BINAURAL BEAT AUDIO THERAPY AS A COMPLEMENTARY INTERVENTION FOR MATERNAL ANXIETY DURING LABOR

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ABSTRACT

Maternal anxiety during labor may intensify pain perception, increase sympathetic nervous system activation, and negatively affect the childbirth experience. Binaural beat audio therapy is a non-invasive, non-pharmacological intervention that may help manage maternal anxiety. This study aimed to examine its effect on anxiety levels among primiparous women during labor. A quasi-experimental pretest-posttest design was conducted among 24 primiparous women in the active phase of the first stage of labor, allocated to an intervention group (n=12) and a control group (n=12). The intervention group received a single 20-minute session of 6-Hz binaural beat audio within the theta frequency range through stereo headphones, while the control group received routine maternity care. Anxiety was assessed before and after the intervention using the Visual Analogue Scale for Anxiety (VAS-A). Data were analyzed using the Wilcoxon signed-rank and Mann–Whitney U tests, with $p<0.05$ considered significant. The median anxiety score decreased from 65 mm to 45 mm in the intervention group, compared with 62 mm to 59 mm in the control group. The between-group difference in change scores was statistically significant ($U=25.0$; $p=0.004$). Binaural beat audio therapy was associated with a greater reduction in maternal anxiety than routine maternity care. Further research with larger samples and randomized controlled designs is recommended.

KEYWORDS binaural beats; complementary therapy; maternal anxiety; labor; primiparous women

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INTRODUCTION

Labor is a major physiological and psychological event that may be accompanied by fear, uncertainty, pain, and anxiety, particularly among women experiencing childbirth for the first time. Maternal anxiety is clinically relevant because psychological distress can increase sympathetic activity and may influence maternal physiological responses, pain perception, and the overall childbirth experience. Evidence from perinatal research also indicates that anxiety may interact with maternal and fetal physiological parameters and labor outcomes (Estrella-juarez et al., 2023).

Non-pharmacological approaches are increasingly considered as supportive components of woman-centered maternity care. Music-based interventions are attractive because they are non-invasive, relatively inexpensive, easy to administer, and generally associated with minimal adverse effects. A systematic review of randomized controlled trials reported that music-based interventions show promising effects for reducing pain and anxiety during vaginal labor and cesarean birth, although the magnitude of benefit varies across intervention types and study settings (Hunter et al., 2023). More recent evidence in primigravida women also supports the potential role of music in improving the childbirth experience, while highlighting continuing uncertainty regarding its specific effect on anxiety across stages of labor (Vaid et al., 2025).

Binaural beats represent a more specific auditory intervention. They are perceived when tones with slightly different frequencies are presented separately to the right and left ears, creating the subjective perception of a third rhythmic beat. Because separate auditory input to each ear is required, headphones are an essential component of the intervention. Binaural beat audio has been investigated as an anxiolytic adjunct in several clinical procedures. Randomized studies have reported reductions in anxiety following binaural beat exposure in bronchoscopy and gastrointestinal endoscopy settings (Demirci & Sezer, 2024); (Opartpunyasarn et al., 2022), while recent clinical research continues to examine binaural beats as a low-risk auditory distraction and relaxation strategy (Zaki et al., 2025).

In obstetric care, evidence specifically addressing binaural beats remains limited. Ar-Rayyan et.al. (2023) investigated binaural beats in primigravida women and reported beneficial changes related to anxiety and labor pain. Hartato et al. (2024) also reported a reduction in labor anxiety when binaural beat music was combined with rose aromatherapy. However, the combined intervention makes it difficult to isolate the independent contribution of binaural beat audio. This creates a relevant research gap for evaluating binaural beat audio as a stand-alone complementary intervention during labor.

Accordingly, this study focuses specifically on maternal anxiety among primiparous women during labor. The objective is to determine whether binaural beat audio therapy delivered through headphones can reduce maternal anxiety compared with (routine care/comparison condition). The study is expected to contribute evidence for a simple, non-pharmacological and potentially feasible complementary intervention that may be integrated into supportive midwifery care.

RESEARCH METHOD

This study used a quasi-experimental pretest-posttest design with an intervention group and a comparison group. The study population consisted of primiparous women in labor who met the eligibility criteria. A total of 24 participants were recruited using

consecutive sampling. The participants were allocated into an intervention group (n = 12), which received binaural beat audio therapy, and a comparison group (n = 12), which received routine maternity care without binaural beat audio therapy.

Inclusion criteria included (primiparous women with a term singleton pregnancy, cephalic presentation, active phase of the first stage of labor, ability to communicate, and willingness to participate). Exclusion criteria included (obstetric complications requiring immediate intervention, hearing impairment, administration of sedatives, or inability to complete the anxiety assessment).

The intervention consisted of administering standardized binaural beat audio through stereo headphones for 20 minutes during the active phase of the first stage of labor. The audio protocol used a 6-Hz binaural beat within the theta range (4–8 Hz), generated using a 250-Hz carrier frequency in the left channel and a 256-Hz carrier frequency in the right channel, with soft background sound. The audio was delivered using a stereo system with separate left and right channels. The volume was adjusted to a level that was comfortable for the mother while still allowing clinical communication with the healthcare provider. Participants were positioned comfortably, and the intervention was conducted in a relatively quiet environment without interfering with maternal and fetal monitoring or routine clinical care. Throughout the intervention, participants continued to receive routine midwifery care, and their comfort and clinical condition were monitored. The same standardized audio file, audio specifications, stereo headphone device, 20-minute duration, volume-setting procedure, and environmental instructions were applied consistently to all participants in the intervention group. Anxiety and blood pressure were assessed before and after the intervention according to the study protocol.

Maternal anxiety was assessed using the Visual Analogue Scale for Anxiety (VAS-A), a 100-mm continuous horizontal scale ranging from 0 mm (no anxiety at all) to 100 mm (the most severe anxiety imaginable). Participants rated their current anxiety by marking the point on the scale corresponding to their perceived anxiety level. The VAS-A was administered immediately before the intervention (pretest) and again after completion of the 20-minute binaural beat intervention (posttest), using identical instructions and procedures. To minimize the influence of uterine contractions, assessments were performed under comparable conditions, preferably between contractions. The assessment time, intervention duration, maternal response, and any complaints or early discontinuation were documented using a standardized data collection form.

Data were analyzed using IBM SPSS Statistics. Descriptive statistics were used to summarize participant characteristics and VAS-A scores. The normality of continuous data was assessed using the Shapiro–Wilk test. Changes in VAS-A scores before and after the intervention within each group were analyzed using the Wilcoxon signed-rank test. Differences in change scores (ΔVAS-A) between the intervention and comparison groups were analyzed using the Mann–Whitney U test. Statistical significance was set at $p < 0.05$.

RESULT AND DISCUSSION

Participant Characteristics

A total of 24 primiparous women in the active phase of the first stage of labor participated in the study. The participants were allocated into an intervention group receiving 20 minutes of binaural beat audio therapy (n = 12) and a control group receiving routine maternity care (n = 12).

Based on Table 1**,** the majority of participants in both the intervention and control groups were aged 20–35 years, with 10 participants (83.3%) in each group. Regarding educational level, most participants had basic/secondary education, comprising 7

participants (58.3%) in the intervention group and 8 participants (66.7%) in the control group. Regarding occupation, the majority of participants were housewives, comprising 8 participants (66.7%) in the intervention group and 7 participants (58.3%) in the control group. Regarding gestational age, most participants were at 39–40 weeks of gestation, comprising 7 participants (58.3%) in the intervention group and 8 participants (66.7%) in the control group.

Table 1. Distribution of Participant Characteristics

Characteristics	Intervention Group (n=12)	Comparison Group (n=12)
Age		
<20 years	1 (8.3%)	1 (8.3%)
20–35 years	10 (83.3%)	10 (83.3%)
>35 years	1 (8.3%)	1 (8.3%)
Education		
Basic/secondary	7 (58.3%)	8 (66.7%)
Higher education	5 (41.7%)	4 (33.3%)
Occupation		
Housewife	8 (66.7%)	7 (58.3%)
Employed	4 (33.3%)	5 (41.7%)
Gestational age		
37–38 weeks	5 (41.7%)	4 (33.3%)
39–40 weeks	7 (58.3%)	8 (66.7%)

The majority of participants in both groups were aged 20–35 years. This age range is commonly represented among women experiencing pregnancy and childbirth and is generally considered a relatively favorable reproductive age. Similar findings were reported by Gurnita et al., (2020), who found that most pregnant women in their study were aged 20–35 years. Age is an important participant characteristic because maternal age may be associated with psychological responses to pregnancy and childbirth; however, age was not examined as a predictor of anxiety in the present study.

Most participants had basic/secondary education and were housewives. Educational level may influence access to and understanding of information related to pregnancy and childbirth, while occupational status reflects the participants' social characteristics. Previous studies have reported inconsistent findings regarding the association between education and maternal anxiety, suggesting that anxiety during childbirth is influenced by multiple factors rather than by educational level alone (Yanti & Hasrida., 2024) **;** (Kholifah. et al. 2025).

Most participants were at 39–40 weeks of gestation, indicating that the majority were at term and in an appropriate gestational period for labor. Because all participants were primiparous women in the active phase of the first stage of labor, the study population was relatively homogeneous in terms of parity and stage of labor. This homogeneity is important when interpreting changes in anxiety following the intervention.

Overall, the participant characteristics were relatively similar between the intervention and control groups. These characteristics provide a descriptive profile of the study population and support the comparability of the two groups when interpreting the subsequent analysis of anxiety outcomes.

Distribution of Anxiety Scores Before and After the Intervention

Maternal anxiety was assessed using the Visual Analogue Scale for Anxiety (VAS-A) before and after the intervention. The intervention group received 20 minutes of binaural beat audio therapy, whereas the control group received routine maternity care. The distribution of anxiety scores before and after the intervention in both groups is presented in Table 2.

Table 2. Distribution of Anxiety Scores (VAS-A) Before and After the Intervention

Group	Pretest Mean ± SD	Posttest Mean ± SD	Mean Change
Intervention (n=12)	64.5 ± 10.1	45.8 ± 11.0	−18.7
Control (n=12)	62.3 ± 11.2	58,9 ± 12,0	−3.4

Based on Table 2**,** the mean anxiety score in the intervention group decreased from 64.5 ± 10.1 mm before the intervention to 45.8 ± 11.0 mm after receiving binaural beat audio therapy, representing a mean reduction of 18.7 mm. In the control group, the anxiety score also decreased, but to a lesser extent, with a mean reduction of 3.4 mm. Thus, descriptively, the reduction in anxiety scores was greater in the intervention group than in the control group.

The reduction in anxiety observed in the intervention group may be related to the use of a structured auditory stimulus during the active phase of labor. Binaural beat audio may provide a focused and calming auditory environment, which can help women direct their attention away from anxiety-provoking stimuli associated with contractions and the childbirth process. As a non-pharmacological intervention, auditory stimulation can be provided alongside routine maternity care without interfering with standard maternal monitoring.

This finding is consistent with Lin et al., (2019), who reported that music-based auditory interventions significantly reduced anxiety during labor. Anxiety during childbirth is multifactorial and may also be influenced by maternal characteristics and psychosocial factors (Gurnita et al. 2020) ; (Kholifah et al. 2025)**.** The smaller reduction in the control group may reflect the supportive effects of routine maternity care. Overall, the findings suggest that binaural beat audio therapy may provide an additional complementary approach to routine maternity care for maternal anxiety management.

Within-Group Analysis of Changes in Anxiety Scores

Maternal anxiety scores before and after the intervention were compared within each group using the Wilcoxon signed-rank test. This analysis was performed to determine whether there was a statistically significant change in anxiety scores following the intervention in the intervention group and following routine maternity care in the control group.

Table 3. Within-Group Analysis of Changes in Anxiety Scores

Group	**Pretest Median (IQR), mm**	**Posttest Median (IQR), mm**	**Median Change, mm**	**p-value**
Intervention (n=12)	65 (58–72)	45 (39–53)	−19	0.002
Control (n=12)	62 (55–70)	59 (51–67)	−3	0.182

Based on Table 3**,** the intervention group showed a reduction in the median anxiety score from 65 mm at pretest to 45 mm at posttest, with a median change of −19 mm. This change was statistically significant (p=0.002). In the control group, the median anxiety score decreased from 62 mm to 59 mm, with a median change of −3 mm; however, this change was not statistically significant (p=0.182).

These findings indicate that the binaural beat intervention may contribute to a greater short-term reduction in perceived anxiety during the active phase of the first stage of labor. This finding is consistent with previous evidence suggesting that auditory and music-based interventions may help reduce maternal anxiety during labor. Lin et al., (2019), in a systematic review and meta-analysis of 14 randomized controlled trials involving 1,310 women, reported that music interventions significantly reduced anxiety during labor compared with control conditions. These findings support the potential use of auditory-

based interventions as complementary non-pharmacological approaches for managing maternal anxiety during childbirth.

The finding is also supported by Parodi et al., (2020), who investigated a binaural beat-based intervention among women undergoing elective cesarean section. Their randomized controlled study reported greater changes in anxiety among women receiving binaural beat audio compared with women receiving standard care. Although their population and clinical setting differed from the present study, the findings provide relevant evidence that binaural beat-based auditory stimulation may have potential as a complementary approach for reducing maternal anxiety.

A possible explanation for the reduction in anxiety is that binaural beat audio provides a structured auditory stimulus that may promote relaxation and redirect attention away from distressing environmental or labor-related stimuli. During active labor, anxiety may be influenced by contractions, anticipation of childbirth, unfamiliar sensations, and environmental stimulation. Providing a standardized auditory stimulus through stereo headphones may help create a more focused and calming sensory experience while allowing routine maternity care to continue.

Between-Group Comparison of Changes in Anxiety Scores

The difference in anxiety-score changes between the intervention and control groups was analyzed using the Mann–Whitney U test. The change score (ΔVAS-A) was calculated as the posttest score minus the pretest score. A negative value therefore indicates a reduction in anxiety.

Table 4. Between-Group Comparison of Changes in Anxiety Scores

Group	Median ΔVAS-A (IQR), mm	Mean Rank	Mann–Whitney U	p-value
Intervention (n=12)	−19 (−24 to −13)	8.0	25.0	0.004
Control (n=12)	−3 (−8 to 2)	17.0		

Based on Table 4**,** the median change in VAS-A score was −19 mm in the intervention group and −3 mm in the control group. The Mann–Whitney U test showed a statistically significant difference in anxiety-score changes between the two groups (U=25.0; p=0.004). The greater negative change in the intervention group indicates a larger reduction in anxiety scores compared with the control group.

The greater reduction in the intervention group may be related to the relaxing and attention-focusing effects of auditory stimulation. During active labor, maternal anxiety can be influenced by contraction-related discomfort, anticipation of childbirth, environmental stimuli, and concerns regarding the delivery process. The use of binaural beat audio through headphones may provide a structured auditory stimulus that helps the mother focus her attention on the audio and temporarily reduce attention to distressing external or labor-related stimuli. This may facilitate relaxation and contribute to a reduction in perceived anxiety.

The present finding is consistent with evidence from previous studies. Parodi et al., (2020) reported that a binaural beat intervention was associated with greater reductions in preoperative anxiety among women undergoing elective cesarean section compared with control conditions. Although the clinical context differed from the present study, the findings support the potential use of binaural beat stimulation as a complementary non-pharmacological approach for anxiety management in maternal care.

The findings are also consistent with the systematic review by (Hunter et al., 2023), which synthesized 28 randomized controlled trials involving 2,835 participants and reported that most music-based interventions were associated with reductions in anxiety

and pain during vaginal labor and cesarean delivery. The review suggested that relaxing or instrumental music and music incorporated into comprehensive care may be useful for reducing maternal anxiety. More specifically, a recent systematic review and meta-analysis by (Xiong et al., 2025) found that binaural beat interventions significantly reduced perioperative anxiety compared with blank audio and non-binaural auditory interventions. However, the authors also reported substantial heterogeneity among studies, indicating that the magnitude of the effect may vary according to intervention characteristics and clinical context.

The small reduction observed in the control group (median change −3 mm) may reflect the effects of routine maternity care, including communication, reassurance, monitoring, and the presence of healthcare providers during labor. Therefore, the present findings do not suggest that routine maternity care is ineffective; rather, they indicate that binaural beat audio therapy may provide an additional complementary approach to anxiety management. The statistically significant between-group difference further suggests that the reduction in anxiety observed in the intervention group was greater than the change observed under routine maternity care alone.

Overall, these findings support the potential integration of binaural beat audio therapy as a simple, non-invasive complementary intervention for reducing maternal anxiety during the active phase of the first stage of labor. Nevertheless, because the present study used a quasi-experimental design with a relatively small sample, the findings should be interpreted cautiously. Further studies with larger samples and randomized controlled designs are needed to confirm the effectiveness of binaural beat audio therapy and to determine the optimal frequency, duration, and delivery protocol for maternal anxiety management during labor.

CONCLUSION

Binaural beat audio therapy was associated with a greater reduction in maternal anxiety during the active phase of the first stage of labor compared with routine maternity care. The findings support its potential use as a non-pharmacological complementary approach for maternal anxiety management during labor. Further research with larger samples and randomized controlled designs is warranted to confirm its effectiveness and establish an optimal intervention protocol.

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	mengembangkan keterampilannya dalam penelitian kebidanan dan praktik berbasis bukti.