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The effect of music on the non-stress test and maternal anxiety

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ABSTRACT

Objective: This study aimed to determine the effect of music that was listened to by pregnant women during the non-stress test (NST) on the test result and maternal anxiety.
Materials and methods: The study utilized a non-randomized controlled trial design. Sequential sample selection method was used. The pregnant women in the experimental group listened to music during the NST (20 min).
Results: There were significant differences between the two groups in terms of mean numbers of acceleration deceleration and reactive NST results (p = 0.001). There were statistically significant differences between the intergroup mean scores of pre- and post-music in favor of the control group (p = 0.001).
Conclusion: This study concluded that music is an effective method of reducing pregnant women's deceleration numbers and increasing their acceleration numbers and reactive NST rates. The use of music during NSTs can be recommended.

1. Introduction

The non-stress test (NST) has become one of the most commonly used methods of assessing fetal well-being during the antenatal period because it is a non-invasive, painless and ambulatory diagnostic method that can be interpreted easily. Although the NST is a non-invasive and painless procedure, it may cause anxiety in pregnant women during the procedure [1,2]. The studies in the literature report that the tests performed to assess fetal health may cause pregnant women to develop anxiety [3,4]. Potur et al. [5] examined the attitudes of pregnant women regarding tests of fetal health and found that the tests were a source of anxiety for some of the mothers. Kocak [6] also found that 73.4% of the pregnant women felt anxiety about screening test results. Anxiety in pregnant women can affect the test results and cause misevaluation by increasing the false-positive rates [2,7]. Increased false-positive rates in the NST results may lead to an increase in operative delivery [1,8]. The studies in the literature show that there is a strong relationship between the psychology of mothers and the well-being of their babies [9,10].

The administration and interpretation of NSTs should be done by health staff and especially by midwifes and nurses according to the administrative guides in Turkey and around the world. Therefore, midwifes and nurses are responsible for eliminating all the problems that could affect NST results and cause pregnant women to feel anxiety [11].

Studies have recently drawn attention to music's potential to reduce anxiety in a variety of clinical environments [12]. However, limited information on the effect of patients' listening to music before NSTs is available. The studies in the literature have shown that listening to music before NSTs has a positive effect on reducing anxiety levels. Therefore, combining music medicine with pharmacological methods in patient care is an important independent nursing initiative [7,12]. There are many studies in the field of obstetrics and gynecology suggesting that music reduces pain and anxiety [13–16]. However, there are limited studies on the effects of music on the NST [1,7]. Studies have shown that music played during pregnancy or NST reduces the anxiety levels of pregnant women [15], increases fetal heart rate [17,18] and fetal movement rate [7,18] and the number of accelerations [7,17,18]. Studying the effect of music on NST with different music pieces and in different cultures will contribute to the literature. That is why, this study aimed to determine the effect of music during the NST on results and maternal anxiety.

1.1. Study hypotheses

H1. Playing music increases the acceleration number in the NSTs of pregnant women.

H2. Playing music decreases the deceleration number in the NSTs of pregnant women.

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H3. Playing music increases the fetal heart rate in the NSTs of pregnant women.

H4. Playing music increases the fetal movement number in the NSTs of pregnant women.

H5. Playing music increases the reactive NST rate.

H6. Playing music decreases the anxiety level of pregnant women during the NST.

2. Materials and methods

2.1. Design

This is a non-randomized controlled clinical study. This study was carried out at the NST polyclinic of Dumlupınar University, Evliya Celebi Training and Research Hospital in Kutahya in Turkey. The inclusion criteria for the study were having 32–41 weeks of gestation, having had an NST before, having no risk factors (multiple pregnancy, premature rupture of membranes, preeclampsia, gestational diabetes, intrauterine growth restriction, etc.), having no diagnosed fetal risk factors (cardiovascular disorder anomaly, etc.), having no uterine contraction in the NST result, having no high (140/90 and higher) or low (80/60 and lower) blood pressure and multiparity. The conditions that must be met before the NST were fulfilled. The participants ate at least 2 h before the NST, urinated immediately before the NST and did not smoke or drink alcohol for at least 2 h before the NST. The population of the study included 2353 pregnant women who were accepted to the NST polyclinic of the hospital within the last year, who had given a live birth at least once, who had had an NST before and who had more than 32 gestational weeks. This study had medium quantity sample size, 80% power with an alpha = 0.05 margin of error and a 95% confidence interval for the use of the *t*-test in independent groups according to power analysis done with the G Power 3.0.10 program.

The study included 100 pregnant women- 50 in the experimental group and 50 in the control group. Sequential sampling method was used. Sampling was conducted between October 2017 and March 2018. Each pregnant woman who applied to the polyclinic was included in either the experimental or control group considering their application sequence on Monday and Thursday. The study was conducted until the required sample number was reached through skipping the pregnant women who had visited the NST polyclinics and included in the study before.

2.2. Data collection

The pregnant women were monitored from the beginning to the end of the NST. Data were collected using a Personal Information Form and the NST Inspection Form, which were developed making use of the literature, and the State Anxiety Inventory used to measure the pre- and post-NST anxiety level of pregnant women. The anxiety levels of the pregnant women in both groups were evaluated at the beginning and end of the NST. Their NST results were recorded on the NST Inspection Form.

Personal information form consists of questions about socio-demographic and obstetric features such as age, educational level, employment status, number of pregnancies and week of pregnancy. The NST inspection form was used to record and evaluate findings regarding the NST. This form consists of questions about the mood of the pregnant women during the NST and the type of music preferred by the women in the experimental group. The NST assesses fetal heart rate and variability, the number of accelerations, decelerations and fetal movements and the status of the test result (as reactive or nonreactive). The NST was performed using a Philips Avalon FM20 fetal monitor. NST results of the participants were assessed by an investigator who has an NST coding certificate. The device is being calibrated once a year.

The NST result was considered reactive in the presence of at least two accelerations above the 15 BPM baseline for at least 15 s in 20 min, during which electronic fetal heart rate traces were printed [1]. The NST result was considered non-reactive in the absence of at least two accelerations above the 15 BPM baseline for at least 15 s in 20 min, during which electronic fetal heart rate traces were printed in the presence of significant variable decelerations or late decelerations or the development of persistent fetal tachycardia at 160 BPM and higher, while the baseline traces were normal [1,2].Having been assessed by the researcher, seven doubtful traces (four for the experimental group and three for the control group) were reassessed by a gynecologist for confirmation. The results were found to be the same.

The State Anxiety Inventory (STAI) which was developed by Spielberger et al., was used to measure the anxiety levels of the pregnant women. Its Turkish validity and reliability studies were done by Oner and Le Compte in 1974–1977 [19]. The STAI is a 4-point Likert scale with twenty questions about how people feel at a specific moment and in a specific condition. The highest possible score is 80 and the lowest is 20. High scores indicate high anxiety levels and low scores indicate low anxiety levels. The scores are evaluated as: 0–19 points mean no anxiety; 20–39 points mean mild anxiety; 40–59 points mean moderate anxiety; 60–79 points mean high anxiety; and 80 points mean severe anxiety (panic). The reliability co-efficient of the scale is between 0.94 and 0.96 [19]. The Cronbach's alpha values of the present study were 0.909 and 0.991 before and after the NST, respectively.

2.2.1. Procedure

After the personal information form and the STAI were administered to the pregnant women in the experimental group (n = 50), they assumed the right or left lateral decubitus position and chose Turkish classical music, Turkish folk music or classical music. The NST was administered to them for 20 min with the music they chose. Also, earphones were provided separately for each pregnant woman to protect their hygiene. This study focused on musical medicine. Musical medicine includes listening to music by using devices such as iPod or mp3 player, it and does not require any guidance of a therapist. The person who enables people to listen to music does not interfere with the process [20]. The pregnant women who participated in this study listened to music with MP3 players. They were free to set the volume and change the music as they wished. After the NST, the NST inspection form and the STAI were re-administered to them. The pregnant women in the control group (n = 50) were provided with the routine NST without music (Fig. 1).

2.3. Data analysis

The data were evaluated using SPPS (Statistical Package for Social Science) 23.0 software. The data evaluation used the chi-square (X^2) and Fisher's exact tests, in which cross tabs were formed for the categorical variable for the comparison of intergroup homogeneity. Chi-square (X^2) test was used to compare the reactive and non-reactive NST results. Mann Whitney *U* test was used to compare the NST results (number of accelerations, decelerations, fetal movements and fetal heart rate). The paired *t*-test and independent *t*-test were used for the comparison of the mean scores of the pregnant women on the STAI. The level of $p < 0.05$ was accepted significant.

2.4. Ethical considerations

The purpose of the study was explained to each pregnant woman, and their consent was obtained. The research ethics committee approval numbered 2015-KAEK-86/12–107 was obtained from the Dumlupınar University Ethics Committee in Clinical Research. The research permit numbered 5571989/604.02 was issued by the General Secretary of the Turkish Public Hospitals Agency of Kutahya Province under the Ministry of Health. Permission to use the STAI was obtained

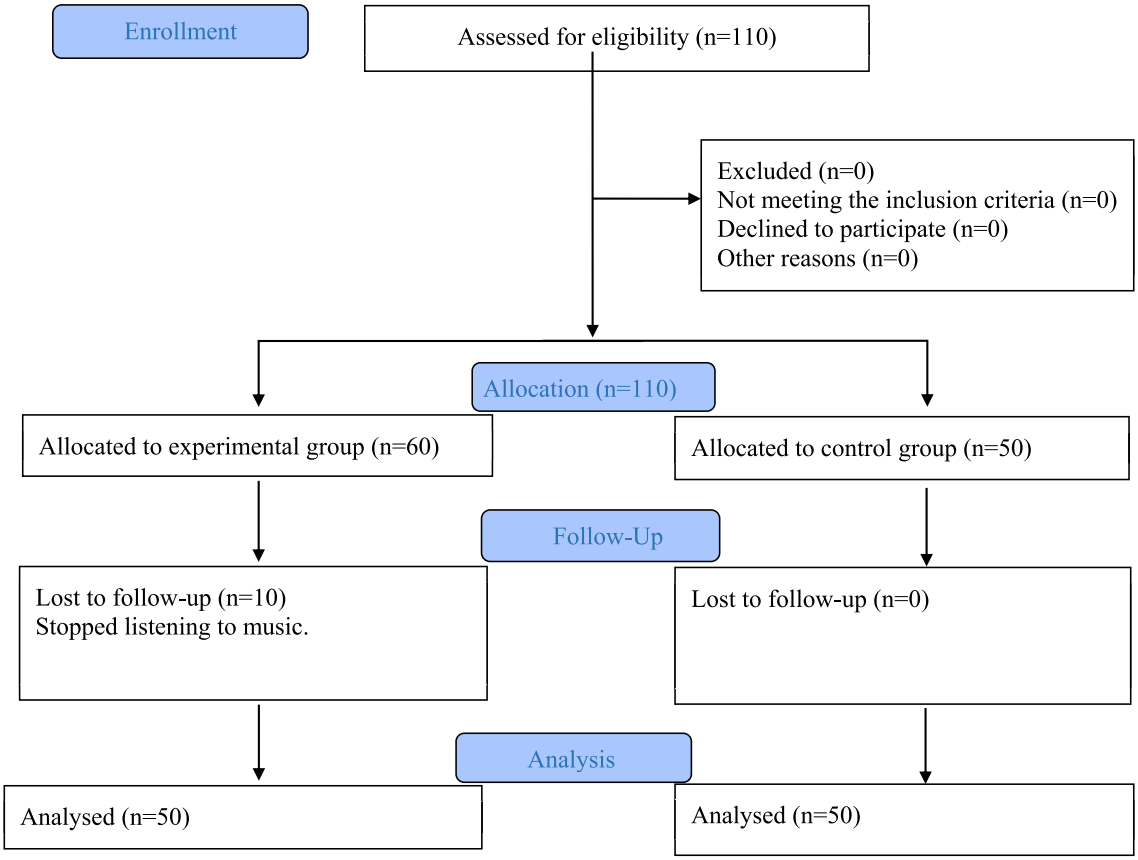

Fig. 1. Consort flowchart.

from Necla Oner, who translated the scale into Turkish.

3. Results

During data collection, 110 pregnant women were assigned to the experimental and control groups. Ten of the pregnant women were excluded from the research as they wanted to continue without music. The research was conducted with 50 pregnant women in the experimental group and 50 women in the control group. Both groups were similar in terms of their socio-demographic and obstetric characteristics (except the number of pregnancies) ($p > 0.05$) (Table 1).

The mean number of acceleration of the experimental group (8.90 ± 3.90) was higher than that of the control group (4.30 ± 3.20). There was a statistically significant difference between the mean numbers of acceleration between both groups ($z = 460.00$, $p < 0.05$) (Table 2).

The mean number of deceleration of the experimental group (0.50 ± 1.00) was higher than that of the control group (1.70 ± 2.00). There was a statistically significant difference between the mean numbers of deceleration between both groups ($z = 816.50$, $p < 0.05$) (Table 2).

The mean fetal heart rate (136.5 ± 8.90) of the experimental group was higher than that (135.10 ± 7.10) of the control group. However, there was not a statistically significant difference between the mean fetal heart rate among both groups ($z = 1178.00$, $p > 0.05$) (Table 2).

The mean fetal movement number (2.52 ± 0.70) of the experimental group was higher than that of the control group (2.48 ± 0.58). There was not a statistically significant difference between the mean fetal movement number between both groups ($z = 1231.00$, $p > 0.05$) (Table 2).

Of the pregnant women, 98.0% of the experimental group and 82.0% of the control group had reactive NST results. There was a

Table 1
Sociodemographic and obstetric history characteristics of the pregnant women.

Characteristics	Experimental Group (n = 50)	Control Group (n = 50)	t	p
Age (year) Mean ± SD	30.40 ± 4.7	30.30 ± 4.9	0.104	0.917
	n (%)	n (%)	X^2	p
Education Level			*	
Illiterate	0 (0)	1 (2)		
Primary School	13 (26)	20 (40)		
Middle School	18 (36)	15 (30)		
High School	15 (30)	8 (16)		
University or higher education	4 (8)	6 (12)		
Employment Status			0.332	0.774
Working	6 (12)	8 (16)		
Not working	44 (88)	42 (84)		
Number of pregnancies			4.596	0.032
< =2	21 (42)	11 (22)		
> =3	29 (58)	39 (78)		
Number of miscarriages			0.044	0.834
Yes	18 (36)	17 (34)		
None	32 (64)	33 (66)		
Week of pregnancy			0.361	0.689
32–36	25 (50)	28 (56)		
37–41	25 (50)	22 (44)		
Was the pregnancy planned?			0.000	1.000
Yes	31 (62)	31 (62)		
No	19 (38)	19 (38)		

*The number of participants was not high enough to conduct statistical analysis.

Table 2
Comparison of the pregnant women's NST results.

NST results	Experimental Group (n = 50)	Control Group (n = 50)	z	p
	Mean ± SD	Mean ± SD		
Number of acceleration	8.90 ± 3.90	4.30 ± 3.20	460.00	0.001*
Number of deceleration	0.50 ± 1.00	1.70 ± 2.00	816.50	0.001*
Fetal heart rate	136.50 ± 8.90	135.10 ± 7.10	1178.00	0.609
Number of fetal movements	2.52 ± 0.70	2.48 ± 0.58	1231.00	0.882

[Z]: Mann-Whitney *U* test, *Significant, SD: Standard Deviation.

Table 3
Comparison NST results of the pregnant women.

NST Result	Experimental Group (n = 50)		Control Group (n = 50)		Total (n = 100)		X^2	p
	n	%	n	%	n	%		
Reactive	49	98.0	33	82.0	82	82.0	17.344	0.001*
Nonreactive	1.0	2.0	17	34.0	18	18.0		

X^2: Chi-square test, *Significant.

statistically significant difference between the reactive NST results between both groups (z = 17.344, p < 0.05) (Table 3).

The mean STAI scores of the pregnant women in the experimental group was 42.04 ± 3.7 before music intervention; this was 42.40 ± 4.5 for the pregnant women in the control group. There was no statistically significant difference between the mean STAI scores of the pregnant women in both groups (t = −0.386, p = 0.701; Table 4) before the intervention. While the mean anxiety score of the pregnant women in the experimental group was 44.32 ± 4.0 after music intervention, it was 41.54 ± 4.2 for the pregnant women in the control group (t = −3.370, p = 0.001; Table 4).

4. Discussion

Music provides relaxation by changing one's soul. Recently, the use of music medicine in hospitals has increased due to study results. Music medicine is specially used to reduce the anxiety levels of pregnant women, eliminate delivery pain and improve fetal parameters [7,21]. This study examined the effect of music during NSTs on fetal parameters (fetal heart rate, fetal movements, acceleration number and deceleration number), the reactivity of the NST and maternal anxiety levels. The present study indicated that music increased the acceleration number and NST reactivity of pregnant women and decreased the deceleration number, but it did not affect maternal anxiety.

In this study, the mean acceleration number of the pregnant women in the experimental group was higher than that of the control group. In our study, the mean number of fetal heart accelerations increased, probably due to music the anxiety reduction. Up to now, few studies have calculated the number of accelerations. Kafali et al. examined the effect of maternal anxiety and music on fetal heart accelerations and showed that music increased the number of fetal heart accelerations [7]. Kucukkelepce [1] and Myung Ok et al. [22] found that the mean number of acceleration of the pregnant women in experimental group was higher than that of the control group. Khoshkholgh et al. [23] found that music increased the number of fetal heart acceleration. The results of that study are similar to those of the present study. This result confirmed hypothesis H1, in other words, playing music increases pregnant women's numbers of acceleration.

Table 4
Comparison of the STAI scores in the experimental and control and groups before and after of the intervention.

Group	Experimental Group	Control Group	t^b	p
	Mean ± SD	Mean ± SD		
Before intervention	42.04 ± 3.7	42.40 ± 4.5	−0.386	0.701
After intervention	44.32 ± 4.0	41.54 ± 4.2	- 3.370	0.001*
	t^a = -4.486	t^a = 2.057		
	p < 0.001	p = 0.045		

t^a: Paired *t*-test, *Significant.
t^b: Independent *t*-test, SD: Standard Deviation.

The present study indicated that music decreased the numbers of deceleration. Unlike this study, Kucukkelepce [1] and Kafali et al. [7] found that playing music did not affect the numbers of deceleration. This study found that playing music decreases the numbers of deceleration, which confirmed hypothesis H2 stating that playing music decreases the pregnant women's numbers of deceleration.

Music's ability to increase the number of acceleration and reduce the number of deceleration is a desired result. On the other hand, relaxing music can suppress severe sympathetic effects such as worry, tachycardia, and tachypnea. Of course, these effects are induced by hormones and neurotransmitters such as acetylcholine, endogenous opioids such as endorphin and enkephalin, and mono amines such as serotonin which play key roles in feeling of happiness, pain, calmness, and well-being. Music also covers the stressful sounds of the environment and distracts the mind from pain and stress [23]. Therefore, increase in the numbers of acceleration and decrease in the deceleration might have resulted from mother's relaxation and lower stress during the NST.

We found that although fetal heart rates and fetal movement numbers of the pregnant women in the experimental group were higher, this difference was not statistically significant (p > 0.05). Kucukkelepce et al. [1] also found no significant difference between the experimental and control groups' mean fetal heart rate. Khoshkholgh et al. [23] conducted a study on the effects of music on NST results and found no significant differences in basal fetal heart rates in the first and second 10 min of the test. Hopkins [24] examined the effect of listening music during the NST on the fetal movement number and found no statistically significant difference before and after music. The results of that study are similar to those of the present study. These results did not confirm hypothesis H3 (playing music increases the fetal heart rate in the NSTs of pregnant women) and H4 (playing music increases the fetal movement number in the NSTs of pregnant women).

Some studies have also shown that music increases the number of fetal heart rate and fetal movement [1,7,25–28]. Although the fetal heart rate and movements of pregnant women were higher in the experimental group than those of the control group, the difference between them was not statistically significant. This is thought to be resulted from the fact that the study was conducted in normal polyclinic conditions, was affected by environmental factors and the study design.

Uterine-placental circulation plays an important role in maintaining health of the fetus. However, catecholamines, which are stress hormones, cause vasoconstriction and disturb the uterine blood supply when the pregnant woman's level of anxiety is not reduced. In cases of stress, listening to music affects the nerve centers that govern blood circulation, leading to vasodilatation and increasing blood circulation. Positive characteristics of music such as pleasing the soul, clearing the mind, freeing from stress, and providing a distraction reduce anxiety levels. This positive effect of music may alter physiological findings such as blood pressure, heart rate, and respiration by affecting the body's parasympathetic nervous system [1]. In this study reactive NST results in the experimental group were higher than the control group. In conclusion, playing music during the NST had a positive effect on the experimental group. Thus, their reactive NST rate was higher. This result confirmed hypothesis H5 suggesting that playing music increases the reactive NST rate. Similarly, Kucukkelepce [1] found that the NST results of the pregnant women in the experimental group were almost two times more reactive than those of the control group. Unlike this study, Toker [29] examined the effect of music on pregnant women with preeclampsia and found no statistically significant difference in their NST results. The results of Toker's study [29] may have been affected by the fact that the pregnant women had preeclampsia.

Various studies have shown the significant effect of music on anxiety [10,14,17,30]. Although there are studies showing the effect of music on anxiety, there are also studies showing that music does not affect anxiety. There was no significant difference between the anxiety scores of the experimental and control groups in a study by Toker [28]. Kafali [7] found a decrease in the anxiety scores of a group that was music listened to during the NST; however, it was not statistically significant. Aba et al. [31] assessed the effect of music on the anxiety levels and pregnancy rates of women who had in vitro fertilization embryo transfer. They found that mean state anxiety scores after transfer were lower than the state anxiety scores before transfer in both groups; however, this difference was not statistically significant [31]. Tseng et al. [32] had a different study sample and examined the effect of music on anxiety levels and postpartum anxiety. They found that there were no statistically significant differences between the groups' stress and anxiety levels due to listening music after giving a birth. The results of that study are similar to those of the present study. In this study, music did not affect anxiety. This result did not confirm hypothesis H6 suggesting that playing music decreases the anxiety level of pregnant women during the NST. This may result from the higher number of pregnancies in the control group. Including pregnant women with prior NST experience in the study may have affected their anxiety levels. Kocak [6] found that while there was no statistically significant difference between the pregnant women with prior NST experience and their anxiety levels, the state and trait anxiety levels of the pregnant women who had not previously undergone the test were higher. Also, the pregnant women listened to music for only 20 min during the NST. In the studies that have shown that music reduces anxiety, the pregnant women listened to music much longer (at least 30 min) and in sessions (for 2 weeks on certain days) [14,18,33].

5. Limitations

One limitation of the study is that only one group (multiparous women) was included in the study sample. The results of this study may only be generalized to this study group. During the music, listened by the pregnant women in the experimental group, there were difficulties arising from environmental factors (voices, noise and power cuts). Due to the unsuitability of the beds in the NST polyclinics, the NST was administered to the pregnant women either in left or right lateral position. The beds in the polyclinic were not suitable for Semi-Fowler's position. That is why, there were difficulties in detecting the fetus position and the fetal heart rate during the NST. The duration of the study had to be extended because there were only 2 NST devices in the hospital, and each test took 20 min on average. Studies that use long-term music sessions to assess the effect of music on anxiety should be carried out. Likewise, studies that include pregnant women with no prior NST experience should be designed. More studies that assess the effect of music on NST results and anxiety should be conducted. According to the literature, every intervention conducted to assess fetal health is a source of anxiety for mothers. Because NST is applied to primiparas for the first time, they experience more anxiety than multiparas. This study is considered to contribute to the literature as the number of the studies on the subject is limited.

6. Conclusion

Our study showed that music increased the number of acceleration and NST reactivity of pregnant women and decreased the number of deceleration; however, it did not affect maternal anxiety. The results of this study provide healthcare professionals performing and interpreting NSTs with evidence-based information, indicating that music can be played for pregnant women during NSTs since it increases the number of acceleration and NST reactivity, and reduces the number of deceleration. The use of music during NSTs can be recommended.

Conflicts of interest

The authors declare no conflicts of interest.

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