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**Original article**

# Effect of music therapy on the biophysical profile and oxygen consumption in preterm babies in a rural hospital

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## Abstract

**Background:** Music therapy in preterm babies helps in early weight gain and stabilization of the heart and respiratory rates, and also affects their biophysiological profile. Moreover, it has a beneficial effect on oxygen consumption and hospital stay.
**Objective**: This study aimed to assess the effect of music therapy on the biophysical profile and oxygen requirement of preterm babies.
**Methods:** The present comparative, observational study was performed in the Department of Neonatology at a rural tertiary care hospital, Sawangi Meghe, Wardha, Maharashtra, India, for one year. All relevant data were collected and analyzed using the prevalidated performa.
**Results:** The male-to-female ratio in the music and nonmusic groups was 1.5:1, and the ratio of normal delivery to cesarean section was 1.2:1. The mean gestational age in the two groups was 31.0 ± 4.0 weeks and 32.0 ± 5.0 weeks. The common etiology in the two groups was respiratory distress syndrome requiring continuous positive airway pressure. The mean birth weight of both groups was 1,240.0 ± 112.0 g and 1,285.0 ± 124.0 g, respectively. The heart rate in the music therapy group was 140.0 ± 14.0 beats/min vs. 122.0 ± 8.0 beats/min before and after intervention, respectively. The number of days that they required oxygen was lower in the music therapy group (8 *vs.* 12 days). We did not find any significant variations in desaturation episodes, respiratory rate, oxygen saturation, blood pressure, and temperature between the two groups.
**Conclusion:** Music therapy in the neonatal intensive care unit (NICU) benefits babies in the form of weight gain, stability, oxygen requirement, and physiological profile compared to no music therapy.

**Keywords:** Heart rate, music therapy, oxygen saturation, preterm babies, weight gain.

The continuous evolution of advances in obstetric and newborn care has decreased the morbidity, mortality, and neurodevelopmental sequelae in preterm babies, especially in developing countries.[1] Music therapy is an important component of developmental supportive care during preterm, which can affect an individual's physiology as well as their behavior.[2] Previous studies have shown that babies start responding to the maternal voice in the intrauterine period, starting from 25 weeks of gestation. Furthermore, the intrapartum exposure of newborns to music therapy can influence the development and maturation of the nervous system. [3] In a study by Loewy J, *et al.*[4] involving premature newborns, it was demonstrated that music therapy and nonpharmacological music medicine have a beneficial effect on pain relief, decreasing stress levels, and stabilizing the heart and respiration rates. Moreover, it helps to lower oxygen consumption, relaxes the muscles, improves physiological behavior, and helps in the early improvement of critically ill patients.[5, 6] Music therapy also has a positive effect on increasing cortisol secretion, decreasing stress levels, and helping in increasing milk secretion reflexes. [7] A study by Chou LL, *et al.* [8] evaluated oxygen saturation in 30 preterm babies and found that when music therapy was given, the oxygen saturation

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levels fell less and returned to normal more quickly compared to the nonmusic therapy group. The present study was performed to assess the biophysical profile, oxygen requirement, and early stabilization of preterm babies who received oxygen therapy in the neonatal intensive care unit (NICU).

## Materials and methods

This study has been reviewed, approved, and registered in the Independent Ethics Committee (IEC) Institute (ref. no. DMIMS(DU)/IEC/2021/659; date of approval 10/12/2021).

This study was performed to analyze the effect of music therapy on the biophysical profile, such as heart rate, respiratory rate, oxygen saturation, and oxygen requirement, of preterm babies who were kept in the NICU for weight gain and were oxygen dependent. It was a cross-sectional, observational, and comparative study conducted in the Department of Neonatology, Acharya Vinoba Bhave Rural Hospital (AVBRH), Sawangi (Meghe), Maharashtra.

### *Study design and setting*

The study analyzed the effect of music therapy in the form of recorded music on the biophysical profile, oxygen saturation, and oxygen requirement of preterm babies. This study adopted a cross-sectional, observational, and comparative design that adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations. The study was conducted in the Department of Neonatology, AVBRH, Maharashtra.

### *Selection criteria and study population*

The study included a sample size of 60 preterm babies, and the parents of the infants provided informed consent for inclusion in the study. The ethical clearance certificate was obtained from the IEC before the start of the study. As per the inclusion criteria, all included preterm babies were hemodynamically stable, recovering from their primary illness, and kept in a step-down NICU for oxygen requirements. Conversely, the exclusion criteria were defined by several parameters, including hemodynamically unstable babies, babies on continuous positive airway pressure (CPAP), and babies with congenital malformations or syndromes.

### *Data sources and variables*

Recorded music was presented to each baby through a recorded song played from a mobile device. In another group, no music therapy was offered. Every time an infant in the music therapy group was fed, music was played for 15 min, five times a day. The baby's serial daily comfort level, oxygen requirement, oxygen saturation, and overall weight gain were recorded in both groups in pre- and postmusic sessions. The age of the mother, type of delivery, gestational age of the baby, birth weight, type of feeding, weight gain, oxygen saturation, requirement of daily oxygen, and duration of hospital stay were the variables assessed for this study. The baby's vital parameters and oxygen saturation were monitored by continuous multipara monitors attached to the baby while feeding and giving kangaroo mother care (KMC).

### *Statistical analysis*

All the mother's baseline characteristics and maternal variables were entered from the maternal case records. The baby's gestation age, weight, type of feeding, daily weight gain, oxygen saturation, requirement of oxygen, and total hospital stay were entered in the prevalidated proforma. All variables and maternal details were recorded in a prevalidated proforma and entered in a Microsoft Excel spreadsheet. Statistical data analysis was performed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY). The chi-square test was employed to calculate the *P*-value. $P<0.05$ was considered statistically significant.

## Results

A total of 60 babies were studied, and the male-to-female ratio was 1.5:1. The inborn-to-outborn ratio was 1.72:1. There was more multigravida than primigravida mothers in both groups. The ratio of normal delivery to cesarean section was 1.2:1. The baseline characteristics of the mother and baby participants are shown in **Table 1.**

The mean GA (weeks) in the two groups was 31.0 ± 4.0 and 32.0 ± 5.0 weeks. The most common etiology was respiratory distress syndrome requiring CPAP. There was no significant variability in desaturation episodes, oxygen requirement, blood pressure, and oxygen saturation ($SpO_2$) in both groups. The heart rate in the music therapy group was 140.0 ± 14.0 beats/min *vs.* 122.0 ± 8.0 beats/min before and after intervention, respectively. Variation in the biophysical parameters in the two groups is presented in **Table 2.** The mean NICU stay in the music and nonmusic therapy groups was 24.0 ± 5.0 and 27.0 ± 8.0 days, respectively.

**Table 1.** Baseline demographic profile of babies in the two groups.

| Characteristics | Music therapy (n = 30) | No music (n = 30) |
|---|---|---|
| Age of mother (years) | 32.0 ± 4.0 | 29.0 ± 5.0 |
| **Gravida; n (%)** | | |
| Primigravida | 12 (40.0) | 14 (46.6) |
| Multigravida | 18 (60.0) | 16 (53.3) |
| **Born; n (%)** | | |
| Outborn | 10 (33.3) | 12 (40.0) |
| Inborn | 20 (66.6) | 18 (60.0) |
| **Gender; n (%)** | | |
| Male | 19 (63.3) | 17 (56.7) |
| Female | 11 (36.6) | 13 (43.4) |
| **Type of delivery; n (%)** | | |
| Normal | 16 (53.3) | 17 (56.6) |
| Cesarean section | 14 (46.6) | 13 (43.3) |
| **Gestation age (GA); n (%)** | | |
| <28 weeks | 8 (26.6) | 7 (23.3) |
| 28–32 weeks | 10 (33.3) | 12 (40.0) |
| 33–37 weeks | 12 (40.0) | 11(36.7) |
| Average GA in weeks | 31.0 ± 4.0 | 32.0 ± 5.0 |
| Corrected GA | 35.0 ± 5.0 | 36.0 ± 4.0 |
| **Diagnosis; n (%)** | | |
| RDS | 11 (36.6) | 12 (40.0) |
| Late-onset sepsis | 5 (16.7) | 7 (23.2) |
| Hs PDA | 4 (13.1) | 4 (13.1) |
| NEC | 6 (20.0) | 4 (13.1) |
| Bronchopulmonary dysplasia | 4 (13.1) | 3 (10.0) |
| **KMC given; n (%)** | 26 (86.9) | 27 (90.0) |

CPAP, continuous positive airway pressure; GA, gestational age; Hs PDA, hemodynamically significant patent ductus arteriosus; KMC, kangaroo mother care; NEC, necrotizing enterocolitis; NICU, neonatal intensive care unit; RDS, respiratory distress syndrome.

**Table 2.** Biophysiological parameters and oxygen requirement in the two different groups.

| Characteristics | Music therapy (n = 30) | No music (n = 30) | *P*-value* |
|---|---|---|---|
| **Heart rate (beats/min)** | | | |
| Before music | 140.0 ± 14.0 | 138.0 ± 12.0 | 0.076 |
| After music | 122.0 ± 8.0 | 132.0 ± 10.0 | |
| **Respiratory rate (cycles/min)** | 42.0 ± 6.0 | 45.0 ± 5.0 | 0.095 |
| **Blood pressure (mmHg)** | | | |
| Systolic | 64.0 ± 5.0 | 62.0 ± 4.0 | |
| Diastolic | 40.0 ± 3.0 | 44.0 ± 5.0 | |
| **$SpO_2$ (%)** | 96.0 ± 4.0 | 92.0 ± 5.0 | 0.058 |
| **Oxygen requirement in days** | 8.0 ± 2.0 | 12.0 ± 4.0 | 0.045 |
| **Flow of oxygen/minute** | | | |
| Nasal prongs | @2 L | @3 L | |
| Oxygen hood | @4 L | @5 L | |
| **Desaturation episodes/day** | 2.4 | 4.5 | 0.056 |
| **Total NICU stay (days)** | 24.0 ± 5.0 | 27.0 ± 8.0 | 0.95 |

*Statistical significance was set at $P = 0.05$. NICU, neonatal intensive care unit; $SpO_2$, saturation of peripheral oxygen

**Table 3.** Weight gain among babies in the two different groups.

| Characteristics | Mother's voice (n= 30) | Recorded music (n = 30) | *P*-value* |
|---|---|---|---|
| Birth weight (g) | 1,240.0 ± 112.0 | 1,285.0 ± 124.0 | 0.065 |
| Weight at the beginning of the study (g) | 1,324.0 ± 96.0 | 1,310.0 ± 92.0 | 0.024 |
| Average daily weight gain (g) | 12.5 ± 4.2 | 11.2 ± 4.0 | 0.127 |
| Average weight gain in the first 7 days (g) | 48.0 ± 9.0 | 42.0 ± 11.0 | 0.056 |
| Average weight gain in the following 7 days (g) | 68.0 ± 11.0 | 62.0 ± 9.0 | 0.035 |
| Overall weight gain (g) | 92.0 ± 12.0 | 90.0 ± 13.0 | 0.476 |

*Statistical significance was set at $P = 0.05$

The mean birth weight in the music therapy and nonmusic therapy groups was 1,240.0 ± 112.0 g and 1,285.0 ± 124.0 g, respectively. The average daily weight gain in the two groups was 12.5 ± 4.2 g and 11.2 ± 4.0 g, respectively **(Table 3)**. Initially, all preterm babies were started on orogastric (OG) feeding, followed by mixed OG and katori spoon, and eventually, they were breastfed.

## Discussion

Music therapy is a proven method and an important component of the multimodal approach for the growth, neurodevelopmental outcome, and physiological profile of preterm babies. A famous randomized controlled Long STEP trial done by Bauer-Rusek S, *et al.*[9] on 201 preterm babies showed similar results where the gestation age was 30.7 and 30.3 weeks, respectively. The distribution was similar to that of the index study. The common presentations in that study were intraventricular hemorrhage, periventricular leukomalacia, sepsis, and bronchopulmonary dysplasia, while respiratory distress syndrome, sepsis, and thermodynamically significant PDA were the common presentations in the index study. The mean weight at enrollment in that study was 1,612 g and 1,630 g, while the average weight of babies in our study was 1,240 g and 1,285 g.

A similar trial conducted by Auto FM, *et al.*[10] on 31 and 30 preterm babies in the experimental and control groups exhibited significant weight gain in preterm babies in the experimental group. The initial characteristics, such as gender, delivery by cesarean section, GA of babies, weight at the beginning of the study, and weight gain, were similar to ours. The postconception age in this study was 36.0 ± 2.0 weeks and 35.0 ± 2.0 weeks. The birth weight pattern was 1,494 g and 1,374 g, while in our study, the weight pattern was 1,240.0 ± 112.0 g and 1,285.0 ± 124.0 g. Furthermore, the average daily weight gain in the two groups was 12.5 ± 4.2 g and 11.8 ± 4 g.

The physiological profile was comparable in both groups in this study, although the babies were more comfortable when music therapy was used. A randomized control trial by Amini E, *et al.*[11] on 25 preterm babies found that classical music and lullabies stabilized their heart rate, maintained their temperature, and decreased their stress levels, but oxygen saturation was unaffected during this intervention. We also found that the baby's heart rate was more stable when the baby was presented with music therapy, and the $SpO_2$ did not vary as much as in those who were not presented with music therapy. A similar study by Kobus S, *et al.*[12] revealed that music therapy substantially stabilizes (decreases) heart rate when a baby sleeps but raises it by 8 beats/min when awake. Our study supports the hypothesis that music therapy stabilizes the heart rate in preterm babies.[6, 10] A possible explanation is that music therapy decreases sympathetic activity, relaxes the muscles, and decreases respiratory drive in babies.

We monitored the heart rate and other vital parameters while giving music therapy to the babies. In a similar study, Arnon S, *et al.*[13] noticed that physiological parameters such as heart rate and respiratory rate were not significantly affected during live music therapy but had a substantial impact after 30 min. They found that the heart rate varies substantially (150 *vs.* 127 beats/min) before and after the therapy. Similar findings were also noticed in our case, where the heart rate was 140 and 122 beats/min, respectively. Furthermore, in a study conducted on 21 preterm babies, Erdei C, *et al.*[14] found that music therapy was effective in preterm patients in stabilizing the physiological parameters and respiratory rate in the music therapy group. Similar results were observed in our study, where the heart rate was

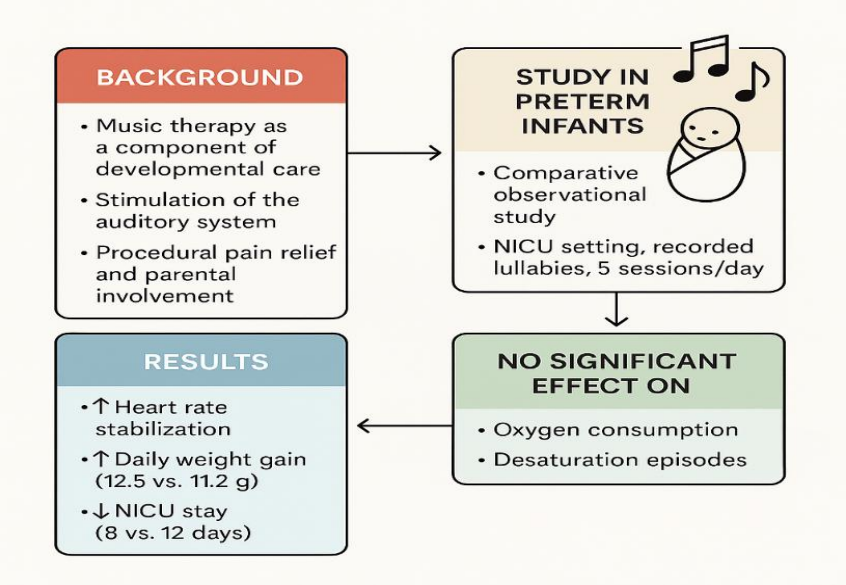


**Figure 1.** Summary of the impact of music therapy on clinical outcomes in preterm infants.

affected, but there was little improvement in the oxygen saturation of the babies. We found that the total number of days requiring oxygen was fewer in the music therapy group than in the nonmusic therapy group. A possible hypothesis postulated to examine this is that music therapy induces homeostasis, which results in relaxation of the muscles, decreased stress levels, stabilization of the respiratory center, and the stimulation of various auditory and visual receptors. In addition, the babies were more comfortable when KMC, along with music therapy, was employed. In our study, the mean NICU stay for the music and nonmusic therapy groups was 24.0 ± 5.0 days and 27.0 ± 8.0 days, respectively. Therefore, music therapy decreased the hospital stay duration and helped achieve the target weight gain early **(Figure 1)**.

We were not able to conduct the hearing test on all babies. Thus, some bias may have arisen because of partial deafness or brain insult due to prematurity or perinatal injury. Ideally, all babies should have a hearing screening (Oto-acoustic emission test) to exclude any hearing impairment.

## Conclusion

Music therapy is noninvasive, feasible, and affordable, and it can be continued at home even after discharge. It increases weight gain and induces auditory and visual stimulation in preterm babies. Furthermore, it stabilizes the heart rate, decreases the duration that oxygen supplementation is required, and can improve oxygen saturation when babies are dependent on additional oxygen provision. Additional large-scale studies are required to verify this hypothesis.

### Author contributions

ML and AT contributed substantially to the concept and design of this study, acquiring the data, reviewing the literature, and its analysis and interpretation. SK and RM contributed substantially to acquiring the data. ML, AL, and RP contributed to drafting the manuscript. RP and MW edited the manuscript critically for important intellectual content.

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### Conflict of interest statement

All authors have completed and submitted the International Committee of Medical Journal Editors Uniform Disclosure Form for Potential Conflicts of Interest. All authors declare that they have no conflicts of interest.

### Data sharing statement

All data generated or analyzed in the present study are included in the published article. Further details are available for noncommercial purposes from the corresponding author upon reasonable request.

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