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Qur'anic Murrotal Therapy on the Vital Signs of Low-Birth-Weight Infants (LBWIs) in the Neonatal Intensive Care Unit (NICU)

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ABSTRACT

Background: Low birth weight infants (LBWIs) receiving care in Neonatal Intensive Care Units (NICUs) are vulnerable to environmental stressors that may affect physiological stability. **Qur'anic Murrotal** may provide a soothing auditory stimulus to support physiological regulation. **Purpose:** This study aims to analyze the effect of Qur'anic Murrotal therapy on the vital signs of LBWIs. **Methods:** This one-group repeated-measures quasi-experimental study included 11 LBWIs selected using purposive sampling. Qur'anic Murrotal from Juz Amma, recited by Qori Muzzammil, was delivered continuously for 3 hours daily for three consecutive days using the same recording through a Rhimoa V-600K speaker positioned approximately 1 meter from the infant at 40 dBA. Vital signs were measured before intervention (Day 1) and after intervention on Day 2 and Day 3. Data were analyzed using repeated-measures analysis of variance with Greenhouse–Geisser correction and Bonferroni-adjusted pairwise comparisons. **Results:** Statistically significant differences were observed in oxygen saturation ($p = 0.026$) and body temperature ($p = 0.003$), but not in heart rate ($p = 0.450$) or respiratory rate ($p = 0.722$). Oxygen saturation increased from 92.64% on Day 1 to 95.45% on Day 2 and 96.09% on Day 3. The significant pairwise difference occurred between Day 1 and Day 2 (mean difference = -2.818 ; $p = 0.002$). For body temperature, the significant pairwise difference occurred between Day 2 and Day 3 (mean difference = -0.373 ; $p = 0.014$). **Conclusion:** This study indicates Qur'anic Murrotal was effective in stability of oxygen saturation and body temperature in LBWIs. Nevertheless, it was not effective on heart and respiratory rates in LBWIs. Further studies are recommended to confirm these findings and to explore the effects of Qur'anic Murrotal on other factors.

INTRODUCTION

Low Birth Weight Infants (LBWIs), according to the World Health Organization (WHO), are those born weighing less than 2,500 grams. Globally, it is estimated that 15–20% of all births, or more than 20 million newborns annually, are classified as LBWIs, with 95.6% of these occurring in developing countries [1]. LBWIs represent a major global health issue with both short-term and long-term implications [2]. Infants with low birth weight are approximately 20 times more likely to die compared to those born with normal weight [1]. Based on the Indonesian Health Profile data, the leading cause of neonatal mortality is low birth weight, accounting for 7,150 cases (35.3%), followed by asphyxia, with 5,464 cases (27.0%) [3]. In South Kalimantan, the incidence of LBWIs is 4.53%. LBWIs significantly contribute to increased infant morbidity and mortality. This condition can lead to heightened susceptibility to infections, malnutrition, developmental disabilities during childhood, higher risk of degenerative diseases in adulthood, and other issues related to reduced child productivity [4]. The majority of LBWIs require treatment in Neonatal Intensive Care Units (NICUs). Stressed neonates in NICUs tend to show physiological signs such as elevated heart rate, increased respiratory rate, and decreased oxygen saturation [5].

Several interventions have been developed to reduce stress in LBWIs undergoing NICU treatment, including position regulation using the nesting method, infant massage, and kangaroo care [6]. Neonates are capable of hearing sounds while still in utero, such as rhythmic noises produced by maternal blood flow in the uterus and the mother's heartbeat, which can have a calming effect [5]. Given their specific physiological and psychological conditions, neonates require distinct sensory stimuli within a controlled range. Those treated in NICUs are particularly vulnerable to excessive auditory sensory stimulation, which can provoke physiological alterations in LBWIs [7].

Because neonates in the NICU are particularly vulnerable to excessive auditory stimulation, both sound intensity and exposure duration should be carefully considered when auditory interventions are provided. The American Academy of Pediatrics recommends limiting NICU sound exposure to approximately 45 dBA [8]. Similarly, the Supporting and Enhancing NICU Sensory Experiences (SENSE) program recommends developmentally appropriate auditory exposure, with music introduced from approximately 32 weeks postmenstrual age when tolerated and gradually increased to a minimum of 3 hours of intentional auditory exposure per day by term-equivalent age [9]. The SENSE guidelines also emphasize maintaining auditory exposure at approximately 45 dBA and avoiding excessive sound levels that may negatively affect neonatal physiology. In the present study, Qur'anic Murrotal was delivered at a sound intensity of 40 dBA through a speaker positioned approximately 1 meter from the infant for 3 hours per day over 3 consecutive days. Thus, the intervention duration was consistent with the minimum daily auditory exposure described in the SENSE framework, while the sound intensity was maintained below the approximately 45 dBA level recommended for NICU auditory exposure. Nevertheless, the optimal duration and safety of repeated Qur'anic Murrotal exposure require further evaluation according to gestational age, postmenstrual age, clinical condition, and individual tolerance.

Non-pharmacological interventions have been increasingly explored to support sensory regulation and physiological stability in infants [10]. One such approach to calming the sensory nervous system is music therapy [7]. Multisite randomized clinical trials have investigated the effects of music on physiological and feeding-related outcomes among premature infants and reported potential benefits during hospitalization. [10]. A calm environment allows infants to rest, conserve energy, and minimize their energy expenditure [11]. It is essential, however, to tailor the type of music used in clinical practice to align with the cultural and religious backgrounds of the individual. The Qur'an is the holy scripture of Islam [7]. The effects of Qur'anic recitation on the physiological responses of neonates have been examined in several studies, which report significant differences in physiological responses following Qur'anic Murrotal therapy among neonates in NICUs [12].

Qur'anic Murrotal has been described as a form of auditory stimulation that may promote relaxation and reduce physiological stress. The recitation of Qur'anic verses may share some characteristics with music-based auditory interventions, including rhythmic and vocal elements that may contribute to a calming auditory experience [13], [14]. The recitation of Qur'anic verses functions similarly to

music therapy, as it contains elements of meditation, autosuggestion, and relaxation [13]. Physically, the recitation comprises human vocal elements, and the human voice is recognized as a powerful instrument for healing [15].

Previous research has shown that Qur'anic recitation in the form of *shalawat* may influence heart rate, respiratory rate, and oxygen saturation in LBW neonates[5]. Other studies have likewise reported physiological responses following Qur'anic recitation among neonates receiving NICUs [7][16]. Despite the growing evidence on neonatal auditory interventions, uncertainty remains regarding the physiological responses of low-birth-weight infants to repeated Qur'anic Murrotal exposure during NICU care. In particular, limited evidence has examined repeated Qur'anic Murrotal exposure while simultaneously evaluating multiple vital-sign parameters, including oxygen saturation, heart rate, respiratory rate, and body temperature, under a controlled sound intensity. Differences in intervention duration, sound intensity, clinical condition, and study design also make direct comparison across previous studies difficult. Therefore, this study aimed to examine changes in oxygen saturation, heart rate, respiratory rate, and body temperature among low-birth-weight infants receiving Qur'anic Murrotal therapy during NICU care. We hypothesized that Qur'anic Murrotal therapy would be associated with changes in these vital-sign parameters.

METHOD

This study was conducted at the NICU of a public hospital in Banjarmasin, using a one-group repeated-measures quasi-experimental design with a pretest-posttest format. The study population consisted of all low-birth-weight infants (LBWIs) admitted to the NICU from September to November 2023, totaling 61 infants. Participants were recruited using purposive sampling and screened according to the predefined inclusion and exclusion criteria. The inclusion criteria were: (1) infants with a birth weight of less than 2,500 g who were at least 7 days of age; (2) LBWIs regardless of gestational age at birth; (3) infants born at Hospital or referred from other hospitals; (4) infants from Muslim families; and (5) infants who were clinically stable or had mild-to-moderate respiratory distress requiring non-invasive respiratory support without endotracheal intubation or mechanical ventilation. The exclusion criteria were: (1) infants with gastrointestinal tract abnormalities; and (2) infants with respiratory distress requiring endotracheal intubation or mechanical ventilation. Eligible infants whose parents or legal guardians provided informed consent were enrolled in the study. A total of 11 infants met the eligibility criteria and were included in the final analysis. Qur'anic Murrotal therapy was administered continuously for 3 hours per day over three consecutive days. The recitation consisted of Qur'anic verses from Juz Amma, performed by Qori Muzzammil. The same audio recording was used for all infants to ensure consistency of the auditory stimulus. The recording was delivered using a Rhimoa V-600K Qur'anic speaker positioned approximately 1 meter from the infant, with the sound intensity maintained at 40 dBA. The intervention was provided while the infants continued to receive routine NICU care and prescribed clinical management. The same recording, sound intensity, speaker model, speaker distance, and daily exposure duration were maintained throughout the intervention period to minimize variation in the auditory stimulus across participants. The outcome measurements included oxygen saturation, heart rate, respiratory rate, and body temperature. Oxygen saturation, heart rate, and respiratory rate were obtained from the same bedside patient monitor routinely used in the NICU, while body temperature was measured using the standard clinical thermometer used in the unit. The measurements were recorded using a standardized vital-sign observation form. Oxygen saturation was recorded as a percentage (%), heart rate as beats per minute (bpm), respiratory rate as breaths per minute (breaths/min), and body temperature in degrees Celsius (°C). The same measurement procedures and equipment were used throughout the three measurement periods to maintain consistency. Measurements were obtained at three measurement periods. Day 1 represented the baseline pre-intervention measurement obtained before the first Qur'anic Murrotal session. Day 2 represented the post-intervention measurement obtained after the intervention on Day 2, and Day 3 represented the post-intervention measurement obtained after the intervention on Day 3. A one-way

repeated-measures analysis of variance (RM-ANOVA) was performed to compare oxygen saturation, heart rate, respiratory rate, and body temperature across the three measurement periods (Day 1, Day 2, and Day 3). Mauchly's test of sphericity was used to assess the assumption of sphericity. When the assumption of sphericity was violated, the Greenhouse–Geisser correction was applied. Pairwise comparisons were performed with Bonferroni adjustment. Statistical significance was set at $p \text{ value} < 0.05$. This study received ethical approval under registration number 273/KEP-UNISM/XII/2022.

RESULTS AND DISCUSSION

Table 1. Results of Repeated-Measures ANOVA for Vital Signs Across Three Measurement Periods

Vital Sign	Time	Mean	SD	P value
Oxygen Saturation	Before Day 1	92.64	13.52	0.026
	After Intervention Day 2	95.45	12.11	
	After Intervention Day 3	96.09	9.45	
Body Temperature	Before Day 1	36.8	0.29	0.003
	After Intervention Day 2	36.5	0.27	
	After Intervention Day 3	36.9	0.24	
Respiratory Rate	Before Day 1	46.36	8.35	0.722
	After Intervention Day 2	49.00	8.77	
	After Intervention Day 3	48.36	7.51	
Heart Rate	Before Day 1	149.82	17.01	0.450
	After Intervention Day 2	149.27	19.50	
	After Intervention Day 3	145.27	18.41	

Based on Table 1, the repeated-measures ANOVA showed no statistically significant differences in heart rate ($p = 0.450$) or respiratory rate ($p = 0.722$) across the three measurement periods. In contrast, statistically significant differences were observed in oxygen saturation ($p = 0.026$) and body temperature ($p = 0.003$). These findings indicate that the mean values of oxygen saturation and body temperature differed significantly across the three measurement periods, whereas heart rate and respiratory rate did not show statistically significant changes over time.

Table 2. Bonferroni-Adjusted Pairwise Comparisons Across Measurement Periods Results

Variable	Time Comparison	Mean Difference	P value
Oxygen Saturation	Day 1 vs Day 2	-2.818	0.002
	Day 1 vs Day 3	-3.455	0.101
	Day 2 vs Day 3	-0.636	1.000
Body Temperature	Day 1 vs Day 2	0.245	0.074
	Day 1 vs Day 3	-0.127	0.515
	Day 2 vs Day 3	-0.373	0.014
Respiratory Rate	Day 1 vs Day 2	-2.636	1.000
	Day 1 vs Day 3	-2.000	1.000
	Day 2 vs Day 3	0.636	1.000
Heart Rate	Day 1 vs Day 2	1.091	1.000
	Day 1 vs Day 3	4.545	0.709
	Day 2 vs Day 3	3.455	1.000

Based on Table 2, Pairwise comparisons with Bonferroni adjustment showed a statistically significant difference in oxygen saturation between Day 1 and Day 2 (mean difference = -2.818 ; $p = 0.002$). However, no statistically significant differences were observed between Day 1 and Day 3 (mean difference = -3.455 ; $p = 0.101$) or between Day 2 and Day 3 (mean difference = -0.636 ; $p = 1.000$). For body temperature, the overall Repeated Measures ANOVA showed a statistically significant difference across the three measurement periods ($p = 0.003$). Pairwise comparisons using Bonferroni adjustment showed a statistically significant difference between Day 2 and Day 3 (mean difference = -0.373 ; $p = 0.014$). However, no statistically significant differences were observed between Day 1 and Day 2 (mean difference = 0.245 ; $p = 0.074$) or between Day 1 and Day 3 (mean difference = -0.127 ; $p = 0.515$). No statistically significant differences were observed in respiratory rate ($p = 0.722$) or heart rate ($p = 0.450$) across the three measurement periods, and none of the pairwise comparisons reached statistical significance (all $p > 0.05$).

The environment of a Neonatal Intensive Care Unit (NICU) is highly stressful and may lead to severe complications in neonates receiving care in such settings [17]. Alterations in vital signs are among the complications that may arise [7][17]. The auditory function of preterm infants becomes optimally functional when the gestational age surpasses 32 weeks [18][17]. One therapy that may be utilized to help maintain stable vital signs in low-birth-weight infants (LBWI) is music therapy [19]. Music is composed of various elements-namely, frequency, intensity, timbre, interval, and duration [20]. Sound stimulation has complex physiological, psychological, and spiritual effects, including changes in brain wave patterns and hormone production [21] [22]. It can lead to decreased activation of the right frontal lobe, subsequently reducing the secretion of stress hormones such as cortisol to within normal limits [5] [23]. Direct vocalizations or lullabies performed by parents, as facilitated by certified music therapists, have been shown to influence both cardiac and respiratory functions [2]. Given these acoustic components, the recitation of the Qur'an (Murrotal) inherently contains elements that can induce tranquility [20] [24] [25].

This study examined changes in the vital signs of low-birth-weight infants receiving Qur'anic Murrotal therapy in the NICU. The overall repeated-measures analysis showed statistically significant differences in oxygen saturation ($p = 0.026$) and body temperature ($p = 0.003$) across the three measurement periods. In contrast, no statistically significant differences were observed in heart rate ($p = 0.450$) or respiratory rate ($p = 0.722$). For oxygen saturation, pairwise comparisons with Bonferroni adjustment demonstrated a statistically significant difference only between Day 1 and Day 2 (mean difference = -2.818 ; $p = 0.002$). The differences between Day 1 and Day 3 (mean difference = -3.455 ; $p = 0.101$) and between Day 2 and Day 3 (mean difference = -0.636 ; $p = 1.000$) were not statistically significant. Although the mean oxygen saturation increased from 92.64% on Day 1 to 95.45% on Day 2 and 96.09% on Day 3, the pairwise analysis indicated that the statistically significant change was limited to the Day 1–Day 2 comparison.

The observed improvement in oxygen saturation is generally consistent with previous studies with previous studies suggesting that Qur'anic recitation and other forms of soothing auditory stimulation may support physiological stability in premature and low-birth-weight infants [20] [23][26]. More recent evidence further supports the potential role of music-based auditory stimulation in neonatal physiological regulation. Shahbazi et al. (2025), in a systematic review and dose-response meta-analysis involving 30 randomized controlled trials and 1,855 neonates, reported a significant positive association between the duration of music therapy and oxygen saturation, with longer exposure associated with greater increases in oxygen saturation. Importantly, their review also included a trial investigating Holy Qur'an recitation among neonates admitted to the NICU, thereby placing Qur'anic recitation within the broader evidence base of neonatal auditory interventions. A recent study by Kusvitasari et al., (2026) similarly reported significant improvement in weight among LBW infants receiving a combination of Kangaroo Mother Care and Qur'anic Murrotal therapy administered for three consecutive days. Although weight gain was the primary outcome in that study rather than oxygen saturation, the authors discussed potential contributions of the intervention to infant comfort, thermal stability, and energy conservation [27]. However, the evidence is not entirely consistent. A Cochrane review by Haslbeck et al. (2023) reported that music and vocal

interventions probably do not increase oxygen saturation during the intervention, indicating that the physiological effects of auditory stimulation may vary across studies and intervention characteristics. The mechanism underlying the observed change in oxygen saturation cannot be determined directly from the present study. One possible explanation is that soothing auditory stimulation may promote comfort and relaxation, thereby reducing physiological stress and metabolic demands. Modulation of autonomic nervous system activity has also been proposed as a mechanism through which music and other soothing auditory stimuli may influence neonatal physiological responses. Shahbazi et al. (2025), proposed that music may act through limbic and autonomic pathways to promote relaxation, regulate respiratory patterns, stabilize heart rate, and support oxygenation. In the NICU, soothing auditory stimulation may also reduce the relative impact of stressful environmental sounds by providing a more organized and predictable auditory stimulus.

Therefore, the findings should be interpreted as an observed temporal change rather than definitive evidence of a causal effect of Qur'anic Murrotal therapy. Increased oxygen saturation is further supported by reduced metabolic demands as infants experience a sense of calm and relaxation while positioned in a nest and exposed to the Qur'anic recitation [5]. Stabilization of vital signs may be attributed to the effect of Qur'anic recitation in decreasing sympathetic nervous system activity in neonates. A reduction in sympathetic activity promotes relaxation, lowers stress, slows respiratory rate, and decreases heart rate. Furthermore, the Qur'anic sound may serve as a distraction, diverting neonates' attention away from inappropriate auditory stimuli in the NICU, thereby enhancing relaxation and sustaining positive physiological responses. According to Ramdaniati et al. (2018) soothing sounds such as music are effective in stabilizing oxygen saturation without negatively impacting apnea or bradycardia. This can be explained by the auditory development in both preterm and full-term neonates, who are capable of responding to environmental sounds as early as 18 weeks of gestation, given that fetal auditory structures begin forming at approximately 7 weeks gestation [6]. Qur'anic Murrotal provides structured auditory stimulation that may promote a calm state and reduce exposure to stressful environmental stimuli in the NICU. The physiological response to soothing auditory stimulation may involve modulation of autonomic nervous system activity, resulting in relaxation and changes in cardiopulmonary regulation.

For body temperature, the overall repeated-measures analysis showed a statistically significant difference across the three measurement periods ($p = 0.003$). However, pairwise comparisons with Bonferroni adjustment showed that the statistically significant difference occurred only between Day 2 and Day 3 (mean difference = -0.373 ; $p = 0.014$). No statistically significant differences were observed between Day 1 and Day 2 (mean difference = 0.245 ; $p = 0.074$) or between Day 1 and Day 3 (mean difference = -0.127 ; $p = 0.515$). The mean body temperature decreased from 36.8°C on Day 1 to 36.5°C on Day 2 and subsequently increased to 36.9°C on Day 3. This pattern indicates that the overall significant effect was driven primarily by the difference between Day 2 and Day 3 rather than by a consistent increase or decrease throughout the three-day observation period. This may be attributed to the rhythmic structure of the Qur'anic recitation, which influences both brainwave activity and stress hormone levels in LBWI, resulting in more effective physiological responses that reduce heat loss. This finding is consistent with previous studies Annisa and Mentari (2021) which confirm that music is effective in maintaining the thermal stability of neonates. Shahbazi et al. (2025) identified body temperature as one of the physiological outcomes examined in randomized controlled trials of neonatal music therapy and reported a dose-response relationship between music exposure and body temperature. These findings suggest that auditory interventions may be associated with changes in neonatal physiological regulation; however, the direction and magnitude of temperature changes may vary across studies.

Nevertheless, the temperature findings in the present study should be interpreted cautiously because neonatal thermoregulation is influenced by multiple clinical and environmental factors. Environmental temperature, incubator or radiant warmer settings, clothing and wrapping, handling, feeding, clinical condition, oxygen therapy, and routine thermal care may all contribute to changes in body temperature during NICU hospitalization. Because these factors were not fully controlled in the present study, the observed difference between Day 2 and Day 3 cannot be attributed solely to

Qur'anic Murrotal therapy. Future studies should standardize thermal management and monitor relevant environmental and clinical variables when evaluating the effect of auditory interventions on neonatal temperature.

In contrast, no statistically significant differences were observed in heart rate ($p = 0.450$) or respiratory rate ($p = 0.722$) across the three measurement periods. These findings should be interpreted within the broader and heterogeneous evidence on auditory and music-based interventions in preterm infants. Yue et al. (2020), in a systematic review and meta-analysis of randomized controlled trials, reported significant pooled effects of music therapy on heart rate and respiratory rate but also identified substantial variability related to intervention characteristics and study designs. More recent evidence provides a more cautious interpretation. A Cochrane review reported that music and vocal interventions probably do not reduce respiratory rate in preterm infants, although a reduction in heart rate was observed during and after the intervention [28]. Similarly, Shen & Bao (2024), in a randomized controlled trial involving 100 preterm infants, observed a decreasing trend in respiratory rate at several observation points, however the differences were no longer statistically significant after adjustment for multiple comparisons. Heart rate also did not show statistically significant changes. In contrast, Aoki et al. (2025), in a randomized controlled trial involving 33 very preterm infants, reported a significant reduction in respiratory rate and a small but statistically significant increase in oxygen saturation following exposure to recorded parental songs, whereas heart rate did not differ significantly between groups. These findings suggest that physiological responses to auditory stimulation may vary according to the type of auditory stimulus, intervention duration and frequency, gestational age, birth weight, clinical condition, and study design. Therefore, the absence of statistically significant changes in heart rate and respiratory rate in the present study should not necessarily be interpreted as evidence of an absence of physiological effects of Qur'anic Murrotal; rather, the present study did not demonstrate statistically detectable changes.

The different patterns observed in oxygen saturation, body temperature, heart rate, and respiratory rate highlight that neonatal physiological responses to auditory stimulation are not necessarily uniform across vital-sign parameters. Music-based interventions may influence physiological regulation through multiple pathways; however the magnitude and direction of these responses may depend on the infant's gestational age, birth weight, behavioral state, clinical condition, type of auditory stimulus, duration and frequency of exposure, and the surrounding NICU environment. The heterogeneity reported in recent systematic reviews and randomized controlled trials further suggests that auditory interventions should not be expected to produce identical physiological responses across different neonatal populations and outcome measures.

The use of Qur'anic Murrotal in the present study also represents a culturally specific form of auditory stimulation within neonatal care. While much of the existing literature has examined recorded music, lullabies, parental singing, and other forms of music therapy, evidence specifically evaluating Qur'anic recitation among low-birth-weight infants in NICU settings remains comparatively limited. The inclusion of Qur'anic recitation within the evidence synthesized by Shahbazi et al. (2025) further indicates that this intervention may be considered within the broader field of neonatal auditory stimulation. The present study therefore provides preliminary evidence regarding the potential physiological responses associated with Qur'anic Murrotal therapy among low-birth-weight infants, while recognizing that controlled studies with larger samples are needed to establish its effectiveness.

This study has several limitations. First, the one-group repeated-measures design without a control group limits the ability to determine whether the observed changes in vital signs were specifically attributable to Qur'anic Murrotal therapy rather than to spontaneous physiological adaptation, maturation, routine NICU care, or other clinical factors. Second, the small sample size ($n = 11$) limits statistical power and the generalizability of the findings. Third, potential confounding factors, including clinical condition, oxygen therapy, medication, feeding, thermal management, environmental conditions, and other routine NICU interventions, could not be completely controlled. Fourth, the absence of randomization further limits causal inference. Therefore, future studies should

employ larger sample sizes, randomized controlled designs, standardized Qur'anic Murrotal protocols, and appropriate control groups while systematically monitoring relevant clinical and environmental factors

Conclusion

Appropriate auditory stimulation may be considered as a supportive non-pharmacological approach for low-birth-weight infants receiving care in the NICU. In the present study, Qur'anic Murrotal therapy was associated with statistically significant differences in oxygen saturation and body temperature across the three measurement periods, whereas no statistically significant differences were observed in heart rate or respiratory rate. Pairwise analysis with Bonferroni adjustment showed that the statistically significant difference in oxygen saturation was limited to Day 1–Day 2, while for body temperature, the significant difference was observed only between Day 2 and Day 3. These findings suggest a potential role of Qur'anic Murrotal in supporting physiological stability; however, the findings should be interpreted cautiously because of the small sample size, absence of a control group, lack of randomization, and potential influence of clinical and environmental confounding factors. In clinical practice, Qur'anic Murrotal may be considered a complementary auditory intervention within developmentally appropriate NICU care, provided that its administration does not interfere with essential clinical management. Future studies should use larger samples, randomized controlled designs, standardized intervention protocols, and appropriate control groups to establish the effectiveness of Qur'anic Murrotal and determine optimal duration and frequency of intervention. Further research may also investigate its potential effects on procedural pain and longer-term neonatal outcomes.

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