born preterm may have a lower threshold for sensory input than full term born peers and have difficulty in tolerating handling and interaction. These problems could diminish critical experiences in their early lives.

**Objectives.** To determine the effect of Music Therapy and Developmental Program on Preterm infants in Neonatal Intensive Care Unit.

**Methods.** Forty participants were found eligible for the study as per inclusion and exclusion criteria and they were selected by simple random sampling. They were divided into two groups. Group A was a controlled group and Group B was an experimental group. There were 2 drop outs in each group because of early discharge, thus each group had 18 participants. All infants motor performance was assessed on the first and last day of intervention using TIMPS and INFANIB. Intervention was given for 3 weeks and for 30 minutes 3 times per week. Group A was given developmental program and Group B was given developmental program and music therapy.

**Results.** Statistical analysis was done using GraphPad InStat 3.06. Statistical significance was set at  $p < 0.05$ . The data analysis shows that there was marked difference in the score of INFANIB and TIMPS score which shows that music therapy and developmental program is effective in the 18 participants of the study.

**Discussions.** There was marked improvement in the activity and alertness of the infant. There were changes in French angle components of INFANIB including heel to hear and popliteal angle.

**Conclusion.** Music therapy can be used to improve the neuromotor development of the preterm infants. Thus, these strategies can be applied on a regular basis for helping such preterm infants to improve their alertness and to improve their neuromotor development.

#### Rezumat:

**Introducere.** Nașterea prematură este asociată cu o prevalență crescută a handicapului major și minor în neurodezvoltare. Sugarii născuți înainte de 37 de săptămâni de sarcină, sunt considerați sugari prematuri, și foarte prematuri copiii sunt cei care sunt născuți înainte de 32 de săptămâni, cu vârsta gestațională. Sugarii născuți prematur pot avea un prag senzorial mai redus decât copiii născuți la termen și au dificultăți în tolerarea la manipulare și interacțiune. Aceste probleme ar putea diminua experiențele critice în viața lor timpurie.

**Obiective.** Determinarea efectului terapiei prin muzică și a programului de dezvoltare la nou-născuții prematur, în unitatea de terapie intensivă de neonatologie.

**Metode.** Patruzeci de participanți au fost găsiți eligibili pentru studiu, conform criteriilor de includere și excludere și au fost selectați prin eșantionare simplă aleatorie. Ei au fost împărțiți în două grupuri: grupul A – de control și grupul B - experimental. În fiecare grup au fost eliminați câte 2 subiecți, astfel încât fiecare grup a avut 18 participanți. Toate performanțele motorii ale copiilor au fost evaluate în prima și ultima zi de intervenție folosind TIMPs și INFANIB. Intervenția a fost administrată timp de 3 săptămâni, câte 30 de minute de 3 ori pe săptămână. Grupul A a urmat programul de dezvoltare și grupul B a urmat programul de dezvoltare și terapia prin muzică.

**Rezultate.** Analiza statistică a fost efectuată folosind GraphPad InStat 3.06. Semnificația statistică a fost stabilită la  $p < 0,05$ . Analiza datelor arată că a fost remarcată o diferență între scorul INFANIB și TIMPs, scor care arată că terapia prin muzică și program de dezvoltare este eficientă la cei 18 participanți luați în studiu.

**Discuții.** A existat o îmbunătățire semnificativă a activității și vigilența a sugarului. Au existat modificări ale componentelor unghiulare franceze ale INFANIB, inclusiv unghiul popliteal.

**Concluzii.** Terapia prin muzică poate fi utilizată pentru a îmbunătăți dezvoltarea neuromotorie a sugarilor prematuri. Astfel, aceste strategii pot fi aplicate în mod regulat pentru a ajuta astfel de sugari prematuri pentru a îmbunătăți vigilența și dezvoltarea lor.

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## Introduction

Preterm birth is associated with an increased prevalence of major and minor neurodevelopmental disability. Every year an estimated 15 million babies are born preterm (before 37 completed weeks of gestation) and this number is rising, that is more than 1 in 10 babies. Three-quarters of them could be saved with current, cost-effective interventions.

Across 184 countries, the rate of preterm birth ranges from 5% to 18% of babies born. Almost 1 million children die each year due to complications of preterm birth. Many survivors face a lifetime of disability including learning disabilities, visual and hearing problems. Incidence of preterm labour is 23.3% and of preterm delivery 10-69% in India. Preterm birth complications are the leading cause of death among children under 5 years of age responsible for nearly 1 million deaths in 2013. [1]

Infants born before 37 weeks of gestational age are considered preterm and infants born before 32 weeks' gestational age are considered very preterm. [2] Preterm birth has been one of the risk factors for developmental disabilities. Infants born preterm may have a lower threshold for sensory input than their full term born peers and have difficulty in tolerating handling and interaction. Among the preterm born infant population it has been indicated that the shorter the gestation, the higher the level of risk factors for the infants. They have found that infants born at earlier gestational ages (< 32 weeks) when compared with later ages (32-36 weeks) scored lower on tests of gross motor development. Thus, time spent in the mother's womb may help to improve and to relate to the quality of motor performance at a later age. In addition to poor quality of postural stability and mobility in the preterm population might be related to differences in experiences such as longer hospital stays, neurological impairment associated with medical complications or immobility due to the constraints of medical technology. [3]

Medical and technological advances in the care of the preterm infant have greatly increased infant survival over the past decades. However, researchers have also noted that medical and nursing procedures and the excessive noise and other stimulation in the NICU environment are stressful for the preterm infant. The American Academy of Pediatrics recommended that environmental noise levels in the NICU should not exceed 45 dB. Much emphasis has been placed on techniques for reducing environmental stress and stimuli such as keeping isolettes dark and quiet as well as minimizing handling of babies. [2] The focus of the highly-trained staff in the NICU has been body system and physiologic support, as well as neuroprotective strategies and neurodevelopmental support however, in comparison with full-term, preterm infants have been found to consistently experience a higher rate of sensory impairments and promote optimal neurological/ behavioral development of these vulnerable premature infants.

More recently the use of structured stimuli (e.g., music therapy) has been encouraged as a means of reducing environmental stress. Other stress reduction techniques that have been employed to minimize environmental stress include clustering of nursery activities, positioning or swaddling of preterm infants, touch/massage therapy, kangaroo care, oral sucrose, non-nutritive sucking, multisensory stimulation and music therapy. The aim of physical therapy program is to optimise motor development and are often based upon the principles of neurodevelopmental therapy (NDT) which aims to modify sensory input and/ or abnormal movement patterns to improve motor outcome through active and/or passive techniques. [4,5] Infant stimulation programs may involve multisensory stimulation such as auditory, visual, vestibular and tactile stimulation.

Music therapy has been shown to be very beneficial in stimulating growth and development in premature infants. The coordination for sucking and breathing is often not fully developed, making feeding a challenge. The use of music in the NICU has been shown to decrease the stress response and increase oxygen levels. Womb sound music has been shown

to be very helpful in the care of mechanically ventilated agitated premature babies with low oxygen levels. [6] Musical selections for fragile premature babies must be carefully considered.

The emphasis must be given to simplicity as well as gentle rhythms, flowing and lyrical melodies, simple harmonies and a soft tone. Transient changes in amplitude must be avoided, as well as abrupt tempo changes. Complexity of sound timbre and color should be avoided as well as complex combinations of different instruments. [7]

### Objective

This study aims to determine the effect of Music Therapy and Developmental Program on Preterm infants in Neonatal Intensive Care Unit.

### Material and Methods

The study was carried out at NICU of Pravara Rural Hospital, Loni (Bk). This is an Experimental study– over study approved by the ethics committee of the institute. Pre-term infant clinically diagnosed by paediatrician were included in this study. Infants with Hypoxic Ischaemic Encephalopathy, any congenital anomalies and genetic disorder were excluded from the study. A written informed consent was obtained after explaining the procedures.

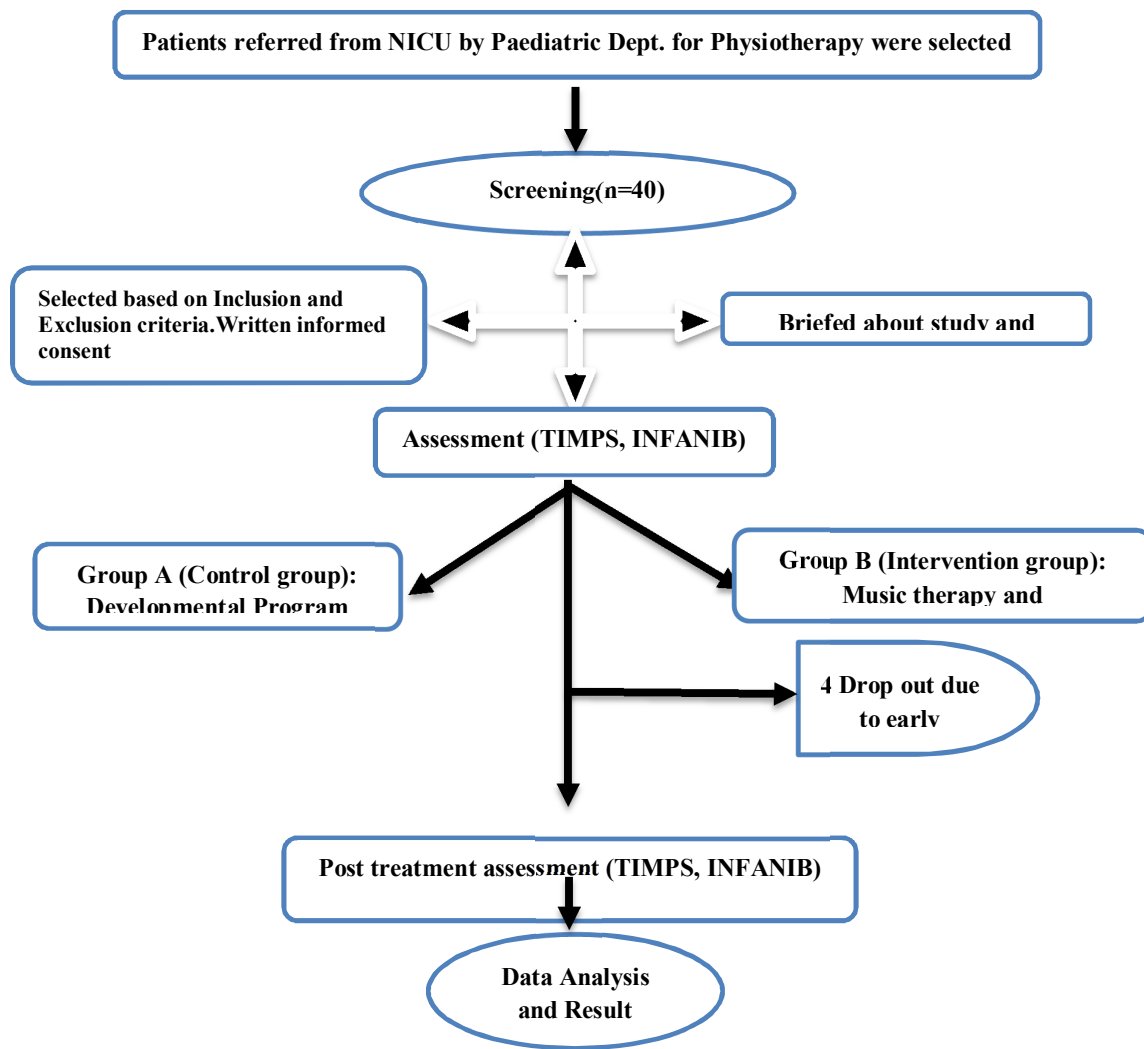


Figure 3.1 Flow Chart representing the procedure of selection of participant

There were total fifty participants who were from the in-patients NICU, referred to Paediatric Physiotherapy, Pravara Rural Hospital, Loni. Forty participants were found eligible for the study, per inclusion and exclusion criteria and they were selected by simple random sampling. They were divided into two groups Group A and Group B. Group A was controlled group and Group B was experimental group. There were 2 drop outs in each group because of early discharge, thus each group had 18 participants. Parents were explained about the nature of the study, the duration of intervention of the study, intervention and its benefits in the language best understood by them. They were encouraged to clarify queries regarding the study, if any. A written informed consent was obtained from their parents. After that demographic details of the participants including Name, Age, Gender, Height and Weight were noted. All infants motor performance was assessed on the first and last day of intervention using TIMPS and INFANIB.

In control group, participants received developmental program and intervention group received developmental program and music therapy. The intervention was planned as 3 weeks and three times a week. The training time duration for every session was approximately 30 minutes. Developmental program involved therapeutic positioning, joint proprioception, tactile facilitation and vestibular facilitation. The developmental program was given during quiet alert state of infant, 30 min before feeding.

**Tactile Stimulation**-Gentle stroking using gauze for 3 min in a sequence of chest, upper limbs and lower limbs in supine position.

**Visual stimulation**-Black and white visual stimulation card hung at 8–10 in. from the neonate for 3 min.

**Auditory stimulation** – Mother chatting with baby while he is laying on the mother lap with face to face contact for control group.

#### **Joint Proprioception**

**Vestibular Stimulation**-Gentle horizontal and vertical rocking for 3 min. Positioning-Side lying position was given using blanket rolls.

In intervention group, developmental program and music therapy was given. In music therapy, soft lullaby of 30–40 dB for 30 min was given using a miniature speaker (PHILIPS, MI 1500, INDIA) and an mp3 player. Developmental program was give as above accept auditory stimulation.

## **Result**

Statistical analysis was done by trial version of Graph Pad InStat (v 3.06) software. Various statistical measures such as mean, standard deviation (SD) and test of significance that is “paired t test” and “unpaired t test” used for comparing data. The results were concluded to be statistically significant which was seen at the post intervention.

*Table 1 Demographic profile of all participants*

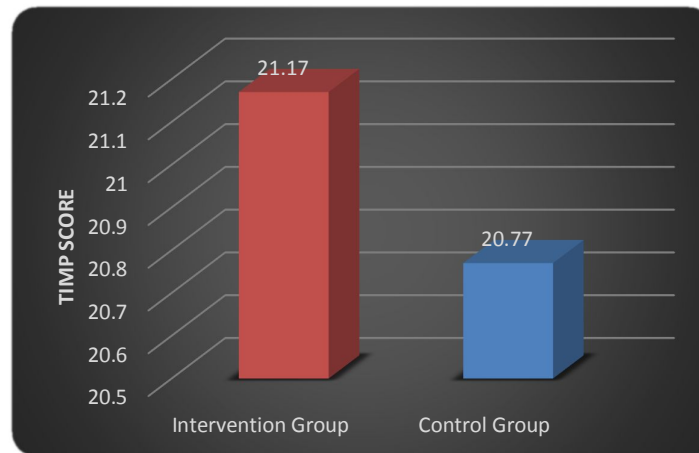
	Demographic characteristics	
	Intervention Group	Control Group
Gestational age	33±2.828	33.33±2.808
Gender ratio (Girls: Boys)	9:9	11:07

### 1. Test of Infant Motor Performance (TIMP) score

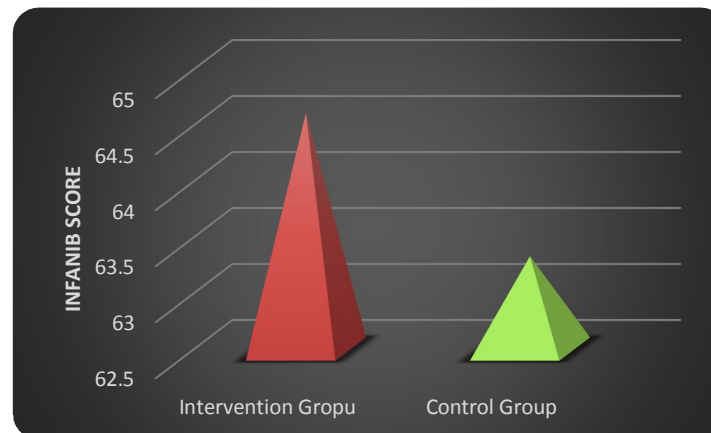
The intervention group mean value of test of infant motor performance score was 21.167 with standard deviation  $\pm 0.5145$ . The control group mean value of test of infant motor performance score was 20.78 with standard deviation  $\pm 0.4278$ . Using the “paired t test” the p value is  $<0.0001$  which shows extremely significant difference. The t value 2.715 with a degree of freedom 34.

### 2. Infant Neurological International Battery (INFANIB) score

The intervention group mean value of infant neurological international battery score was 65.11 with standard deviation  $\pm 1.568$ . The control group mean value of infant neurological international battery score was 63.22 with standard deviation  $\pm 2.756$ . The p value is 0.0163 which shows extremely significant difference. The t value 2.528 with a degree of freedom 34.



*Graph 1: -Comparison of TIMP Scores at intervention and control group of TIMP Score*



*Graph 2: -Comparison of INFANIB Scores of intervention and control group*

The data analysis shows that there was marked difference in the score of INFANIB and TIMPS score which shows that music therapy is effective in the 36 participants of the study.

## Discussion

Interventions that mimic the intrauterine environment may have a beneficial effect on the development of preterm infants and will assist them cope up with the unfavorable environment. Multisensory stimulation (ATVV) has been shown to be safe in stable preterm infants. It helps to improve alertness in preterm babies, festinate the feeding progression and reducing the length of hospital stay.

The foetus from the time of conception is thought to be organizing five distinct but interrelated subsystems: autonomic; motor; state; attention/interaction and self-regulatory. These subsystems continually react and influence each other, thus the term synactive. In babies born before term, the maturation of the five subsystems is interrupted as well as they have lost the uterine supports for these subsystems. The preterm baby is adapted for functioning in the

womb, but is required to function outside the womb at a crucial time in development and, therefore, faces a very challenging existence. [8-10]

The use of music in the NICU has been shown to decrease the stress response and increase oxygen levels. The sound level of lullabies administered was marked to 45–55 dB because it is recommended to support stable vital signs of infants in NICU. Sound is the most effective modality to achieve concurrent decrease in motility along with enhancement of cortical activity. Music can stimulate the many areas of the brain including the Hippocampus which governs the area of long-term memory. Music provide multisensory experience for infants to enhance and encode body movement awareness. It enhances the natural movement and vocalization infants make without words. Infants tend to focus while listening to soothing and sedative music. Children who grow up playing and listening to music develop strong music-related connections in the brain.

Listening to music also helps to develop spatial reasoning. Spatial awareness is the ability to be aware of one self in space. Spatial awareness also involves understanding the relationship of these objects when there is a change of position. Thus, the awareness of spatial relationship is the ability to see and understand two or more objects in relation to each other and to oneself. This is a complex cognitive skill that children need to develop at an early age.

Music provides multisensory stimulation which helps in enhancing body movement awareness. In this study, there was marked improvement in the score of pre-intervention and post intervention score after a session of music therapy for 3 weeks. There was marked improvement in the activity and alertness of the infant. Music therapy provides balanced sensory stimulation. Infants receiving music therapy session displayed more body movement and vocalization compared to the control group.

There were changes in French angle components of INFANIB including heel to hear and popliteal angle. The limb activity was increased. These responses could indicate an improved alertness and habituation response to sensory stimulation in preterm infants. The infants were turning their head towards the source of music. This will help them for proper visual tracking of toys and help them to explore their surroundings.

Music facilitates the neurogenesis, the regeneration and repair of cerebral nerves by adjusting the secretion of steroid hormones, ultimately leading to cerebral plasticity. The importance of music therapy is the relationship between temporal perceptive processes in the central nervous system and the temporal components of motor learning and performance processes. [11] Music is a complex temporal organization of acoustic events, which is sensed mainly through the auditory modality, which possesses inherent qualities that may be used specific aspects of motor behaviour. Temporal awareness is elaborately related to the coordinated interaction of muscular systems and sensory modalities. Rhythm is the most important aspect of developing a stable temporal world. [12]

It was observed in previous studies that neuronal populations in the cerebellar anterior lobe showed motor associated activity regardless of rhythmic time structure in vermal and hemispheric parts ipsilateral to the movements. It was also observed that neuronal populations in bilateral anterior posterior lobe, mainly the simple lobule, increased their activity stepwise with each increase in tempo modulation from a steady beat. Neuronal populations in other parts of the posterior lobe also showed an increase of activity only during the 20% condition, which involved conscious monitoring of rhythmic pattern synchronization, mainly on the left side contralateral to the movements.<sup>13</sup> It was also observed that music therapy causes auditory and motor interactions which mostly engage the posterior aspects of the superior temporal gyrus and the ventral and dorsal premotor cortex. This helps in initiating Central to Peripheral developmental concept of neuromotor development in infants. Through this, the present study concludes that music therapy has a positive effect on neuromotor development of preterm infants.

## Conclusion

The present study shows that the use of music therapy along with developmental program for preterm infant in NICU had similar improvement in TIMPS and INFANIB scoring. Thus, these strategies can be applied on a regular basis for helping such pre-term infants to improve their alertness and to improve their neuromotor development.

## Limitations:

The limitations of this study were:

- Smaller duration of intervention
- Small sample size

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