Journal of Islamic Nursing, 2026, 11(1), 42-59
DOI : https://doi.org/10.24252/join.v11i1.64888 pISSN 2528-2549; eISSN 2545127
Received 22 January 2026, Revised 18 July 2026, Accepted 21 July 2026, Published 24 July 2026

THE EFFECT OF LISTENING QUR'AN RECITATION THERAPY TOWARDS PHYSIOLOGIC OUTCOMES AMONG NEONATES UNDERWENT IN NEONATAL INTENSIVE CARE UNIT: META-ANALYSIS

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Abstract

Audio stimulation, including Qur'an recitation therapy is broadly utilized within the neonatal intensive care unit (NICU). This study aimed to evaluate the effect of Qur'an recitation therapy compared with routine care on physiological outcomes among neonates admitted to the NICU. A comprehensive systematic review was conducted in PubMed, ScienceDirect, Cochrane Library, Scopus, ProQuest, and ClinicalKey, and the final search was performed on 16 October 2025 in Google Scholar to identify relevant English and Arabic studies comparing Qur'an recitation therapy with routine care. A systematic review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-analyses 2020 (PRISMA) guidelines, with search terms containing "neonate", "Qur'an recitation", "physiological response" and "NICU". A total of 738 neonates, consisting of three quasi-experimental and nine RCTs studies. The RCT trials were subjected to a meta-analysis. The results revealed a substantial difference between the two groups when it came to using Qur'an recitation therapy to reduce heart rate with a standard mean difference (SMD) effect value of -0.437 ($p < 0.001$), respiratory rate (SMD = -0.463; $p < 0.001$) and increasing oxygen saturation (SMD = 0.490; $p < 0.001$). Our study suggested adopting Qur'an recitation therapy in the regularly care of NICU patients to control their physiology. The timing, duration, type of surah, and schedule of Qur'an recitation therapy can be designed to a neonate's clinical conditions. Future research should concentrate on data collecting that is consistent and well-defined, as well as the use of established terminology for Qur'an recitation therapy.

Keywords: Qur'an recitation therapy; neonate; NICU; physiologic outcomes; meta-analysis.

Abstrak

Stimulasi audio, termasuk terapi lantunan bacaan Al-Qur'an, telah banyak digunakan di Neonatal Intensive Care Unit (NICU). Penelitian ini bertujuan untuk mengevaluasi pengaruh terapi lantunan bacaan Al-Qur'an dibandingkan dengan perawatan rutin terhadap luaran fisiologis pada neonatus yang dirawat di NICU. Tinjauan sistematis yang komprehensif dilakukan dengan menelusuri basis data PubMed, ScienceDirect, Cochrane Library, Scopus, ProQuest, dan ClinicalKey, sedangkan penelusuran terakhir dilakukan pada 16 Oktober 2025 melalui Google Scholar untuk mengidentifikasi penelitian berbahasa Inggris dan Arab yang membandingkan terapi lantunan bacaan Al-Qur'an dengan perawatan rutin. Tinjauan sistematis ini dilaksanakan sesuai dengan pedoman Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 (PRISMA 2020), dengan menggunakan kata kunci yang mencakup "neonate", "Qur'an recitation", "physiological response", dan "NICU". Sebanyak 738 neonatus dari 12 penelitian memenuhi kriteria inklusi, yang terdiri atas 3 studi kuasi-eksperimental dan 9 uji coba terkontrol secara acak (Randomized Controlled Trials/RCT). Seluruh studi RCT kemudian dianalisis lebih lanjut menggunakan meta-analisis. Hasil penelitian menunjukkan adanya perbedaan yang bermakna antara kelompok terapi lantunan bacaan Al-Qur'an dan kelompok perawatan rutin. Terapi lantunan bacaan Al-Qur'an terbukti efektif dalam menurunkan denyut jantung dengan nilai standardized mean difference (SMD) sebesar -0,437 ($p < 0,001$), menurunkan frekuensi napas (SMD = -0,463; $p < 0,001$), serta meningkatkan saturasi oksigen (SMD = 0,490; $p < 0,001$). Hasil penelitian ini menunjukkan bahwa terapi lantunan bacaan Al-Qur'an layak dipertimbangkan untuk diintegrasikan ke dalam perawatan rutin pasien NICU sebagai upaya membantu mengendalikan

respons fisiologis neonatus. Waktu pelaksanaan, durasi, jenis surah, dan jadwal pemberian terapi lantunan bacaan Al-Qur'an dapat disesuaikan dengan kondisi klinis masing-masing neonatus. Penelitian di masa mendatang perlu berfokus pada pengumpulan data yang lebih konsisten dan terstandarisasi, serta penggunaan terminologi yang baku dalam mendeskripsikan terapi lantunan bacaan Al-Qur'an.

Kata kunci: *terapi lantunan bacaan Al-Qur'an; neonatus; NICU; luaran fisiologis; meta-analisis.*

Introduction

Newborns with fewer than 37 weeks' gestation are premature (World Health Organization, 2018). Preterm births account for 35% of all neonatal mortality worldwide, with 15 million preterm infants born annually (Chawanpaiboon et al., 2019). Preterm births, which are currently the largest cause of child mortality, were predicted to comprise 13.4 million births in 2020 (World Health Organization, 2023).

Due to their weakened respiratory systems, challenging feedings, irregular body temperatures, and increased risk of infection, preterm newborns are especially susceptible to problems (World Health Organization, 2015). Hospitalized newborns are exposed to various environmental stressors that can lead to elevated stress responses with immediate or long-term consequences (Anderson & Patel, 2018; Majidipour et al., 2018; Sanders & Hall, 2018). The NICU stressors include high noise or light levels, clinical procedures, and separation from the mother (Aita et al., 2013; Montirosso et al., 2012; Nist et al., 2019; Weber & Harrison, 2019). Interventions to mitigate such stressors before or during pregnancy, as well as for the preterm infant after birth, have been shown to reduce preterm infant mortality (Cao et al., 2022).

Among non-pharmacological strategies in the neonatal intensive care unit (NICU), audio stimulation is recommended to alleviate stress, promote relaxation, lessen pain during procedures, and support vital signs such as respiration, pulse, and oxygen saturation (Caparros-Gonzalez et al., 2018; Cardoso et al., 2015; Cavaiuolo et al., 2015; Loewy et al., 2013; Pölkki & Korhonen, 2014). Audio interventions may take the form of music therapy or Qur'an recitation therapy (QRT), defined as measured and melodic Qur'anic recitation delivered at safe sound intensities (Qolizadeh et al., 2019). Mechanistically, listening to Qur'anic recitation has been associated with increased alpha brain wave activity, reduced stress and negative affect, calmer behavioral states, and stabilization of vital signs, effects that could be relevant for fragile preterm neonates (Vaghefi et al., 2015). Consistent with these calming and anxiolytic properties, evidence outside the NICU shows that QRT significantly reduces labor anxiety in primiparous women, reinforcing its potential to modulate stress-related physiology (Handriyani et al., 2024).

In 2019, systematic review of five studies found that recitation of the Qur'an significantly associated physiological responses in neonates admitted to NICU (Devi & Rustina, 2019). However, the available evidence remained inconclusive and required further quantitative synthesis. Therefore, this study aimed to evaluate the effect of Qur'an recitation therapy compared with routine care on heart rate, respiratory rate, and oxygen saturation among neonates admitted to the NICU.

Methods

Design

This study followed the PRISMA guidelines (Page et al., 2021). Search results are shown in Figure 1, and the PICO's framework (participants, intervention, comparison, results, study design) was utilized to answer the review question. The study protocol was registered with PROSPERO (CRD42022369554).

Search methods

An online search was conducted with no time constraints in ScienceDirect, PubMed, Cochrane, Scopus, ProQuest, and ClinicalKey, with the final search performed on 16 October 2025 in Google Scholar. We comprehensively searched the database to identify all the relevant studies on Qur'an recitation therapy in neonates underwent to the NICU. In the search strategies, the following terms were used; ("neonate OR infant") AND ("holy quran" OR "quran recitation" OR "quran murottal") AND ("physiological response") AND ("intensive care unit" OR "neonatal intensive care unit" OR "NICU").

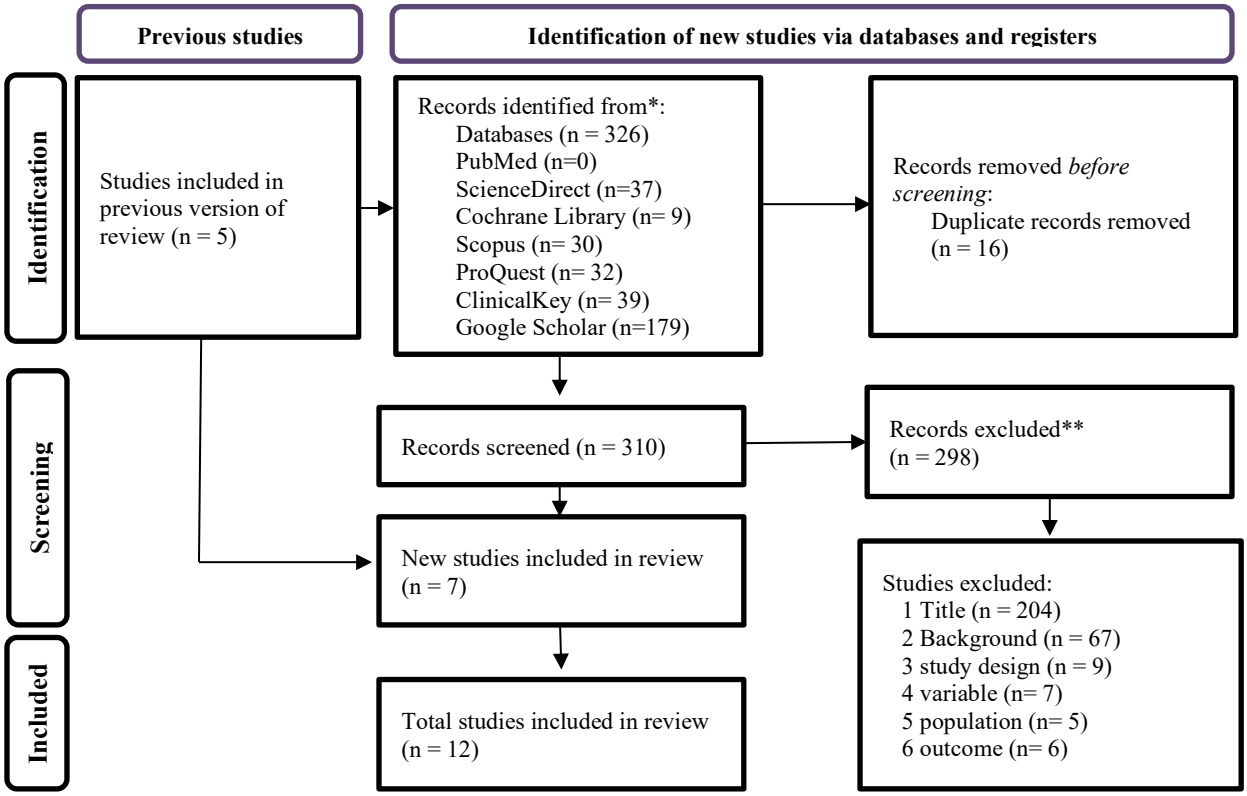


Figure 1. PRISMA 2020 flow diagram for updated systematic reviews.

Inclusion and exclusion criteria

In the current review, the inclusion criteria of the studies were based on PICO, as follows: (i) neonate or infant patients, male and female, who have been admitted to the NICU. (ii) Intervention: research studies in those patients who receiving Qur'an recitation therapy as a therapy, administered by a trained person, such as a nurse or therapist in the NICU, without distinction of the frequency, duration, and schedule of Qur'an recitation therapy interventions. It includes any Surah as well as devices such as headphones, MP3 players, and speakers. (iii) Comparator: we included any comparator in studies where patients in the control group got routine care. (iv) Results: physiological outcomes such as heart rate, respiratory rate, oxygen saturation, temperature, and blood pressure were measured. Patients not admitted to the NICU, any protocols, reviews, ongoing clinical trials, meta-analysis, conference posters, and letters to editors were all excluded.

Data Extraction

The studies identified by four independent reviewers (MM, DDSAD, WYS), data management Rayyan.ai was used to generate a list of prospective studies and to delete duplicates. The primary reviewers (SKW, AH) The primary reviewers extracted data in data extraction sheets individually. Formal discussions and consensus with the other reviewers resolved the differences and discrepancies. Extracted final data were study (author's name, year, country, study methods, and sample size), intervention (frequency, duration, devices, sound intensity), and outcomes evaluated. Table 1 summarizes the 12 studies that investigated the effects of Qur'an recitation therapy on physiological outcomes in hospitalized neonate in the NICU.

Quality appraisal

Following data extraction, two primary reviewers (SKW and AH) independently assessed the methodological quality and risk of bias of the included studies. The nine randomized controlled trials were evaluated using the Cochrane Risk of Bias tool and the JBI critical appraisal checklist for randomized controlled trials, while the three quasi-experimental studies were assessed using the JBI critical appraisal checklist for quasi-experimental studies (Barker et al., 2023; Higgins et al., 2011; Munn et al., 2023). The Cochrane tool was used to evaluate domain-specific risks of bias, whereas the JBI checklists were used to assess the methodological rigor of each study. Disagreements between SKW and AH were discussed with the other reviewers (MM, DDSAD, and WYS) until consensus was reached. No numerical cutoff was used to determine study inclusion. All studies that met the predefined eligibility criteria were retained, and the appraisal findings were used to inform the synthesis and interpretation of the pooled results.

Outcome measures
Physiological outcomes such as heart rate, respiratory rate, and oxygen saturation were the primary results of this review. Temperature, blood pressure, comfort, pain level, diet, surah use, and how this therapy works were secondary outcomes.

Data analysis
Post-intervention means, standard deviations, and sample sizes were extracted for the QRT and routine-care groups. Effect sizes were calculated as standardized mean differences with Hedges' correction for small-sample bias and were presented with 95% confidence intervals. Negative effect sizes indicated lower heart rate or respiratory rate in the QRT group, whereas positive effect sizes indicated higher oxygen saturation. When multiple post-intervention measurements were reported, the measurement obtained immediately after completion of QRT was selected. For repeated interventions, the measurement obtained immediately after the final scheduled session was used. Only one effect estimate from each study was included for each outcome. For multi-arm trials, only the QRT group and the routine-care control group were included.
Meta-analyses were performed using a random-effects model because clinical and methodological variation was expected across studies. Between-study variance was estimated using the DerSimonian–Laird method. Heterogeneity was evaluated using Cochran's Q, I^2, and τ^2. Leave-one-out sensitivity analyses were performed by sequentially excluding each study to determine whether an individual study substantially influenced the direction, magnitude, or statistical significance of the pooled effect. Formal subgroup analyses according to delivery device or intervention duration were not performed because of the small number of studies, uneven subgroup distribution, and incomplete reporting of intervention characteristics. Publication bias was assessed separately for each outcome using visual inspection of funnel plots, Egger's regression test, and Rosenthal's fail-safe N. Publication-bias findings were interpreted cautiously because fewer than ten studies were included in each meta-analysis.

Results

Study selection
A total of 326 records were identified through searches of seven databases. After 16 duplicate records were removed, 310 records remained for screening. Of these, 298 records were excluded based on the title, abstract, study design, variables, population, or outcomes. Seven new studies met the eligibility criteria and were combined with five studies included in the previous review, resulting in a total of 12 studies in the updated systematic review.
Table 1 summarizes and presents the characteristics of the 12 included studies, which included nine RCTs and three quasi-experimental studies. The total number of participants who took part in the included studies was 738. Intervention was delivered via headphones or speakers, with sound intensity between 45–75 dB. Six studies used headphones mounted on neonatal ears (Eskandari et al., 2012, 2014; Keshavars et al., 2010; Majidipour et al., 2018; Qolizadeh et al., 2019; Taheri et al., 2015). Three studies provided intervention with speakers and an MP3 player beside the neonates' head (Damayanti et al., 2018; Devi et al., 2019; Marofi et al., 2018). A study provided an intervention using an MP3 player placed beside the patient's bed (Aisyah et al., 2019), and two studies do not describe how to perform the intervention (Ningsih & Rosida, 2023; Nurhusna et al., 2020). The Qur'anic content also varied across studies. Surah Ar-Rahman was most frequently used, followed by Surah Yasin and Surah Yusuf. Other interventions used Surah Al-Isra, Juz 30, or combinations of several surahs and verses (Aisyah et al., 2019; Damayanti et al., 2018; Devi et al., 2019; Eskandari et al., 2014; Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019; Taheri et al., 2015).

Table 1. Overview characteristics of included studies

No	(Author's name, year)	Country	Study Design	Sample size	Frequency, length, and duration of intervention	Device used	Sound intensity	Outcomes
1	Taheri et al., 2015	Iran	Randomised Clinical Trial	78 neonates Control n=26 Lullaby n=26 Qur'an n=26	Three days, 20 minutes/day	Headphones	Qur'an=50-60 dB Lullaby=55 dB	Decrease the changes in heart rate
2	Marofi et al., 2018	Iran	Randomised Clinical Trial	72 neonates Control n=36 Qur'an n=36	3 minutes before the procedure	Played using an MP3 player device at a one-meter distance from the neonates' beds	65 dB	Reduce responses (heart rate, respiratory rate, oxygen saturation percentage) and Pain related to collecting blood from hospitalized infants' heels.
3	Eskandari et al., 2014	Iran	Randomised Clinical Trial	120 neonates Control n=30 Qur'an n=30 Lullaby n=30 Silent n=30	20 minutes	Headphones	50-60 dB	There were no negative impacts on the premature infants' oxygen saturation, respiratory rate, heart rate, or behavioural states, and it did not interfere with technical aspects or routine care.
4	Qolizadeh et al., 2019	Iran	Randomised Clinical Trial	64 neonates Control n=32 Qur'an n=32	To reduce noise from morning normal activities such as visits, all interventions were performed in the afternoon.	Headphones	45 dB	Improve physiological responses such as heart rate, respiration rate, arterial oxygen saturation percentage, mean arterial pressure, and temperature.

5	Majidipour et al., 2018	Iran	Randomised Clinical Trial	56 neonates Control n=24 Qur'an n=24	25 min	Headphones and MP3 players	50–55 dB	At all the assessed time points, there was a decrease in heart rate and an increase in oxygen saturation, however this effect on respiratory rate persisted for only 20 minutes after the intervention.
6	Damayanti et al., 2018	Indonesia	Quasi-Experimental	30 neonates	3x15 minutes every day for 3 days in a row	Speaker	65-75 dB	Increasing the level of oxygen saturation
7	Nurhusna et al., 2020	Indonesia	Quasi-Experimental	20 neonates	20 minutes every day for three days	-	-	The effect of breathing assistance on heart rate, respiration rate, and oxygen saturation in infants with LBW treated in NICU treatment rooms.
8	Aisyah et al., 2019	Indonesia	Quasi-experimental	36 neonates Control n=18 Qur'an n=18	3 minutes before the venipuncture or infusion procedure	Mp3 player	65 dB	Improve pain level of neonates during invasive procedure
9	Devi et al., 2019	Indonesia	Randomised Clinical Trial	52 neonates Control n=26 Qur'an n=26	In three days, four times a day for 20 minutes every three hours.	MP3 player and portable speaker in one. The speaker was placed approximately 10-15 cm from the baby's head.	-	Improve the comfort and weight of low-birth-weight newborns.
10	Keshavars et al., 2010	Iran	Randomised Clinical Trial	60 neonates Control n=30 Qur'an n=30	20 minutes in the morning shift	Phone	50-60 dB	Improve physiological responses in premature newborns by increasing oxygen saturation and decreasing the number of breaths and heartbeats.
11	Eskandari et al., 2012	Iran	Randomised Clinical Trial	120 neonates Control n=60 Qur'an n=60	20 minutes on the morning shift	Headphones	50-60 dB	Improved physiological responses include increased oxygen saturation, respiratory rate, and heart rate.

12	Ningsih & Rosida, 2023	Indonesia	Randomised Clinical Trial	30 neonates Control n=15 Qur'an n=15	30 minutes - every day for six days in a row.		50-60 dB	Improved responses: temperature, oxygen saturation, respiratory rate, heart rate

Across the 12 included studies, 10 evaluated one or more physiological outcomes, including heart rate, respiratory rate, oxygen saturation, body temperature, and blood pressure (Damayanti et al., 2018; Eskandari et al., 2012, 2014; Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Nurhusna et al., 2020; Qolizadeh et al., 2019; Taheri et al., 2015). Two studies assessed neonatal pain during invasive procedures (Aisyah et al., 2019; Marofi et al., 2018), while one study evaluated neonatal comfort and weight (Devi et al., 2019). Heart rate, respiratory rate, and oxygen saturation were quantitatively pooled because these outcomes were reported by a sufficient number of randomized controlled trials. The remaining outcomes, including temperature, blood pressure, pain, comfort, weight, and feeding, were synthesized narratively because of limited and heterogeneous reporting.

Quality assessment

Figure 2 summarizes the Cochrane risk-of-bias assessment for the nine randomized controlled trials. Green indicates low risk of bias, yellow indicates unclear risk of bias, and red indicates high risk of bias. Most studies showed a low risk of bias for random sequence generation, blinding of participants and personnel, and other potential sources of bias. However, concerns were identified regarding allocation concealment, blinding of outcome assessment, incomplete outcome data, and selective reporting.

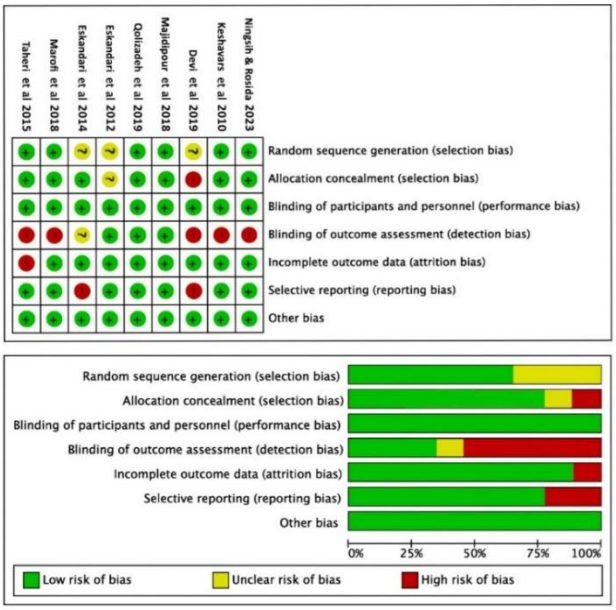


Figure 2. Cochrane risk-of-bias assessment of the included randomized controlled trials.

Table 2. JBI for randomized control trial

Study	Critical appraisal of the studies													JBI critical appraisal result (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Marofi et al., 2018	+	+	+	+	-	U	+	U	U	+	+	+	U	8/13 (62%)
Eskandari et al., 2012	U	+	+	+	U	U	+	U	+	+	-	+	U	7/13 (54%)
Qolizadeh et al., 2019	+	+	+	+	U	+	+	U	+	+	U	+	U	9/13 (69%)
Majidipour et al., 2018	+	+	+	+	U	+	+	U	-	+	U	+	U	8/13 (62%)
Keshavars et al., 2010	+	+	+	+	U	U	+	U	+	+	U	+	U	8/13 (62%)
Eskandari et al., 2014	U	U	+	+	U	+	+	U	+	+	+	+	U	8/13 (62%)
Taheri et al., 2015	+	+	+	+	U	U	+	U	-	+	+	+	U	8/13 (62%)
Devi et al., 2019	U	-	+	+	U	U	+	U	+	+	+	+	U	7/13 (54%)
Ningsih & Rosida, 2023	+	+	+	+	-	U	+	U	-	+	+	+	U	8/13 (62%)

+: Yes; -: No; U: Unclear

Table 3 presents the detailed item-level JBI critical appraisal results for the three quasi-experimental studies. Several methodological criteria were adequately addressed, while others were rated as "No," or "Unclear," No numerical cutoff or overall quality category was applied, and the appraisal findings were considered when interpreting the review results.

Table 3. JBI for Quasi-experimental

Study	Critical appraisal of the studies									JBI critical appraisal result (%)
	1	2	3	4	5	6	7	8	9	
Damayanti et al, 2018	+	+	+	-	+	-	+	-	U	5/9 (55%)
Nurhusna et al, 2020	+	+	+	-	+	-	+	-	U	5/9 (55%)
Aisyah et al., 2019	+	+	+	+	-	-	+	-	+	6/9 (67%)

+: Yes; -: No; U: Unclear

Primary outcomes

Effect of Qur'an recitation therapy on heart rate

Figure 3 presents the pooled analysis of post-intervention heart-rate data from eight studies, involving 254 neonates in the QRT group and 253 neonates in the routine-care control group (Eskandari et al., 2012, 2014; Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019; Taheri et al., 2015). QRT was associated with a statistically significant reduction in heart rate compared with routine care, with an SMD of −0.437 (95% CI −0.646 to −0.227, p < 0.001). Heterogeneity was modest and not statistically significant ($Q(7) = 10.360$, p = 0.169, $I^2 = 32.43\%$, and $\tau^2 = 0.0288$).

The study-level findings were generally consistent with the pooled estimate, with most estimates favoring QRT, although the magnitude and timing of the heart-rate response varied across studies (Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019; Taheri et al., 2015). Reductions were observed during or shortly after QRT exposure in several studies. Together with the modest and statistically non-significant heterogeneity, this pattern indicates a reasonably consistent short-term reduction in neonatal heart rate following QRT.

Effect of Qur'an recitation therapy on respiratory rate

The result of the post-intervention respiratory rate of seven studies is shown in Figure 3, where the pooled sample sized was 227 neonates each in QRT and routine control gorups (Eskandari et al., 2012, 2014; Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019). QRT was found to cause a statistically significant decrease in the respiratory rate as compared to routine care with an SDM of −0.463 (95% CI −0.690 to −0.235, p < 0.001). There was some between-study heterogeneity but not statistically significant ($Q(6) = 9.495$, p = 0.148, $I^2 = 36.81\%$, and $\tau^2 = 0.0339$).

The individual results of several studies were sonsistent with the overall pooled effect. Several researchers indicated the decreased respiratory rate or increased respiratory stability due to QRT intervention (Keshavars et al., 2010; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019). For example, Marofi et al. (2018) described the temporary increase in respiratory rate during the blood sampling, followed by the gradual restoration of the baseline values after procedure. In contrast, Qolizadeh et al. (2019) showed that the intervention group exhibited significantly lower respiratory rate than the control group. Given the low amount of statistical heterogeneity, the overall findings indicate that QRT intervention causes the temporary reduction in the neonatal. However, this response was not consistently observed at every assessment point.

Effect of Qur'an recitation therapy on saturation

Figure 3 provides pooled results of oxygen saturation outcomes post-intervention among 227 infants undergoing QRT and 227 infants under routine care condition based on results of seven articles (Eskandari et al., 2012, 2014; Keshavars et al., 2010; Majidipour et al., 2018; Marofi et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019). Compared with the routine care group, the application of QRT had a statistically significant positive impact on oxygen saturation with SDM of 0.490 (95% CI 0.149 to 0.831, p = 0.005). However, there was considerable statistical heterogeneity between results obtained ($Q(6) = 18.508$, p = 0.005, $I^2 = 67.58\%$, and $\tau^2 = 0.1387$).

Results obtained by different researchers were consistent with the direction of the pooled effect. Specifically, some studies showed better oxygen-saturation values among infants after applying QRT, yet the extent of improvement differed from

study to study (Eskandari et al., 2012; Keshavars et al., 2010; Majidipour et al., 2018; Ningsih & Rosida, 2023; Qolizadeh et al., 2019). Thus, the presence of substantial and statistically significant heterogeneity means that the oxygen-saturation response was more variable in comparison with heart rate and respiratory changes. The cause of the heterogeneity could

be the time duration of the intervention, sound delivery devices used, sound intensity, timing of the recitations, and different methods used to measure outcomes. As a result, the pooled effect suggests improved oxygen saturation among infants under QRT, though its magnitude was significantly different.

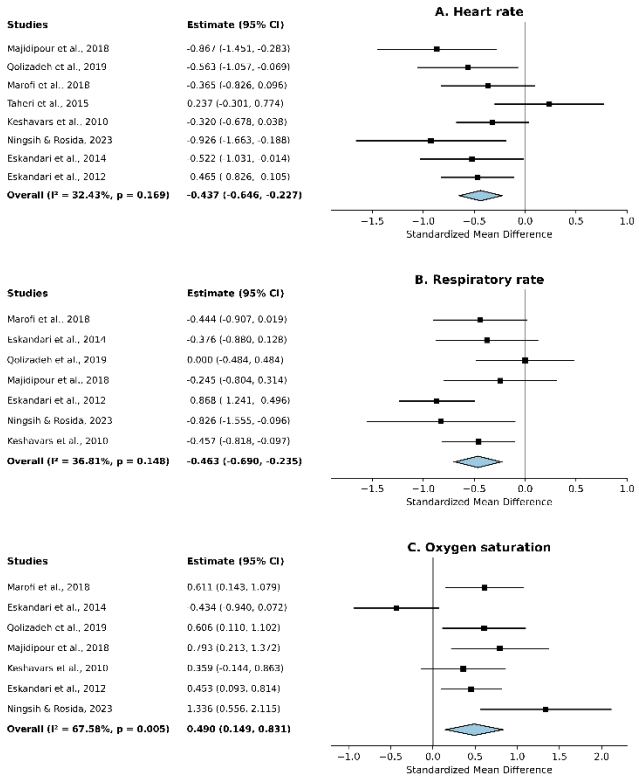


Figure 3. Forest plots of random-effects meta-analyses comparing Qur'an recitation therapy with routine care for (A) heart rate, (B) respiratory rate, and (C) oxygen saturation among neonates admitted to the neonatal intensive care unit.

Synthesis of primary outcomes

The pooled result across the three outcomes produced consistent preference towards QRT with small-to-moderate standardized effect sizes in heart rate, respiratory rate, and oxygen saturation. These were consistent in terms of heart rate and respiratory rate but were more variable when it came to oxygen saturation. It is important to note that this was done using standardized mean difference and no study provided a clinically significant difference. This means that the statistical significant difference does not mean anything in terms of clinical significance.

Sensitivity analysis

Leave one out sensitivity analyses suggested that excluding each study sequentially does not affect the direction and statistical significance of the overall pooled effects. The recalculated SDMs for heart rate were between −0.496 and −0.391, for respiratory rate between −0.547 and −0.367, and for oxygen saturation between 0.396 and 0.593. When Eskandari et al. (2014) were excluded from the oxygen-saturation pooled effect, heterogeneity was greatly reduced from $I^2 = 67.58\%$to $I^2 = 4.05\%$, while still maintaining statistical significance (SMD = 0.593, 95% CI 0.386 to 0.801). This implies that the cited paper is responsible for a great proportion of the inter-study heterogeneity, though it does not affect the direction and significance of the overall effect.

Secondary outcome

Secondary outcomes were reported less consistently and were therefore synthesized narratively. Findings for body temperature were mixed, with no between-group difference reported in one study and an increase from 36.5°C to 37.2°C reported in another (Ningsih & Rosida, 2023; Qolizadeh et al., 2019). QRT was associated with lower pain scores during invasive procedures (Aisyah et al., 2019; Marofi et al., 2018). One study reported improved neonatal comfort but no significant effect on body weight (Devi et al., 2019). Additional single-study findings included lower mean arterial pressure after the intervention and increased breast-milk intake over three days (Nurhusna et al., 2020; Qolizadeh et al.,

2019). These findings should be interpreted cautiously because each outcome was evaluated in only a small number of studies.

Publication bias

Figure 4 presents the outcome-specific funnel plots for the meta-analyses of heart rate, respiratory rate, and oxygen saturation. Visual inspection did not reveal marked asymmetry in any of the three plots. Egger's regression tests also did not indicate statistically significant funnel-plot asymmetry for heart rate ($z = -0.957$, $p = 0.339$), respiratory rate ($z = 0.254$, $p = 0.800$), or oxygen saturation ($z = 1.345$, $p = 0.179$). Rosenthal's fail-safe N values were 69 for heart rate, 59 for respiratory rate, and 56 for oxygen saturation. However, these findings should be interpreted cautiously because fewer than ten studies were included in each meta-analysis, limiting the reliability of formal publication-bias assessment.

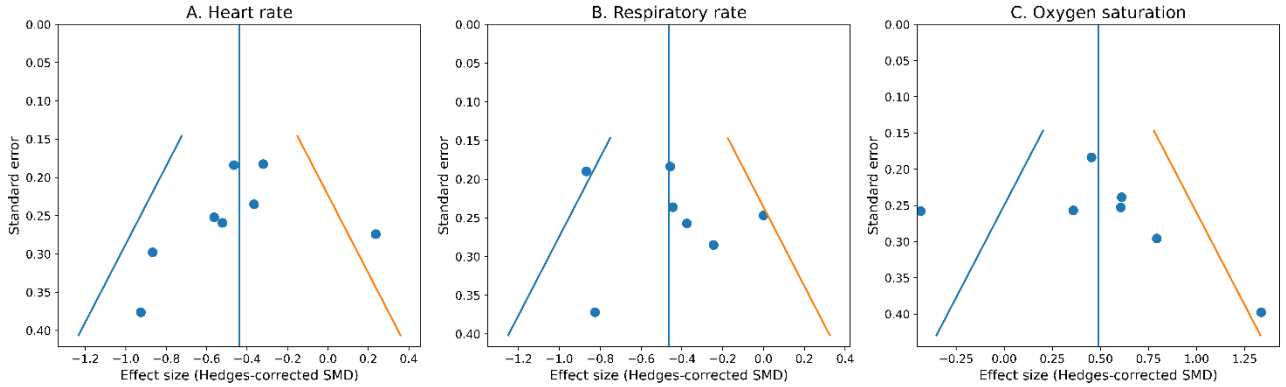


Figure 4. Outcome-specific funnel plots assessing potential small-study effects in the meta-analyses of Qur'an recitation therapy compared with routine care for (A) heart rate, (B) respiratory rate, and (C) oxygen saturation.

Discussion

The pooled estimates favored QRT across all three primary physiological outcomes. QRT was associated with lower heart rate (SMD = −0.437, 95% CI −0.646 to −0.227), lower respiratory rate (SMD = −0.463, 95% CI −0.690 to −0.235), and higher oxygen saturation (SMD = 0.490, 95% CI 0.149 to 0.831). These figures represent moderate-to-small standardized effect. Low heterogeneity existed on heart rate and respiratory rate, thus indicating the consistency of the effects in terms of magnitude and direction across the studies that were included in the meta-analyses. However, considerable heterogeneity was identified in the case of oxygen saturation, indicating variable in terms of magnitude of the pooled effect.

However, one has to be caution while interpreting these findings in relation to the possible effects of QRT since the data cannot be regarded as conclusive. Considering that the standardized mean difference has been used in all the meta-analyses, the pooled effects cannot provide any information about the changes in beats/minutes, breaths/minutes or oxygen-saturation percentage points. They also fail to establish whether the observed changes are clinically significant. Particularly, there cannot be any information about the ability of QRT to help the neonates reach the necessary saturation. Thus, although the pooled evidence supports continued evaluation of the QRT as an adjunctive intervention in neonatal care, it is not sufficient on its own to support routine clinical use.

The psychological responses seen after QRT need to be considered along with the development of the autonomic system in premature newborns. The longitudinal assessment of heart rate variability has shown that sympathetic and parasympathetic control develops in preterm during their NICU stay, although this process varies among babies. The gradual increase of autonomic activity was seen in a group of preterm with low morbidity (Mulkey et al., 2021). At the same time, in another group of preterm, there was an increase in sympathetic control indices at 32-35 weeks postmenstrual age, but the parasympathetic ones did not change significantly (Israeli-Mendlovic et al., 2021). This information explains the physiological changes in neonates but does not show how QRT affects them biologically.

Research on related auditory therapies also does not provide conclusive evidence regarding the influence of autonomic processes. It, higher increases in a measure of parasympathetic heart rate variability were registered during live music therapy along with skin-to-skin contact, than in skin-to-skin contact therapy only (Yakobson et al., 2021). However, the intervention was multimodal, therapist-delivered, and limited to clinically stable preterm infants, making direct

extrapolation to recorded QRT inappropriate. In contrast, no detectable changes in sympathetic or parasympathetic responses were found during recorded music exposure in very preterm infants, while postmenstrual age was more consistently associated with autonomic responses (Barcos-Munoz et al., 2025). Therefore, the reductions in heart rate and respiratory rate and the increase in oxygen saturation observed in the present meta-analysis should not be interpreted as evidence of parasympathetic activation. Future QRT trials should consider incorporating heart rate variability and other autonomic or stress biomarkers to evaluate the proposed mechanisms directly.

The reduction in heart rate observed in the present meta-analysis is broadly consistent with evidence from music and vocal interventions, which showed lower heart rates during and after the intervention but no clear improvement in respiratory rate or oxygen saturation (Haslbeck et al., 2023). A multisite trial of live, therapist-delivered interventions similarly demonstrated that physiological responses varied according to the auditory condition and measurement period, with heart-rate reductions observed for selected interventions rather than uniform changes across all outcomes (Loewy et al., 2013). Short-term decreases in heart rate and increases in oxygen saturation have also been reported following music-therapy sessions, although the absence of a concurrent control group limits causal interpretation of these findings (Kobus et al., 2021). Therefore, differences between the pooled QRT findings and the broader music literature should not be interpreted as evidence that QRT is more effective than music or vocal interventions.

Comparisons require a clear differentiation of intervention methods. Music therapy is characterized by the presence of a qualified music therapist, clinical goals set for each patient individually, and the presence of a therapeutic alliance, while music medicine is usually used when the music is played without the presence of any such relational factor, and inmost cases, recorded sound is used (Foroushani et al., 2020). Recorded auditory interventions cannot be labeled as music therapy just because of music and structured sound in interventions (Corrigan et al., 2022). In most QRT studies included, recorded recitation was used thus the procedure used in QRT is much closer to passive auditory interventions than to music therapy conducted by a music therapy

Comparability is hindered by differences between interventions concerning content, intensity of sound, time, frequency, equipment used, characteristics of the infants, and physiologic measurement protocol. Investigations regarding passive music listening have also had geographic bias and a protocol with poor standardization (Papatzikis et al., 2024). Therefore, while the literature on NICU music and vocal interventions provides a relevant comparison, it cannot validate the efficacy, mechanism, and means for best delivering QRT.

From the perspective of Islamic healthcare context, QRT could potentially carry spiritual importance for families since Qur'an recitation and prayer are some carried by some Muslim women to practice their faith and gain confidence while receiving maternity care. However, Muslim families differ in terms of their beliefs and preferences thus the spiritual needs of those families should be determined through discussions (Hassan, 2022). Parents from different cultural groups can also refer to the situation of their newborn being admitted to the ICU, highlighting the necessity to determine the spiritual needs in culturally competent neonatal care (Nyaloko et al., 2023). On recent quasi-experimental study has demonstrated a decrease in stress levels and improvement in the spiritual well-being of Muslim mothers whose premature babies had received Islamic spiritual self-care that involved Qur'an recitation, prayers, and reflections. Still, this intervention involved multiple aspects of spiritual care of mothers thus the results cannot serve as evidence about the feasibility or physiological impact of QRT delivered to neonates directly (Khezri et al., 2026).

The cultural sensitivity in the delivery of the QRT therapy should begin with the evaluation of the beliefs, preferences, and expectations of the individual families, along with culturally tailored communication and institutional support, not just with the application of the religious treatment as usual (Nyaloko et al., 2025). Effective communication is important because parents' engagement in the NICU environment could be limited due to emotional distress, unclear roles of parents as caregivers, lack of information, and poor communication with healthcare practitioners (Jafari et al., 2024). The result of the latest study conducted via a QRT trial revealed the protocol of the procedure, which involved the informed consent from parents, the use of Qur'an along with conventional neonatal therapy, control of the sound intensity, and continuous evaluation of the tolerance of infants to the therapy (Rashvand et al., 2025). Hence, QRT treatment should be presented to parents as a option and preference-sensitive therapy without any influence on the availability of neonatal therapy.

From a NICU-practice perspective, the pooled findings suggest that QRT may be considered as a non-pharmacological adjunct to standard neonatal care for supporting short-term changes in physiological measures. It should not replace routine neonatal monitoring or established clinical management. A recent QRT trial demonstrated that recitation could be delivered alongside routine care using defined eligibility criteria, calibrated sound intensity, specified timing and duration, and interruption when infants showed signs of distress or intolerance (Rashvand et al., 2025). Related NICU music-therapy guidance emphasizes structured eligibility and referral processes, staff preparation, documentation,

interdisciplinary coordination, and ongoing assessment of infant tolerance (Erdei et al., 2024). QRT delivery should therefore follow a structured but adaptable protocol that considers the infant's developmental stage, clinical stability, behavioral cues, and tolerance. Parental willingness and the family's cultural and religious preferences should also be established before the intervention is provided (Gaden et al., 2023; Haslbeck & Bassler, 2018). Because the clinical importance of the pooled standardized effects has not been established and substantial heterogeneity was observed for oxygen saturation, routine implementation should remain cautious until further QRT-specific trials establish its safety, effectiveness, and optimal delivery across diverse NICU populations.

Within the context of NICU practice, the overall results from the studies suggest that QRT can be considered as a non-pharmacological addition to the exiting neonatal practice concerning short-term physiological alterations. It is important to note that QRT is not intended replace usual neonatal surveillance and management tectinques. For instance, one study has shown that recitation within QRT can be combined with routine practice using inclusion criteria, specific sound intensity level, timing and duration of the procedure, as well as stopping the procedure once the infant displays certain signs of intolerance (Rashvand et al., 2025). The NICU guidelines on music therapy recommended having a clear structure concerning eligibility and referrals, preparation of NICU personnel, documentation, interprofessional cooperation, and constant assessment of the infant's tolerance (Erdei et al., 2024). In other words, the delivery of QRT should follow a structured but flexible protocol, considering development level, clinical condition, behavioral signs, and tolerance of the infant. At the same time, parental consent and cultural-religious preference of the family should be established before conducting the intervention (Gaden et al., 2023; Haslbeck & Bassler, 2018). Due to the unclear clinical significance of standardized effect sizes and heterogeneity in relation to oxygen saturation, routine application of QRT should be made cautiously until additional trials are conducted.

Limitations and implications for future research

This review provides a targeted synthesis of the physiological impacts of QRT on heart rate, respiratory rate, and oxygen saturation through meta-analyses and sensitivity analyses conducted specifically for each outcome measure. It is important, however, to consider certain factors when interpreting the results. Even though seven major databases were searched, searching only peer-reviewed literature in English and Arabic languages may have limited further searches of other papers. Geographical clustering of evidence in Iran and Indonesia suggest that the conclusions are drawn mainly specific cultural and medical environments. Differences in intervention length, recitation, timing, modality used to delivery QRT, volume intensity, timing of measures taken, and procedures of data collecting related to physiological measures, especially oxygen saturation, posed a source of methodological heterogeneity.

Some of studies included had relatively small sample sizes, which could have affected the accuracy of the estimates of the individual studies and the effect of sampling variability on the pooled estimates. The lack of sufficient studies in possible subgroups and insufficient description of the interventions used made subgroup analysis difficult. Randomization, allocation concealment, blinding, follow-ups, and selective reporting were adequately described in some of the included studies. Publication bias or small-study effects could not be ruled out because there were less than ten studies for each of the outcomes assessed. However, the direction of the pooled estimates was consistent even in the sensitivity analyses.

Conclusions

This systematic review and meta-analysis offer evidence about the impact of Qur'an recitation therapy on the physiological markers of neonates who were admitted into NICUs. The combined analysis indicates that QRT might help lower heart rate and respiratory rate and increase oxygen saturation levels in newborns. Nonetheless, the above-mentioned findings can be considered positive indicators of the possible benefits that need to be confirmed in further research.

Under proper calibration in accordance with the medical condition of the baby, the preference of the family, the cultural setting and institutional guidelines, QRT can serve as a cheap and easy non-medication intervention to standard neonatal therapy. While there were no negative consequences in any of the studies examined, safety was not always investigated. Further studies need to focus on randomized method for intervention, and validate heart rate variability, auditory, evoked potentials and biomarkers of stress. In addition, further research by multiple disciplines is needed to increase confidence and reliability of evidence in clinical practice.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Author contribution
Sholichah Kusuma Wardani conceived and designed the study, analyzed and interpreted the data, drafted the manuscript, approved the final version, and collected and assembled data; Ahmad Hidayat analyzed and interpreted the data, critically revised the manuscript for important intellectual content, approved the final version, and provided study materials or patients; Mahmasoni Masdar provided study materials, contributed statistical expertise, drafted the manuscript, collected and assembled data; Desi Dwi Siwi Atika Dewi and Wahida Yuyun Suciati provided administrative, technical, drafted manuscript and assisted with data collection and assembly. All authors read and approved of the final manuscript and agree to be accountable for all aspects of the work.

Funding
The authors received no specific grants from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgement
The authors wish to acknowledge the support of Research Institute of Indonesian Medical Association for their feedback during the initial discussion and planning of this study.

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