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BINAURAL BEATS AS AN INTERVENTION TO REDUCE ACADEMIC ANXIETY IN FIRST SEMESTER STUDENTS

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Abstract

Anxiety and difficulty concentrating are often experienced by first-year college students, especially those with introverted personalities, poor coping mechanisms, low adaptability, and an inability to manage stress. These conditions can impact their academic performance.
This is a quantitative study with a pre-experimental design using a one-group pretest-posttest design. A sample of 57 students in the Applied Undergraduate Study Program, Department of Nursing, Poltekkes Jakarta III, was selected through purposive sampling. Data were analysed using the Wilcoxon signed-rank test.
The results showed that the average academic anxiety score before the intervention was 55.95, while after the intervention it decreased to 41.00, with a p-value of 0.001.
These findings indicate that binaural beats are effective in reducing academic anxiety levels in nursing students at Poltekkes Kemenkes Jakarta III, thus offering an alternative approach to addressing students' academic anxiety.

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INTRODUCTION

Academic anxiety in new students is generally caused by adapting to a new environment, socioeconomic pressures, and increased academic workload 1. A study by Simanjuntak & Amir of 93 first-year students concluded that 13 (14.3%) experienced very high anxiety, 54 (58%) experienced high anxiety, and 22 (23.8%) experienced moderate anxiety. A study of 78 first-year nursing students concluded that 20 (25.6%) experienced very high anxiety, 10 (12.8%) experienced severe anxiety, and 16 (20.5%) experienced mild anxiety 3. A similar study of 123 second-semester nursing students at Surya Global Health College in Yogyakarta concluded that 61.8% experienced moderate anxiety, and 30.9% experienced mild anxiety 4.

Academic anxiety in students can hinder the learning process, leading to decreased motivation and difficulty focusing. This can hinder student productivity in completing assignments, leading to decreased academic achievement.

Various techniques and strategies can be applied to reduce academic anxiety, one of which is binaural beats. Binaural beats are created when two tones with different frequencies are played to each ear. The brain then perceives the difference in frequency as a "third tone."

Several empirical studies have shown that when binaural beats are delivered in the low-frequency band (e.g., theta: 4–8 Hz), they can modulate the autonomic nervous system by increasing parasympathetic activity. This effect is typically measured through heart rate variability (HRV), where an increase in the high-frequency (HF) component indicates greater parasympathetic dominance. This modification creates a physiological state conducive to relaxation, which can indirectly reduce stress hormone activity.

Furthermore, although direct evidence is limited, theoretical reports and preliminary research suggest that

binaural beats can influence the balance of inhibitory and mood-regulating neurotransmitters—specifically, increasing levels of GABA (gamma-aminobutyric acid) and serotonin. Several non-clinical applications of music therapy have demonstrated these effects, potentially supporting anxiety reduction.

However, not all empirical results show the same results because consistent entrainment or EEG power changes, and methodological variations (e.g., carrier tone, beat frequency, exposure duration) significantly affect research results.

Overall, binaural beats work by creating a third tone by synchronizing brainwave activity, increasing parasympathetic dominance, and modulating calming neurotransmitters. These neurophysiological changes will reduce anxiety, although further research is needed to directly measure the effects on stress hormones and neurotransmitters.

Research by Lee et al on sleep quality showed that exposure to binaural beats improved sleep quality in the intervention group compared to the control group 5. Research by Yang et al. has shown that exposure to binaural beats can reduce anxiety levels and improve autonomic nervous system regulation in college students, with effects varying depending on the frequency used 6. A similar study by Mosheshe et al. concluded that binaural beats effectively reduced anxiety in college students during a cadaver dissection lab 7.

Research by Băseanu concluded that this therapy is effective in reducing anxiety and depression 8. A similar study by Wahyuni on female student Aisyiah concluded that binaural beats music can reduce stress levels during thesis writing 9.

Research on binaural beats has demonstrated their effectiveness in regulating the autonomic nervous system, thereby reducing anxiety. However, this research has not been widely conducted in Indonesia. Therefore, the researcher was interested in conducting this study to determine the effect of binaural beats on reducing academic anxiety in new nursing students at Poltekkes Kemenkes Jakarta III. The purpose of this study was to determine the effect of binaural beats on the level of academic anxiety in first-year undergraduate students of the applied nursing program at Poltekkes Kemenkes Jakarta III.

METHODS

This study employed a quantitative design with a pre-experimental approach, consisting of a one-group pretest and posttest. The study took place at the Poltekkes Jakarta III campus. The study was conducted from May 7 to 14, 2025. The population was 110 first-year nursing students experiencing anxiety. The sample was selected using a non-probability sampling technique with a purposive sampling method, with a sample size of 57 respondents.

The inclusion criteria were first-year Applied Bachelor of Nursing students at Poltekkes Jakarta III with mild, moderate, and severe levels of academic anxiety. Ethical approval was issued by the Ethics Commission of Poltekkes Kemenkes Jakarta III No. DP.04.03/F.XIX.13/3485/2025, while the research permit was issued under number PP.06.02/F.XI/4495/2025.

The research questionnaire consisted of respondents' demographic data and a questionnaire on factors influencing academic anxiety, modified from research by Farraisa et al., which included five variables: performance pressure, fear of failure, social comparison, academic ability, and stress management skills. This questionnaire consisted of nine items, utilizing a Likert scale 10.

The validity test obtained a value of 0.368–0.853, and the reliability test obtained a Cronbach's alpha value of 0.931. The results of the univariate test analysis were described in the frequency distribution of respondent characteristics. The Wilcoxon bivariate test was used to determine whether there was a significant difference in pretest and posttest scores related to the intervention. To

determine the relationship between factors influencing academic anxiety and the level of academic anxiety, the Spearman Rank Correlation test was used.

RESULTS AND DISCUSSION

A. RESULT

Tablel 1.1 Distribution of Respondent Characteristics

Characteristic	n	f (%)	Mean	Std. Deviation
Age				
18 years	20	35.1%		
19 years	28	49.1%	18.84	0.797
20 years	8	14.0%		
22 years	1	1%		
Sex				
Male	7	12.3%		0.331
Female	50	87.7%		

Based on the data above, the majority of respondents aged 19 years old were female. Demographic analysis showed that the majority of respondents were 19 years old (49.1%), followed by 18 years old (35.0%), 20 years old (14.0%), and 22 years old (1.8%). This age distribution reflects the general pattern of first-year students at Poltekkes Kemenkes Jakarta III, where most students begin higher education between the ages of 18 and 19. The age range of respondents is crucial for understanding students' psychological development and academic adaptation, as this transitional age is often associated with an increased risk of academic anxiety.

In terms of gender, the majority of respondents were female (87.7%), while only 12.3% were male. This finding aligns with the characteristics of nursing programs, which are traditionally female-dominated. Gender differences are relevant because previous research has shown that levels of academic anxiety can vary by gender, with females generally reporting higher levels of anxiety.

Overall, these demographic characteristics indicate that the study sample is representative of the first-year nursing student population, providing appropriate context for interpreting the results regarding academic anxiety and its influencing factors.

Table 1.2 Frequency Distribution of Academic Anxiety Level Categories

Variable	Anxiety Category	N	f (%)
Academic Anxiety Level (Pretest)	Mild	42	73.7%
	Moderate	15	26.3%
Academic Anxiety Level (Post test)	No Anxiety	15	26.3%
	Mild	37	64.9%
	Moderate	5	8.8%

Table 1.2 above shows the results that the majority of students have mild academic anxiety, with a total of 42 respondents (73.7%).

Binaural beats are an auditory perception phenomenon that stimulates the brain to resonate with the differences in frequencies simultaneously received through each ear. When two tones with different frequencies are heard simultaneously through each ear, the brain processes the frequency difference as a new waveform, creating the sensation of a beat at 10 Hz. When the frequency difference is in the alpha wave range (8–12 Hz), the brain tends to relax and focus, increasing the balance of the autonomic nervous system, reducing sympathetic nervous system activity associated with the stress response, and increasing parasympathetic activity, which plays a role in calming and emotional recovery.

Several studies support this mechanism, including a study by Mosheshe et al. that found exposure to 10 Hz binaural beats for 3 minutes before and during anatomical dissection significantly reduced State Anxiety Inventory (STAI-S) scores ($p = 0.003$). The results of a study by Chairinkam et al. showed similar results: students who listened to superimposed binaural beats for five days experienced a median decrease in the STAI-S of 20 points compared to the control group 15. Research by Yang et al. demonstrated that binaural beats with a frequency of 6–10 Hz can lower blood pressure and heart rate, as well as improve the balance of the autonomic nervous system 6. Alpha-frequency binaural

beat stimulation helps reduce sympathetic nervous system activity and increase parasympathetic activity, which plays a role in the relaxation process and reduces physiological stress responses such as rapid heart rate or muscle tension 11.

Physiologically, exposure to binaural beats lowers brainwave frequency toward a calming alpha state, thereby reducing levels of stress hormones like cortisol, slowing the heart rate, and increasing heart rate variability (HRV), an indicator of relaxation. Psychologically, this state improves focus, emotional stability, and the perception of control over environmental stressors.

Furthermore, these positive effects can be explained through the theory of brain entrainment, which refers to the brain's ability to synchronize its electrical activity with a specific external frequency. When the brain resonates with alpha waves, individuals experience a state of calm and focus, which in turn reduces the perception of academic stressors.

Table 1.3 Difference in Average Academic Anxiety Score

Variable Academic Anxiety	**Mean**	**Mean Difference**	**SD**	***p-value***
(Pretest)	55.95	14.95	14.481	**0.001**
(*Posttest*)	41.00		12.619	

Table 1.3 illustrates a 14.95-point difference in average scores between the pretest and posttest. The p-value between the pretest and posttest was 0.001 (<0.05), indicating a significant difference in the data. These statistical test results indicate an effect of binaural beats on students' academic anxiety levels.

In first-semester college students, anxiety levels tend to increase due to the demands of adapting to a new environment, different learning methods, and academic and social pressures. First-semester college students face a complex transition period, both academically and socially. Factors such as separation from family, pressure to achieve, and adjustment to a new learning system can trigger situational anxiety. Binaural beat therapy is a relevant alternative because it can be done independently, is affordable, and is flexible without the need for special medical equipment.

The study also showed that positive responses to binaural beats tended to be higher in participants who listened regularly in a quiet environment and used high-quality stereo headsets. Therefore, consistency and environmental conditions during therapy are crucial factors that influence the success of the intervention.

The reduction in anxiety scores after binaural beats administration suggests that this therapy has potential as a non-pharmacological intervention that is easily accessible and free of side effects. The use of alpha waves (8–12 Hz) for 15–30 minutes per session has been shown to be effective in reducing mild to moderate anxiety symptoms in college students 12.

This research aligns with the findings of Venkatesan et al., who stated that the combination of music and binaural beats significantly reduced anxiety in college students with a moderate effect size (d = -0.58) 13. Pang et al. also added that the effects of binaural beats were more pronounced in individuals with high levels of initial anxiety, suggesting that this technique could be used selectively for students with moderate to severe anxiety symptoms 14.

Binaural beats interventions have been shown to reduce situational anxiety experienced by college students during this transition period. The use of binaural beats offers an easily accessible relaxation experience with no side effects and can be performed independently using stereo headphones. Therefore, this intervention is a relevant non-pharmacological alternative for enhancing the mental health of college students.

The resulting relaxation effects also strengthen students' capacity to cope with academic and social pressures, thus supporting adaptation and improving psychological well-being. Furthermore, this intervention can be utilized as part of mental health promotion programs in higher education institutions through counseling, academic advising, and group relaxation sessions.

In general, the results of this study align with several international studies that have found binaural beats to be effective in reducing anxiety and promoting relaxation. Research by Padmanabhan et al. showed that 30 minutes of 10 Hz sound therapy significantly reduced preoperative anxiety 12. Similar findings were also reported by Le Scouarnec et al, who found that exposure to alpha-frequency binaural beats induced feelings of calm and reduced muscle tension 11.

However, several studies have shown that the effects of binaural beats can vary depending on the duration of exposure, environmental conditions, and individual characteristics such as baseline anxiety levels, sensitivity to sound, and adherence to the protocol. Therefore, further research with a large-scale randomized trial design is needed to confirm its general effectiveness. These findings have important implications for higher education and community nursing.

Educational institutions may consider integrating music therapy or binaural beats into student mental health promotion programmes, particularly during orientation or the first semester. For nursing staff, binaural beats could be part of a complementary intervention for non-pharmacological anxiety management in clinics, on campus, or in the community.

Based on the results and discussion above, it can be concluded that binaural beats are effective in reducing anxiety in first-semester students through mechanisms such as brainwave synchronization, increased relaxation, and decreased stress-related physiological activity. This intervention is simple, non-invasive, and has the potential for implementation in higher education settings.

CONCLUSION

Binaural beats to reduce anxiety in new college students suggest that this technique can be an effective alternative method in helping reduce anxiety levels. Binaural beats can influence brain waves, promote relaxation, and create a calmer mood. Therefore, implementing binaural beats as part of a new college student adaptation program can improve mental well-being and support their academic and social development

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