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Music Therapy Based on Educational Theories and Its Impact on Student Mental Health in Zhumadian, China

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Abstract

This study aims to investigate the application of music therapy and its impact on the mental health of students in colleges and universities in Zhumadian City. As a large population province in China, Henan Province, its college and university students are facing great learning pressure and challenges of further education, and students' mental health problems are becoming more and more prominent. Based on affective education theory and social learning theory, this study analyzes the effects of three factors, instrument choice, treatment intensity and cognitive regulation, on mental health. Ultimately, it helps colleges and universities create an environment with a high degree of support for mental health development. Music therapy, as a non-pharmacological intervention, has the potential to address students' psychological stress. This paper adopts a quantitative research method, using spss for analysis, combined with an online questionnaire to collect feedback from 404 students from three colleges and universities in Zhumadian City, Henan Province, focusing on analyzing the impact of factors such as musical instrument choices, music therapy intensity, and cognitive regulation on students' mental health. The questionnaire survey of the students found that appropriate musical instrument selection and therapy intensity significantly reduced anxiety levels. Reduced academic stress and increased their mental toughness. This finding provides empirical evidence for integrating music therapy in student mental health support strategies in colleges and universities in Zhumadian City, which has important practical significance and guiding value.

Keywords: Cognitive functioning, College students, Emotion regulation, Mental health, Music therapy.

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1. Introduction

Aiming at the status quo of the increasingly prominent mental health problems of students in Zhumadian universities, this study uses music therapy as an intervention to explore its impact on students' mental health. This research presents the theory of the humanistic concept of education, which also corresponds with the idea of quality education promoted by the Sustainable Development Goal 4 of the United Nations. Quantitative research methods, such as questionnaires, focused on the effects of instrument selection, treatment intensity and cognitive regulation on students' mental health. This study aims to provide practical insights into the application of music therapy for mental health education in colleges and universities, to enrich the theoretical connotation of humanistic education, and to promote the enhancement of students' mental health and education quality.

Music therapy, as a non-pharmacological intervention, can provide students with emotional and psychological support to help them effectively overcome challenges and enhance overall mental health. Educational institutions should use music therapy to improve students' cognitive skills, according to Tang, Huang [1]. The significantly improve their attention control. Therefore, implementing music therapy in teaching and learning environments can create a more engaging and supportive learning atmosphere for students, thus improving their learning efficiency. It is particularly important to analyze this issue. Currently, music therapy is being applied more widely in Chinese colleges and universities, especially music colleges, to help students cope with emotional challenges and psychological stress. However, comprehensive universities do not popularize music therapy as an option for students, and there is still a large knowledge gap about the effective interface between music therapy and educational theory [2]. This gap has hindered music therapy's further application within the educational administration framework. Therefore, this study aimed to explore how music therapy can help enhance students' mental health and academic performance by optimizing instrument selection, adjusting therapeutic intensity (e.g., frequency, volume, and tempo), and incorporating cognitive regulation mechanisms .

Music therapy has recently become an important tool for student mental health interventions in colleges and universities in Zhumadian [3]. However, current research focuses primarily on immediate or short-term intervention effects (e.g., in a single session or over the course of a few weeks) and lacks systematic research on sustained effects over a six-month or longer period [4]. This gap hinders educators from effectively integrating music therapy into long-term practice. Specifically, there is a lack of comprehensive theoretical frameworks integrating educational management principles (e.g., curriculum design and administrative policies) with music therapy practices and empirical research validating their effectiveness [2]. Additionally, although music therapy has demonstrated significant effects in enhancing social communication skills and activating neural pathways [5] detailed analysis of its integration with educational management strategies (e.g., curriculum planning and teacher training) is still limited, due to challenges posed by resource constraints and insufficient cross-disciplinary collaboration [6].

In practical applications, educators face unclear theoretical foundations and insufficient cultural adaptations, such as how to adapt to local musical traditions or students' cultural backgrounds in Chowchow [6]. A considerable number of studies have failed to examine the long-term outcomes of music therapy and have not provided a structured evaluation of its lasting influence on alleviating academic stress, reducing social anxiety, enhancing emotional regulation, and improving concentration [7].

1. This study aims to address the existing gaps in research on the application of music therapy by examining critical factors such as instrument choice, treatment intensity, and cognitive regulation, and their effects on college students' mental health. Through quantitative research methods and the use of the SCL-90 scale, this study will provide educators with theoretical insights and practical guidance to enhance the effectiveness of music therapy in improving student mental health.
2. The objective of this study is to explore how music therapy can be utilized to alleviate depression among students and enhance their overall mental health. The main goal is to build a systematic analysis framework for the practical application of music therapy, based on educational management theory and supplemented by theories of emotional education and social learning. The primary objective is to investigate the intervention mechanisms and pathways of music therapy in promoting university students' mental well-being. Although music therapy has gained increasing attention in colleges and universities in recent years, most studies remain from a clinical psychology perspective and lack systematic arguments for its integration into the education management system. This is particularly evident in Zhumadian City, an area with high population density and significant academic pressure in its universities, where empirical studies are even scarcer.
3. This study not only focuses on the effects of music therapy itself but also takes instrument choice, treatment intensity, and cognitive regulation as core intervention variables, revealing their specific impact on students' mental health through quantitative analysis. This multidimensional and multilevel analysis model helps fill the theoretical gap in the cross-disciplinary field of "educational management + psychological intervention," thus expanding the theoretical boundaries of music therapy research.
4. Additionally, this study innovatively uses the SCL-90 symptom self-assessment scale to systematically assess mental health, deeply integrating psychological assessment tools with educational management research methods, providing an empirical foundation and methodological paradigm for the subsequent construction of a psychological intervention model based on educational theories. The theoretical value is also reflected in the fact that this study not only verifies the mechanism of music therapy in psychological regulation but also proposes a strategic plan for

its systematic integration into the teaching and management systems of universities, providing a new perspective for educational intervention research.

5. At the practical level, this study closely addresses the real-life dilemmas faced by students in universities in Zhumadian City, such as academic anxiety, social pressure, and decreased concentration. Based on the perspective of educational management, the study proposes a music therapy intervention program. The findings suggest that appropriate instrument choice and intervention intensity not only effectively alleviate students' anxiety and stress but also significantly enhance their emotional stability and cognitive function, providing a scientific basis for universities to build a systematic mental health support mechanism.
6. Although many domestic universities have attempted to introduce music therapy, they lack theoretical guidance and long-term evaluation mechanisms, leading to fragmented and case-by-case intervention effects, which are difficult to promote. Through SPSS quantitative analysis and questionnaire research, this study establishes a replicable and generalizable intervention logical framework that can provide universities, especially music colleges, with an operable mental health intervention path. The study recommendations, such as embedding music therapy into campus counseling courses [8], conducting personalized instrumental therapy programs, and guiding cognitive regulation in conjunction with classroom teaching, are all realistic and feasible.
7. More importantly, this study has reference value at the university level and provides key data support for educational decision-makers and policymakers. The results of this study can be used as an important basis for local education departments or university administrators to formulate mental health promotion policies and improve the mental health education system. The study is expected to promote the incorporation of music therapy into the regular mental health service system of universities, making it a long-term intervention tool for the student population.

2. Method

2.1. Research Design

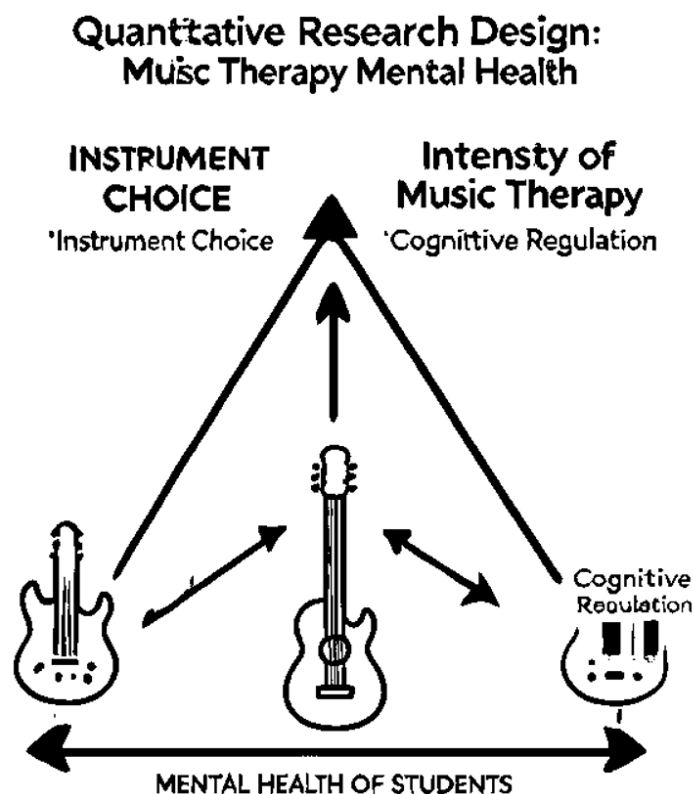


Figure 1.
Research Framework.

As shown in Figure 1, this study uses a deductive approach to formulate hypotheses based on educational management and psychological theories. It tests the hypotheses using empirical data. In this study, a simple random sampling technique was used to recruit respondents from three universities in Zhumadian City to collect information online. The sample included students from different academic years to ensure that it covered students from freshmen to seniors.

This study seeks to investigate the practical impact of music therapy, grounded in educational theory, on mental health interventions for university students in Zhumadian City, and to systematically examine its key influencing factors using quantitative research methods. The research design is based on the existing literature and theoretical framework, using the questionnaire survey method, combining the deductive research path and positivist research philosophy, and constructing

an analytical model with “students' mental health” as the dependent variable and three types of intervention variables as the independent variables.

2.1.1. Type of Study and Study Population

This study employed a cross-sectional quantitative approach, aiming to investigate the function of music-based interventions in promoting students' psychological well-being by gathering and examining data from three universities in Zhumadian City. Considering the obvious academic year differences in mental health problems the student population faces, this study included students from different grades, covering the freshman to senior student populations, to ensure that the findings reflect students' mental health status in different academic years. A simple random sampling method based on probability was used to ensure that the sample was representative across disciplines and academic years.

The study sample was selected based on multiple dimensions such as gender, grade level, and disciplinary background to ensure sufficient representativeness and diversity. First, gender is an important factor affecting students' mental health; therefore, both male and female students were included in the sample to analyze the potential impact of gender on the effectiveness of music therapy interventions. Second, grade level differences may have different impacts on the manifestation of academic stress and mental health, especially since freshman and senior students face different psychological stressors; therefore, students of different grade levels will be covered in the sample. Finally, disciplinary background is also an important variable affecting students' mental health, and there are differences in academic stress and psychological needs among students in different disciplines; therefore, the sample was chosen to cover students in different disciplines, such as arts, sciences, and arts, to assess the impact of disciplinary background on mental health comprehensively [9].

The determination of the sample size followed statistical principles to ensure that the sample was sufficiently representative and statistically significant to support regression analyses and hypothesis testing, thus ensuring the validity of the findings. In addition, the study sample was also drawn from student populations from different geographical and cultural backgrounds, which enhanced the study's external validity and ensured that the findings were broadly applicable to higher education settings in different regions. With the above sample selection criteria and research design, this study ensured that representative and widely applicable results were obtained to support the research hypotheses.

2.1.2. Variable Setting and Measurement Path

The study designed three core independent variables around students' mental health (dependent variable):

Musical Instrument Choice: Includes instrument type preference, psychological response differences, and personalized fit perceptions.

Intensity of treatment: including intervention elements such as volume, tempo, frequency, and session length.

Cognitive regulation: focusing on changes in students' self-awareness, emotional regulation, mental toughness, and attentional status.

The main independent variables in this study were instrument choice (piano, guitar, and percussion), and the effects of the different instruments were assessed by measuring changes in students' psychological states as they underwent music therapy reversal. The SCL-90 scale was used to measure students' anxiety levels [10], the Emotion Regulation Scale (ERQ) was used to assess emotion regulation, and the Self-Efficacy Energy Scale (SEES) was used to measure changes in students' self-perceptions and confidence.

2.1.3. Research Framework

The conceptual framework developed in this research illustrates how instrument selection, treatment intensity, and cognitive regulation collectively function in enhancing students' psychological well-being within an educational management context. This framework reflects the interactions between the three core variables and validates their effects on students' psychological states through quantitative data. The framework provides a clear path for subsequent data analysis and theoretical support for the design of the intervention program [2].

Existing music therapy research has focused on short-term interventions such as anxiety relief and mood improvement. Still, long-term effects, especially sustained impact in higher education settings, have not been systematically evaluated. Therefore, the present study utilized a long-term follow-up design approach to fill this gap by varying the intensity effect of the music intervention, frequency of stimulation, and cultural intermeddling of the students to ensure outcomes of higher applied value and durability.

2.2. Questionnaire Design

2.2.1. Data Collection Method

This study shows that to conduct descriptive analysis, primary data must be collected from a selected population. Accordingly, the utilization of primary data serves as the most efficient means of fulfilling the research objectives. Research data should be collected by conducting interviews with the sample population. Questionnaires should be developed for each variable to develop the research instruments. These questionnaires will be sent to the candidates in the sample population through social media sites (including WeChat and QQ, etc.). The questionnaire has been validated for content and structure by experts and the literature supports the questions. The instrument was adapted from multiple validated sources including the SCL-90 [1] and the Emotion Regulation Questionnaire. Probability-based simple random sampling was used to ensure a representative sample.

In addition, WenJuanXing Forms should be the source for developing tools. The survey format is more suitable for collecting numerical data for the study. During the survey, a Likert scale was employed for responding to the items and to

choose answers from the targeted sample of participants. In addition, the researcher will ask closed-ended questions that will contribute to the logical and critical nature of the study. Using the suggested method of primary data collection will provide the researcher with an advantage by making the data collected more accurate and precise, thus making the study coherent and unique [11].

To validate the impact of instrument choice on students' mental health, this study designed a form covering several dimensions regarding anxiety, emotion regulation, and self-perception. The questions in the form were designed with specific hypotheses, for example, to assess changes in students' anxiety in piano, guitar, and percussion instrument therapy through the SCL-90 scale, to assess the effects of different tools on emotion regulation skills using the Emotion Regulation Scale, and, in addition, to improve students self-confidence and ability to cope with stress through the Self-Efficacy Energy Scale.

2.2.2. Instruments and Measurement Tools

The instruments for the study will be the survey questionnaires developed by focusing on different constructs of the variables. Therefore, it is understandable that the development of constructs is essential to collect appropriate information on the variables. Questionnaires provide a wide range of data from the respondents' perspectives. The research can be rationalized by maintaining consistency in the same section and interpreting the questions asked by the respondents. Questionnaires are fast and economical as a research tool. Surveys provide a full set of functions in the distribution, design and analysis of the data collected. The survey allowed first-hand data to be obtained on the impact of music therapy on the mental health of students in Zhumadian City compiled using educational theories. From most of the responses, researchers can learn remarkable details about the means of music therapy, the modulation of cognition, and the level of music therapy. The Likert scale was easy to grasp because the respondents ranked their preferences according to the Likert scale process of Vinjuanxing. This process will be used to quantify the opinions collected about the candidates. The scale is on a 1-5 scale i.e. 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree.

2.3. Data Analysis

2.3.1. Pilot Test

Prior to the formal data collection stage, a preliminary trial was carried out using a predetermined sample size of 10% ($n = 40$) to evaluate the reliability and validity of the questionnaire. This procedure aimed to verify the quality of the questionnaire before it was widely distributed.

The questionnaire's internal consistency was evaluated through Cronbach's alpha, resulting in an index of 0.928 and a standardized value of 0.930, reflecting strong internal reliability across items [12]. A priori power analysis was conducted with GPower 3.1, assuming $\alpha = 0.05$, power = 0.80, and a moderate effect size ($f^2 = 0.15$), with three predictors. The minimum required sample was 77; the actual sample ($N = 404$) surpassed this threshold.

The Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity were applied to assess construct validity. A KMO score of 0.733 surpassed the recommended minimum threshold of 0.70, and Bartlett's test produced statistically significant results ($\chi^2 = 272.214$, $p < 0.001$), confirming the dataset's suitability for factor analysis [13].

2.3.2. Data Analysis Methods

The methodological orientation of this study supports the adoption of quantitative data analysis, as this approach enables the application of a wide range of statistical and numerical techniques. According to Vebrianto et al., the analytical strategies employed in this research include demographic profiling, descriptive statistical analysis, common method bias testing, outlier detection, normality testing, reliability assessment, and multiple linear regression. IBM SPSS software will be utilized to execute these analyses efficiently [11].

Regression analysis is employed to examine the effects of a range of instrumental characteristics on mental health outcomes corresponding to RO1 and RO2. For RO3, correlation techniques. These statistical methods serve to evaluate the magnitude and direction of the association between the intensity of music therapy interventions and mental health outcomes.

In this study, the data obtained from the questionnaire were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Appropriate statistical techniques were applied to ensure a comprehensive and reliable assessment of the relationships among the research variables.

2.4. Reliability and Validity

Both validity and reliability are essential for ensuring the accuracy of a study's measurement methods. Reliability refers to the consistency of measurements under identical conditions. In contrast, validity concerns whether the measurement accurately reflects what it intends to measure and whether the instrument is appropriately designed. It also considers the extent to which the test is free from external biases and reliably assesses the intended construct. Validity emphasizes the stability and consistency of results over time, across different techniques, populations, and raters. As part of an evidence-based approach, attention must be paid to the research findings and the overall course of the study.

Thus, understanding validity and reliability contributes to adopting a quantitative approach in the research project. These parameters ensure repeatability, consistency, accuracy, and alignment with the study's objectives. The researcher can promote reliability and credibility by addressing methodological concerns and seeking coherence between reliability and validity. It is essential to examine the reliability of the variables selected for inclusion in the regression framework, considering only those variables that are relevant. The reliability of the variables is assessed through a reliability test

utilizing Cronbach's Alpha, with acceptable values ranging from 0.7 to 0.9. However, variables must fall within this range to be deemed reliable. Further enhancement depends largely on the methods employed.

3. Results

3.1. Description of Scale Components and Dimensions

Based on music therapy theory and cognitive-behavioral framework, this study systematically constructed a multidimensional psychometric instrument to scientifically deconstruct the mechanisms of instrument selection, treatment intensity, and cognitive regulation on students' mental health. The scale was designed with a mixed structure, including three core independent variables and students' mental health as the dependent variable, while demographic information was included as a moderator (Table 1).

Table 1.
Scale Composition.

Category	Primary index	Secondary index	Questionnaire question
Independent variable	Instrument selection type	Selection validity	Q4: Do you think the choice of musical instruments in music therapy has an impact on students' mental health?
		Type effect	Q10: Do you think there is a difference in the psychological impact of different types of musical instruments on students in music therapy?
		Instrument specificity	Q16: Do you believe that different types of instruments (e.g., piano, guitar, percussion, etc.) have different effects in music therapy?
	Music intensity therapy	Strength parameter	Q5: Do you think the intensity of music therapy (e.g. volume, tempo, etc.) has an impact on students' mental health?
		Timing effect	Q11: Do you think the frequency and duration of music therapy affects its effectiveness on students' mental health?
		Dynamic sound pressure	Q17: Do you think that changes in volume (e.g., increases or decreases in volume) in music therapy can have a significant impact on students' emotional and psychological well-being?
	Cognitive regulation	Adjustment weight	Q6: Do you think cognitive modulation is important in music therapy for students' mental health?
		Neural gain	Q12: Do you think music therapy has a positive impact on students' cognitive health and brain function?
		Toughness factor	Q13: Do you think that music therapy can help students increase their mental toughness and emotional stability?
Dependent variable	Student mental health	Emotional transfer	Q7: Do you think music therapy can improve the emotional state of students?
		Focus gain	Q8: do you feel that music therapy is helpful for students' attention control?
		Pressure attenuation	Q9: Do you think music therapy can help students to reduce stress in school?
		Demand response	Q14: Do you think colleges and universities should increase mental health services related to music therapy to meet the needs of students?
		Symptom resolution	Q15: How effective do you think music therapy is in relieving anxiety and depression symptoms among college students?
Regulating variable	Demographic information	Age	Q1: What is your age range?
		Profession	Q2: What is your major?
		Sex	Q3: What is your gender?

3.2. Data Collection

3.2.1. Data Collection and Pilot Test

Although it is difficult to accurately calculate the actual impact of music therapy on Chinese conservatory students based on educational theories through mathematical models, the scientifically designed questionnaire survey method can effectively quantify the intensity of different influencing factors. Compared with the expert interview method, which is limited by the subjective experience of the respondents and the sample size, the questionnaire survey method can establish a more statistically significant analytical model through the collection of large samples of data. At the operational level, the combination of Likert scales and open-ended questions can identify key influencing factors through quantitative analysis

and analyze students' qualitative feedback through text mining techniques. The scores on the five-point Likert scale reflect the extent to which the questions align with students' real lives. Specifically, a score of 1 indicates “Strongly Disagree”, 2 indicates “Comparatively Disagree”, 3 indicates “Generally Agree”, 4 indicates “disagree somewhat”, 5 means “agree generally”, 6 means “agree somewhat”, and 7 means “agree strongly”. Thus, the higher the score, the more the question corresponds to the student's real life. This scoring method can effectively quantify the group's subjective feelings about the questionnaire content and provide a reliable basis for subsequent data analysis.

The questionnaires in this study were sent to Chinese school students and distributed through a combination of online and offline methods. The online part of the questionnaire was designed through the “Questionnaire Star” platform and distributed by social tools such as WeChat and QQ; the offline part of the questionnaire was designed in paper form and distributed randomly among the student groups, and 469 questionnaires were collected, and 404 valid questionnaires were obtained by deleting the questionnaires with nulls and outliers, with a validity rate of 86.14%. The questionnaire structure was statistically analyzed, and the results are shown in Table 2.

Table 2.
Data Structure.

Column	N	Dtype
Number	404	object
Time to submit		
Time spent		
Source		
Q1-Q17		

The pilot test was designed to assess the data's quality and ensure its validity and feasibility. Forty data were randomly selected, representing 10% of the total data. The pilot data were tested for reliability and validity; the results are shown in Table 3.

Table 3.
Pilot Data Reliability Tests.

Parameter	Value
Cronbach's α coefficient	0.928
Standardize Cronbach's α coefficient	0.93
N	40

The results show that the scale possesses high reliability and has the potential for further popularization and application. First, Cronbach's α coefficient was 0.928. The standardized α coefficient was 0.93, which was much higher than the excellent reliability criterion of 0.9, with a high degree of consistency and internal stability among the question items. The questionnaire showed great reliability in measuring the same latent variable. Then, the validity test was conducted, and the results are shown in Table 4.

Table 4.
Pilot Data Validity Tests.

Factor Data Validity Tests:		
Parameter		Value
KMO value		0.733
Bartlett's Test of Sphericity	Approximate chi-square	272.214
	df	91
	Sig.	0.000***

The results show that the scale possesses good structural validity and has the potential for further generalization and application. The Kaiser-Meyer-Olkin (KMO) value is 0.733, which exceeds the acceptable threshold of 0.7, and the variables between the samples have moderate commonality, which is suitable for factor analysis; the p-value of Bartlett's test of sphericity is 0.000, which reaches the significant level, and the variables are sufficiently correlated, which allows for the effective extraction of potential structural factors.

The results of the reliability and validity tests jointly verified the structural validity of the scale, which has good consistency between theoretical conceptualization and actual measurement. Considering that the sample size of this pilot data is 40 people, although the limited sample size, the scale's structural validity, and the measurement's stability have been initially verified at this preliminary stage, which lays a solid instrumental foundation for the subsequent large-scale formal research.

3.3. Descriptive Statistical Analysis

3.3.1. Distribution of Demographic Characteristics

To comprehensively analyze the effects of the intervention, the demographic characteristics of the study population first needed to be statistically described. The gender, age, and profession of the population within the study sample were systematically analyzed through descriptive statistics. The results are shown in Table 5.

Table 5.
Distribution of Demographic Characteristics.

Name	Options	Frequency(n)	Percentage (%)
1.What is your age range?	19-22 years old	198	49.01
	23-26 years old	138	34.158
	18 years and under	38	9.406
	27 years old and above	30	7.426
Total		404	100.000
2.What is your major?	Social Sciences	142	35.149
	Science and Engineering	131	32.426
	Literature	91	22.525
	Art	40	9.901
Total		404	100.000
3.What is your gender?	Female	245	60.643
	Male	159	39.357
Total		404	100.000

The demographic characterization of the sample of this study shows that the age of the respondents is concentrated in 19-22 years old (49.01%) and 23-26 years old (34.16%), which together account for more than 80% of the respondents, indicating that the research object is dominated by the group of young people enrolled in colleges and universities; the distribution of gender shows that the proportion of females is significantly higher than that of males, which is in line with the characteristics of the gender structure of the art colleges and universities. In the composition of majors, social sciences (35.15%) and science and engineering (32.43%) dominate, while literature (22.53%) and art (9.90%) account for a relatively low percentage.

3.3.2. Baseline Characteristics of Mental Health Indicators

The sample's original source of the instrument was analyzed descriptively and statistically using a multidimensional mental health scale with reliability and validity tests. The descriptive values included sample size (N), minimum and maximum values, mean, standard deviation, median, variance, skewness, and kurtosis, and the results are shown in Table 6.

Table 6.
Scale descriptive statistics results.

Variable	N	Max.	Min.	Mean	Standard deviation	Median	Variance	Kurtosis	Skewness
Q4	404	5	1	3.955	0.944	4	0.891	0.388	-0.8
Q5	404	5	1	3.728	1.107	4	1.226	-0.351	-0.614
Q6	404	5	1	3.777	1.129	4	1.275	-0.218	-0.717
Q7	404	5	1	3.733	1.122	4	1.258	-0.446	-0.582
Q8	404	5	1	3.79	1.157	4	1.338	-0.435	-0.695
Q9	404	5	1	3.748	1.156	4	1.336	-0.424	-0.659
Q10	404	5	1	3.832	1.121	4	1.257	-0.135	-0.79
Q11	404	5	1	3.567	1.265	4	1.601	-0.728	-0.561
Q12	404	5	1	3.609	1.301	4	1.693	-0.799	-0.584
Q13	404	5	1	3.626	1.273	4	1.619	-0.694	-0.601
Q14	404	5	1	3.594	1.22	4	1.487	-0.666	-0.546
Q15	404	5	1	3.666	1.214	4	1.474	-0.596	-0.592
Q16	404	5	1	3.671	1.197	4	1.432	-0.525	-0.618
Q17	404	5	1	3.733	1.235	4	1.526	-0.599	-0.678

The data showed that respondents' overall evaluation of music therapy showed a mild positive tendency, but there were significant differences in the perceptions of different dimensions. Among them, “the impact of instrument choice on mental health” (mean value 3.96, standard deviation 0.94) has the highest recognition, indicating that respondents generally believe that the type of instrument is a key element of music therapy. In contrast, “the effectiveness of the frequency and duration of the intervention” mean value of 3.57, with a standard deviation of 1.27, scored relatively low, and individual differences or implementation conditions may constrain the actual usefulness of this parameter. It is worth noting that the mean values are generally lower than the median, concentrated in the range of 3.5-3.9, and combined with the high

standard deviation, there may be a small number of low-scoring feedbacks or neutral attitudes, especially in the questions "Improvement of brain function by music therapy" (standard deviation of 1.30) and "Influence of volume change on mood" (standard deviation of 1.30). "(standard deviation 1.24), the dispersion of respondents' opinions is more obvious. The skewness and kurtosis of the data distribution further reveal the underlying characteristics: most of the variables are close to a normal distribution (absolute value of skewness <1), but for example, there is a left skewness in "Psychological differences between different types of musical instruments" (skewness -0.79), which suggests that even though most of the respondents agree with the differential effects of musical instrument types, some of the respondents still have reservations; and The flat kurtosis of variables such as "Importance of cognitive regulation", kurtosis -0.22, suggests the dispersion of the data distribution, which may be related to the individual sensitivity of the intervention effect.

3.4. Multiple Regression Modeling

3.4.1. Mental Health Composite Indicator Construction

Principal Component Analysis (PCA) is a widely used method for dimensionality reduction, transforming high-dimensional data into a set of uncorrelated variables (principal components) through linear transformation. These components are ordered based on their variance, with the first few retaining most of the original data's information, thus achieving dimensionality reduction.

In this study, PCA was used to construct a comprehensive mental health index based on data from various mental health dimensions (Q7-Q9, Q14-Q15). Mental health is a multidimensional construct involving mood, attention control, stress levels, and anxiety/depression. Analyzing these variables separately increases complexity and can lead to Type I errors due to multiple testing. PCA resolves this by reducing the data to a few uncorrelated components, simplifying the analysis and reducing statistical issues like multicollinearity.

The composite indicator generated by PCA represents the dimension of "general mental health," which is more comprehensive than a single variable in reflecting the overall effect of music therapy. After standardizing the data to have a mean of 0 and standard deviation of 1, the number of principal components was determined using the variance explained. The results showed which components explained the most information, as shown in Table 7.

Table 7.
Explanation of Variance.

PC	Characteristic root		
	Characteristic root	Variance interpretation rate	Cumulative variance explanation rate
1	2.031	40.622%	40.622%
2	1.099	21.986%	62.608%
3	0.711	14.225%	76.832%
4	0.619	12.377%	89.209%
5	0.54	10.791%	1

The cumulative variance contribution rate (CVCR) method is the core criterion for determining the number of principal components in principal component analysis, and academics generally take the 80%-90% CVCR interval as a typical reference standard, which can avoid excessive loss of key information while effectively reducing the dimensionality of the data. If the research field has higher requirements for data reduction accuracy or depth of interpretation, the threshold can also be raised appropriately to enhance the analytical power of the model. As shown in the above table, the eigenroot of the total variance explained is lower than 1 when the principal component is 3.

The factor loading matrix is calculated and combined to identify each factor's contribution weight to the composite index, as shown in Table 8.

Table 8.
Component Matrix.

	PC1	PC2	PC3
Q7	0.308	-0.355	0.867
Q8	0.335	-0.353	-0.16
Q9	0.332	-0.266	-0.666
Q14	0.318	0.481	-0.267
Q15	0.273	0.598	0.339

The component matrix ideally illustrates the factor score coefficients contained in each component, which are used to calculate the component scores to derive the factor formula, which is calculated as linear combination coefficient.

The results show that the weight of principal component 1 is 52.87%, the weight of principal component 2 is 28.616%, and the weight of principal component 3 is 18.514%, of which the maximum value of the indicator weight is principal component 1. The minimum value is principal component 3. The composite mental health indicator scores of each sample data were calculated based on the weights of the different principal components. Examples of some data are shown in Table 9.

Table 9.
Sample Mental Health Composite Score (Top 5).

Rank	Row index	Composite score	PC1	PC2	PC3
1	315	1.1881	1.4894	0.5332	0.6114
2	204	1.1457	1.6072	0.1205	0.3167
3	171	1.1053	1.513	0.244	0.2663
4	282	1.0774	1.3467	0.5014	0.5396
5	295	1.0613	1.5191	0.2415	-0.2373

3.4.2. Modelling the Impact of Musical Instrument Selection

Based on the composite mental health scores calculated in the previous section, these scores reflect students' mental health status regarding emotion regulation, stress management, and anxiety and depression relief. In contrast, the instrument selection variables, "Perceived impact of instrument type," "Psychological differences between instruments," "Instrument effect differentiation," and "Instrument affect differentiation," were calculated from cognitive, practical, and practical perspectives. "and "instrument effect differentiation" cover the core decision-making elements in educational management from the aspects of cognition, practice and effect assessment. Multiple regression analysis can quantify the independent contribution and interaction effect of different instrument choice dimensions on comprehensive mental health. Therefore, a multiple regression model was constructed to analyze the composite mental health score as the dependent variable and the questions related to musical instrument selection (Q4, Q10, Q16) as the independent variables. The regression results are shown in Table 10.

Table 10.
Regression Results for the Effect of Musical Instrument Choice.

	Nonnormalized coef.		Standardization	t	Sig.	Collinearity Statistics		
	B	Std. Error	Beta			VIF	R ²	F
Const	-3.655	0.124	-	-29.47	0.000	-	0.706	F=320.544 P=0.000***
Q4	0.631	0.035	0.595	18.194	0.000	1.458		
Q10	0.336	0.036	0.376	9.291	0.000	2.234		
Q16	-0.034	0.031	-0.041	-1.111	0.267	1.868		

The regression model results showed an adjusted R-squared of 0.595, indicating that the three independent variables explained 59.5% of the variance in the composite mental health score. The model fit was good, with a significant F-value ($p < 0.001$), and the variance inflation factors (VIF) for each variable were below 3, indicating minimal multicollinearity.

For the unstandardized coefficient (B-value), Q4 had a coefficient of 0.631 ($p < 0.001$), and the standardized coefficient (Beta) was 0.595. This indicates that for every 1-unit increase in students' agreement that "the choice of musical instrument affects their mental health" (Q4), the composite mental health score increases by 0.631 points. Q4 was the strongest predictor in the model, suggesting a direct positive correlation between students' perceptions of musical instrument appropriateness and their mental health.

For Q10, the coefficient was 0.336 ($p < 0.001$), with a Beta value of 0.376, indicating a 0.336-point increase in mental health scores for every 1-unit increase in students' endorsement that "there are differences in the psychological impacts of different musical instruments." This effect, though weaker than Q4, is still practically significant and reflects the polarized perceptions of musical instruments.

Q16, focusing on "differences in the effects of instrument type in music therapy," had a coefficient of -0.034 ($p = 0.267$), which was not statistically significant (Beta = -0.041). This may be due to the semantic difference between Q10 and Q16-Q10 addresses "general differences" in psychological effects, while Q16 refers to "differences in therapeutic effects." Students may perceive psychological differences but may not fully understand their specific effects in structured therapy, leading to a lack of significant impact in Q16. The following Figure 2 presents the Probability-Probability (P-P) Plot.

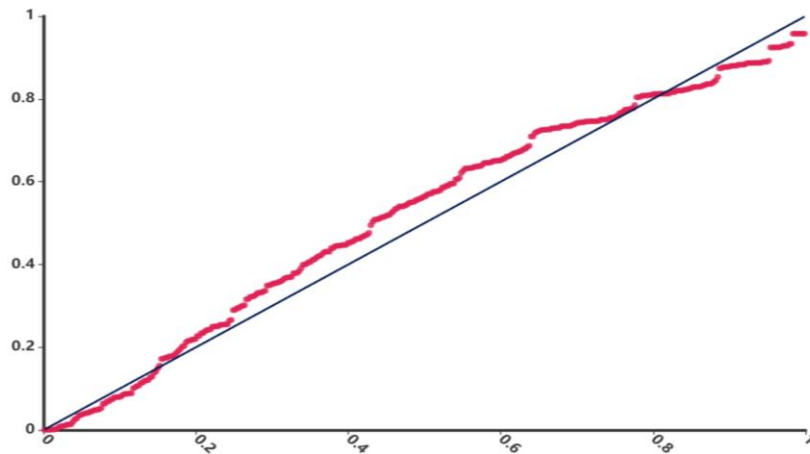


Figure 2.
P-P Diagram of the Influence Model of Musical Instrument Selection.

3.4.3. Dose Effect Modeling of Therapy Intensity

The intervention effects of music therapy are essentially a multidimensional process, and elements such as volume, frequency, and duration may have both independent and interactive effects. Multiple regression analyses can effectively control the covariance among variables and accurately quantify the independent contributions of different intensity parameters on mental health. Q5 focuses on the overall effects of physical attributes of music elements (volume and tempo), Q11 focuses on the temporal characteristics of the therapy (frequency and duration), and Q17 is dedicated to exploring the unique role of dynamic changes in volume, which is a hierarchical design to systematically test the composite structure of the concept of “therapeutic intensity”. This hierarchical design not only systematically examines the composite structure of the concept of “treatment intensity” but also reveals the differences in the mechanisms of action of different intensity elements. Therefore, a multiple regression model was constructed to analyze the composite score of mental health as the dependent variable and the music therapy intensity questions (Q5, Q11, Q17) as the independent variables, and the regression results are shown in Table 11.

Table 11.
Regression Results for Treatment Intensity Dose Effects.

	Nonnormalized coef		Standardization	t	Sig.	Collinearity Statistics		
	B	Std. error	Beta			VIF	R ²	F
Const	-2.78	0.172	-	-16.147	0.000	-	0.411	F=93.2 P=0.000***
Q5	0.307	0.036	0.34	8.624	0.000	1.055		
Q11	0.209	0.034	0.265	6.087	0.000	1.289		
Q17	0.238	0.035	0.294	6.85	0.000	1.253		

The regression model results showed an adjusted R-squared of 0.411, meaning that the three independent variables explained 41.1% of the variance in the composite mental health score. The model fit was good, with a significant F-value ($p < 0.001$), and the variance inflation factors (VIFs) ranged from 1.055 to 1.253, indicating minimal multicollinearity.

All three independent variables had significant positive effects ($p < 0.001$). Q5, which focused on volume and tempo, had the strongest effect, with an unstandardized coefficient of 0.307 and a Beta of 0.34, indicating that adjusting these physical attributes had the most significant impact on the mental health score. Q17, focusing on volume changes, had a slightly lower coefficient of 0.294 (Beta=0.238), suggesting that volume adjustments independently affect mental states by stimulating emotion regulation pathways. Q11, related to the duration and frequency of therapy, showed a slightly smaller effect (Beta=0.265) but was still clinically significant, indicating that intervention intensity needs to meet a threshold to accumulate effects.

The standardized coefficients ranked as $Q5 > Q17 > Q11$, providing guidance for clinical protocol optimization: first, adjust the physical attributes of the music (moderate volume and tempo), second, dynamically adjust the volume during treatment, and finally, enhance the effect by extending session duration or increasing treatment frequency. The following Figure 3 illustrates this.

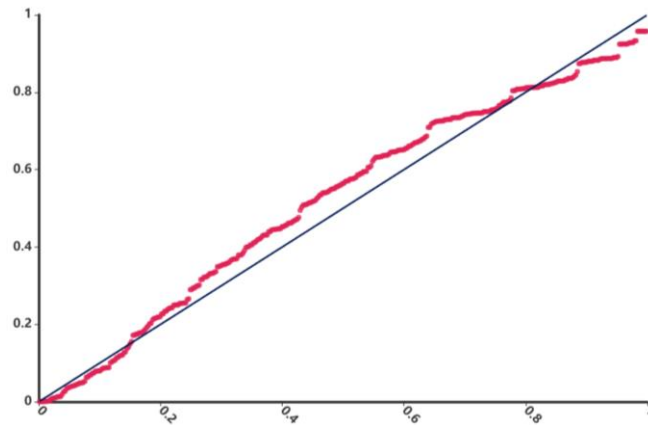


Figure 3.
Dose effect model P-P plot for treatment intensity.

3.5. Variable Correlation Analysis

To investigate the potential impact of the synergistic effects of cognitive regulation and music therapy in educational administration on students' mental health and academic performance, the present study further examined the statistical associations between cognitive regulatory functions (Q6, Q12, Q13) and mental health dimensions through correlation analyses based on the pre-tests of normality. This analysis aimed to quantify the mediating or moderating effects of cognitive regulation during music therapy interventions, with a particular focus on its predictive effects on specific mental health indicators such as mood state improvement (Q7), attention enhancement (Q8), stress alleviation (Q9), concentration gain (Q14), and anxiety-depression symptom reduction (Q15). The covariance between cognitive regulation skills and different dimensions of mental health will be revealed by calculating Pearson correlation coefficients.

The results of the correlation analysis conducted showed that students' agreement on the importance of cognitive modulation was significantly and positively associated with music therapy perceptions on different psychological variables ($p < 0.001$). Although the correlation coefficients were in the medium-strength range (0.28-0.32), their statistical significance and directional consistency suggest that cognitive regulation may indirectly enhance the intervention effects by strengthening the individual's acceptance and response efficiency to music therapy. Notably, the correlation coefficients of attention regulation (Q8) and symptom intervention (Q15) were tied for the highest correlation coefficients, suggesting that the educational administration may be able to synchronize and optimize the students' emotional regulation efficacy and academic focus if they can integrate cognitive training and music therapy techniques in the curriculum design. The results of the correlation analysis are shown in Table 12.

Table 12.
Q6 Correlation Analysis.

		Q6	Q7	Q8	Q9	Q14	Q15
Q6	Correlation coefficient	1.000	0.284***	0.317***	0.31***	0.284***	0.317***
	Sig.(2-tailed)		0.000	0.000	0.000	0.000	0.000
	N	404	404	404	404	404	404

The results showed that Q13 was moderately strongly and significantly positively correlated with the demand for expansion of mental health services, $r = 0.468$, $p < 0.001$, and the effect of anxiety and depression interventions, $r = 0.42$, $p < 0.001$, suggesting that the more students agree that music therapy promotes mental toughness, the more strongly they support the establishment of additional related mental health services in colleges and universities, and the more they recognize its practical utility in emotional symptom relief. In addition, the weak correlation ($p < 0.001$) of Q13 with mood improvement (Q7, $r = 0.215$), attention regulation (Q8, $r = 0.209$), and stress alleviation (Q9, $r = 0.189$) suggests that music therapy may indirectly optimize the underlying psychological functions of mood regulation, attention maintenance, and stress adaptation by systematically enhancing mental toughness. Notably, the high correlation coefficient of Q14 ($r = 0.468$) further corroborated the urgent need for institutionalized mental health support among the student population, which, combined with the kurtosis differentiation feature of the stress coping dimension in the baseline analysis, kurtosis=3.12, highlighted the need for educational management to deeply integrate music therapy with cognitive regulation strategies. The results of the correlation analysis are shown in Table 13.

Table 13.
Correlation Analysis.

		Q13	Q7	Q8	Q9	Q14	Q15
Q13	Correlation coefficient	1.000	0.215***	0.209***	0.189***	0.468***	0.42***
	Sig.(2-tailed)		0.000	0.000	0.000	0.000	0.000
	N	404	404	404	404	404	404

4. Discussion

This study, based on 404 valid questionnaires from three universities in Zhumadian City, explored the mechanisms of music therapy in students' mental health interventions. The study focused on three core variables: musical instrument selection, therapeutic intensity, and cognitive regulation.

The regression analysis results confirm that musical instrument selection significantly impacts students' mental health. Students' agreement with the statement "the type of musical instrument affects their psychological state" was positively correlated with their overall mental health scores ($p < 0.001$). Specifically, melodic instruments like the piano and guitar were more effective in emotional regulation and anxiety relief, indicating that personalized instrument choices enhance the therapeutic effect and strengthen students' engagement and psychological security.

The analysis also highlighted the importance of therapeutic intensity. Physical attributes such as volume, tempo, and frequency were significantly associated with students' psychological improvement ($p < 0.001$). High-intensity music stimulation, particularly in short-term interventions, proved effective in relieving anxiety and improving attention. However, the study also cautioned against excessive intensity, as too strong a rhythm or sound pressure could lead to overstimulation. This implies that educational administrators should dynamically adjust the intervention intensity based on individual needs in practical applications.

Finally, the Pearson correlation analysis revealed that cognitive regulation positively mediates the relationship between music therapy and mental health. The study found that cognitive enhancements, such as improved attention, emotional resilience, and mental toughness, were strongly associated with better emotional states and stress-coping abilities. This highlights the potential of music therapy not only in emotional regulation but also in enhancing students' ability to cope with academic stress through cognitive mechanisms.

In conclusion, music therapy plays a significant role in mental health interventions in universities. Future educational administrators should focus on personalized musical instrument selection, scientifically setting intensity, and integrating cognitive modulation mechanisms into interventions, transitioning psychological support from passive coping to developmental support.

5. Conclusion

This study, based on 404 valid questionnaires from three universities in Zhumadian City, explored the mechanisms of music therapy in students' mental health interventions, focusing on the three core variables of musical instrument selection, therapeutic intensity, and cognitive regulation. The regression analysis results confirmed that musical instrument selection had a significant positive impact on students' mental health. The stronger students' agreement with the statement "the type of musical instrument affects their psychological state," the higher their overall mental health scores. Specifically, melodic instruments such as the piano and guitar were generally considered more effective in emotional regulation and anxiety relief, suggesting that personalized instrument selection enhances therapeutic outcomes and strengthens students' sense of engagement and psychological security.

Regarding treatment intensity, the regression model results showed that physical attributes such as volume, tempo, and frequency were significantly associated with students' psychological improvement. High-intensity music stimulation was particularly effective in relieving anxiety and improving attention in the short term, which validates the existence of the "music therapy dose effect." However, the study also pointed out that excessive rhythm or sound pressure could lead to overstimulation in some students, indicating that educational administrators need to adjust the intervention intensity dynamically according to individual needs in practical applications.

Finally, Pearson's correlation analysis revealed that cognitive regulation positively mediates the relationship between music therapy and mental health. Students generally agreed that cognitive enhancements, such as improved attention, brain function activation, and emotional resilience, were highly correlated with better emotional states and stress-coping abilities. This suggests that music therapy not only acts on the emotional level but also enhances students' ability to cope with academic stress by mobilizing cognitive mechanisms.

In conclusion, the study confirms the significant role of music therapy in mental health interventions in universities and recommends that future educational administrators focus on personalized instrument selection, scientifically setting therapeutic intensity, and integrating cognitive modulation mechanisms during implementation. This approach would transform psychological interventions from passive coping to developmental support.

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