

## THE APPLICATION AND IMMEDIATE EFFECTIVENESS OF THETA-WAVE BINAURAL BEAT MUSIC INTERVENTION FOR HIGH-STRESS PUBLIC SERVANTS

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### ABSTRACT

Discipline inspection and supervision cadres are exposed to substantial occupational stress, yet convenient and accessible psychological interventions for this group remain limited. As an emerging digital intervention, binaural beat music has shown potential for stress reduction among individuals with anxiety; however, its effectiveness has not been examined in this high-stress occupational population. This preliminary mixed-methods study explored the immediate stress-relieving effects, subjective experiences, and practical acceptability of theta-wave binaural beat music among discipline inspection and supervision cadres. Forty on-duty cadres from a region in Sichuan Province participated in a single 6 Hz theta binaural beat music session during routine work and subsequently completed subjective assessments and open-ended written feedback. The findings indicated that most participants experienced immediate physical and psychological relaxation, improved mood, enhanced attentional focus, temporary relief from acute stress, and greater emotional stability. Many participants also reported reduced anxiety and irritability, immersive listening experiences, and a diminished sense of time. Qualitative results further revealed a gradual shift from tension to calmness, suggesting that physical relaxation and cognitive attentional diversion may function as complementary mechanisms of stress relief. No marked differences were observed across gender or age groups, indicating broad adaptability of the intervention. This study represents an initial application of binaural beat music among discipline inspection and supervision cadres and provides preliminary evidence for its feasibility and immediate stress-relieving effects. The findings contribute to the development of digital, non-pharmacological stress management strategies for public servants, while observed individual differences offer directions for optimizing future intervention protocols.

**Keywords:** binaural beats; music intervention; discipline inspection and supervision cadres; psychological stress; digital intervention

### 1.0 INTRODUCTION

Discipline inspection and supervision cadres work on the front line of Party conduct and integrity building and the fight against corruption. They face multiple stressors such as complex cases, heavy responsibilities, and high social attention, making their mental health an urgent issue that cannot be ignored. Related surveys show that this group commonly experiences psychological distress including tension, anxiety, emotional exhaustion, and sleep disorders, which have to some extent affected their work performance and physical and mental health (Zhang et al., 2023; Song et al., 2014). A large sample study of civil servants further revealed

that in the context of sustained stress during the COVID 19 pandemic, nearly half reported anxiety symptoms (49.24%) and 47.1% reported depressive symptoms, indicating a high prevalence of psychological problems (He et al., 2023). Without systematic and effective psychological interventions, long term accumulated occupational stress may further impair individuals' work effectiveness and career development. Therefore, exploring stress intervention pathways adapted to the characteristics of discipline inspection and supervision work has become an urgent and important task in cadre team building (Lei, 2023).

Among various psychological intervention methods, music therapy has become one of the most widely used art based therapies due to its non invasive, low cost, and easily accessible features (Xu & Wang, 2020). Numerous empirical studies have confirmed its positive effects on stress relief and emotional improvement. A systematic review of music therapy for stress reduction reported a medium to large overall effect size, indicating that music intervention has robust beneficial effects on stress related physical and mental indicators (de Witte et al., 2022). The World Health Organization has also noted that music, as an emotional regulatory medium, can effectively help individuals alleviate physical and mental pain (World Health Organization, 2019).

Of particular interest, binaural beat music therapy, as an emerging form of digital music intervention, has recently attracted widespread attention from researchers. This technique presents pure tone signals with slightly different frequencies to the left and right ears, and utilizes the brain's perception of the binaural frequency difference to guide brainwave activity toward specific frequency bands, thereby inducing physiological and psychological states such as relaxation and focused attention. Preliminary research has shown that binaural beat intervention has positive effects on stress relief, sleep improvement, and attention enhancement (Elnazer, 2026), and can reduce anxiety and depression to some extent (Zheng et al., 2023). With the widespread use of smartphones and mobile applications, mobile based binaural beat music tools provide users with highly convenient self regulation pathways, making them particularly suitable for occupational groups with tight work schedules and difficulty arranging fixed treatment times.

However, psychological intervention research specifically targeting discipline inspection and supervision system staff is still in its early stages, and evidence on intervention effectiveness is particularly lacking (Chen & Xiao, 2020). Although binaural beat music therapy has shown potential for application in general anxious populations and some clinical groups, its applicability and effectiveness in the specific high stress occupational group of discipline inspection and supervision cadres have not been systematically examined. How to integrate digital binaural beat music intervention with the actual work of discipline inspection and supervision to build an operable and scalable stress management model still requires further investigation.

Based on this background, this study intended to take serving discipline inspection and supervision cadres from a region in Sichuan Province as participants, and to systematically examine the effects of digital binaural beat music intervention on their psychological stress and emotional state using a combination of questionnaires and in depth interviews. The study adopted a mixed methods design with equal emphasis on quantitative and qualitative approaches. Immediately after completing one session of digital binaural beat music listening,

participants completed questionnaires to obtain self report data on their subjective experiences and immediate effects, while semi structured interviews were used to gain in depth understanding of participants' feelings and acceptance, in order to comprehensively evaluate the actual effects of the intervention. The significance of this study lies in extending the application of binaural beat music intervention to the previously understudied group of discipline inspection and supervision cadres, providing empirical reference for the scientific and routine mental health promotion work in the discipline inspection and supervision system, and exploring a feasible pathway for digital, non pharmacological psychological interventions in stress management for public employees.

## 2.0 MECHANISMS AND RESEARCH PROGRESS OF BINAURAL BEAT MUSIC THERAPY

Binaural beats are an auditory phenomenon in which pure tones with slightly different frequencies are presented to each ear, causing the brain to perceive a third virtual beat frequency. This is considered a potential means to guide brainwave activity toward specific frequency bands.

In terms of stress reduction effects, Elnazer (2026) systematically reviewed the effects of music and binaural beat interventions on anxiety, sleep, and cognitive performance in young adults. The results showed that binaural beats had significant or moderate effects on reducing anxiety and improving emotional state (standardized mean difference 0.3–0.6), and that a core advantage is the ability to deliver the intervention conveniently via mobile devices. A randomized controlled trial by Tegeler et al. (2025) involving 144 healthcare workers with moderate to high stress further showed that acoustic neuromodulation based on individualized brainwave patterns produced meaningful improvements in stress, anxiety, and insomnia, and that the effects did not depend on baseline stress severity, suggesting broad applicability across stress levels.

In specific high stress contexts, the stress reducing effects of binaural beats have also received empirical support. Garcia-Argibay et al. (2019), through a meta analysis, found that binaural beat exposure significantly affects cognitive function and has a moderate overall effect size ( $g = 0.45$ ) in reducing anxiety and pain perception, providing early quantitative evidence for the cross situational effectiveness of binaural beat intervention. A systematic review and meta analysis of perioperative anxiety (Xiong et al., 2025) found that binaural beat intervention effectively reduced patients' preoperative anxiety levels, with a medium effect size. 2.4 Limitations of Existing Research and Positioning of the Present Study

Synthesizing the above literature, three limitations can be identified. First, in terms of research participants, mental health studies of discipline inspection and supervision cadres have mostly focused on status description and factor analysis (Zhao et al., 2023; He et al., 2023), lacking targeted intervention effect evaluations. Research remains at the problem description stage and has not yet entered the intervention verification phase. Second, in terms of intervention methods, binaural beat music therapy research has mostly concentrated on clinical patients (Zheng et al., 2023) or general youth populations (Elnazer, 2026), and evaluation of its applicability in occupational groups, especially high stress occupations like discipline inspection and supervision, is still absent. Third, in terms of research design, existing binaural

beat studies have mostly focused on immediate stress reduction effects, but lack in depth exploration of participants' subjective experiences, acceptability, and practical evaluation in work settings.

Therefore, this study took discipline inspection and supervision cadres from a region in Sichuan Province as participants, and used a mixed methods approach combining questionnaires and interviews to assess stress reduction effects and subjective experiences immediately after listening to digital binaural beat music. The study aimed to examine the immediate stress reduction efficacy and acceptance of binaural beat music in this group, provide empirical reference for digital mental health promotion in the discipline inspection and supervision system, and promote the extension of binaural beat music therapy to specific high stress occupational groups.

## Research Questions

To systematically evaluate the potential of digital binaural beat music in the group of discipline inspection and supervision cadres, this study proposed the following research questions:

**Question 1:** Can digital binaural beat music intervention immediately improve the psychological stress and emotional state of discipline inspection and supervision cadres?

**Question 2:** What are participants' subjective experiences of this intervention, and what core experiential themes exist?

**Question 3:** How acceptable is this intervention in the group of discipline inspection and supervision cadres, and is it moderated by demographic factors such as gender and age?

## 3.0 RESEARCH DESIGN

### 3.1 Participants

This study took serving discipline inspection and supervision cadres from a region in Sichuan Province as participants. Convenience sampling was used. An electronic questionnaire link was distributed through internal work group chats and personal contact information. Participants voluntarily clicked the link and entered the questionnaire after reading and agreeing to the electronic informed consent form. A total of 40 electronic questionnaires were collected. After logic checks (reverse item contradictions, excessively short response times, etc.), no invalid questionnaires were found, resulting in a final valid sample size of 40, with an effective response rate of 100%.

Among the participants, there were 13 males (32.5%) and 27 females (67.5%). Age distribution was as follows: 18–25 years old 21 people (52.5%), 26–30 years old 5 people (12.5%), 31–40 years old 8 people (20.0%), 41–50 years old 4 people (10.0%), 51–60 years old 1 person (2.5%), over 60 years old 1 person (2.5%). All participants self reported no serious hearing impairment and had not used sedative drugs or alcohol within 24 hours prior to the study.

### 3.2 Intervention Method

### 3.2.1 Intervention Material

The binaural beat audio was generated using professional audio software, with a carrier frequency of 200 Hz and a frequency difference of 6 Hz between the left and right channels (theta frequency band, 4–8 Hz), a band associated with relaxation, meditation, and light sleep. The audio duration was 10 minutes, including a 2 minute fade in and a 1 minute fade out to avoid discomfort caused by sudden sound changes. Participants used their own headphones (in ear type recommended) and adjusted the volume to a comfortable level (suggested 40–50 dB SPL). The audio file was embedded in the WJX platform in 320 kbps MP3 format, and all participants accessed and played it through the same link.

### 3.2.2 Intervention Procedure

The intervention was completed individually via mobile phone or computer in participants' daily work environments, following the procedure below:

Electronic informed consent and code setting: After clicking the questionnaire link, participants first read the electronic informed consent form, clicked Agree, and then entered the questionnaire. They were prompted to set an anonymous code for themselves (question 34) for subsequent data matching.

Baseline psychological state assessment (about 5 minutes): Participants completed questions 1 to 33 (Self Rated Psychological State Scale) to record their immediate emotional and cognitive state before the intervention.

Binaural beat music listening (10 minutes): The system automatically jumped to the audio playback page. Participants wore headphones and listened to the complete 10 minute binaural beat audio in a quiet environment. They were asked not to pause or engage in other tasks during this time.

Subjective experience evaluation (about 5 minutes): After listening, participants continued to complete questions 35 to 38 (Subjective Evaluation of Music Experience) and questions 39 to 40 (demographic information).

The entire process was implemented with sequential jumping through the WJX platform to ensure all participants completed the steps in the same order. Total time was about 20–25 minutes.

## 3.3 Measurement Tools

This study used a self developed Digital Binaural Beat Music Psychological Stress Intervention Evaluation Questionnaire, released via the WJX platform.

### 3.3.1 Psychological State Scale (Questions 1–33)

The scale was adapted from the State Trait Anxiety Inventory (STAI S) by Spielberger et al. (1983) and the Flow State Scale to assess participants' baseline emotional state and flow experience before listening to the music. It consisted of 33 items, rated on a 5 point Likert scale

(1 = not at all / never, 5 = completely applicable / always). Positive and reverse items were mixed. Items requiring reverse scoring were numbers 3, 5, 9, 11, 12, 14, 17, 18, and 20 (9 items in total). The reverse scoring conversion formula was: new score = 6 – original score.

The scale was divided into three dimensions: negative affect (9 items after reverse scoring, reflecting negative states such as anxiety, tension, distress), positive affect (11 items, reflecting positive states such as calmness, safety, satisfaction), and flow and sense of control (13 items, reflecting concentration, sense of control, self efficacy). In this study, the Cronbach's alpha coefficient of this scale was 0.87, indicating good internal consistency.

### 3.3.2 Subjective Evaluation of Music Intervention

Quantitative evaluation (questions 30–33): Four items were rated on a 5 point Likert scale (1 = not at all, 5 = very much) to assess immediate experience after listening. The items included: I felt physically and mentally relaxed during listening (Q30), My attention was naturally drawn to the music and I was not easily distracted (Q31), The music helped me temporarily set aside work related stress and worries (Q32), After listening, I felt my emotions were more stable than before (Q33). The Cronbach's alpha for this section in the present sample was 0.70.

Open ended evaluation (questions 35–38): Four open ended questions were used to collect qualitative feedback: ① What are your feelings about this piece of music? ② Was there a moment during listening when your irritability and anxiety noticeably diminished? Could you describe that moment? ③ How did your emotions change throughout the listening process? ④ Was there a moment during listening when you lost track of time, as if immersed in your own world?

### 3.4 Data Analysis Methods

This study used SPSSAU (online statistical analysis platform, version 24.0) for all quantitative analyses.

**(1) Descriptive statistics:** Frequencies and percentages were calculated for demographic variables (gender, age group). For items 1–33, means and standard deviations were calculated. After reverse scoring of the required items, total scale scores and dimension means were computed.

**(2) Reliability analysis:** Cronbach's alpha coefficient was used to test the internal consistency reliability of the Psychological State Scale (33 items).  $\alpha \geq 0.7$  was considered acceptable.

**(3) Difference analysis:** Independent samples t tests were used to compare differences in total psychological state scores and total music effect scores between genders (male vs. female) and between age groups (younger group 18–25 years vs. middle younger group  $\geq 26$  years).

**(4) Qualitative analysis:** The open ended responses to questions 35–38 were analyzed using thematic analysis (Braun & Clarke, 2006). The procedure involved reading the texts repeatedly to familiarize with the data, extracting initial codes related to emotional changes, stress reduction, and immersion experiences, grouping the codes into potential themes, and then



reviewing, defining, and naming the themes through discussion to form the final analytical framework.

## 4.0 RESULTS

### 4.1 Demographic Characteristics of the Sample

As shown in Table 1, among the 40 participants, females accounted for 67.5% and males 32.5%. The age distribution was dominated by the 18–25 year old group (52.5%), followed by the 31–40 year old group (20.0%), with the remaining age groups dispersed. This is consistent with the target population orientation.

**Table 1 Distribution of gender and age**

| Variable  | Category      | Frequency (n) | Percentage (%) |
|-----------|---------------|---------------|----------------|
| Gender    | Male          | 13            | 32.5           |
|           | Female        | 27            | 67.5           |
| Age group | 18–25 years   | 21            | 52.5           |
|           | 26–30 years   | 5             | 12.5           |
|           | 31–40 years   | 8             | 20.0           |
|           | 41–50 years   | 4             | 10.0           |
|           | 51–60 years   | 1             | 2.5            |
|           | Over 60 years | 1             | 2.5            |

### 4.2 Reliability and Descriptive Statistics of the Psychological State Scale

#### 4.2.1 Reliability Analysis

Internal consistency of the Psychological State Scale (questions 1–33) was tested. After reverse scoring the appropriate items, Cronbach's alpha coefficient was calculated. The result showed that the total scale alpha was 0.874, indicating good internal consistency.

#### 4.2.2 Total Scale Score and Dimension Scores

From the dimension scores, negative affect (mean item score 3.07) and positive affect (mean item score 3.08) were almost equal, both in the middle range of the 5 point scale, showing no clear positive or negative bias. This result may reflect two coexisting psychological realities. On the one hand, discipline inspection and supervision cadres may have developed a restrained emotional expression pattern over long term high stress work, rarely reporting extreme self evaluations. On the other hand, moderate positive affect also suggests that this group lacks sufficient positive emotional arousal in daily life, with their emotional state tending toward flat rather than good. In contrast, the flow and sense of control dimension had a relatively higher score (mean item score 3.53), indicating that participants can maintain a certain level of

concentration and task engagement in their daily work. However, whether this concentration represents active immersion or passive coping is worth further exploration. Dimension scores are shown in Table 2.

Overall, this group presented a psychological profile of flat emotions, moderate concentration but significant individual differences before the intervention, providing a meaningful baseline for examining the immediate effects of binaural beat music.

**Table 2 Dimension scores of the Psychological State Scale (N=40)**

| Dimension                        | Number of items | Total mean (M) | Total standard deviation (SD) | Mean item score (M) | Item standard deviation (SD) |
|----------------------------------|-----------------|----------------|-------------------------------|---------------------|------------------------------|
| Negative affect (reverse scored) | 9               | 27.63          | 5.13                          | 3.07                | 0.57                         |
| Positive affect                  | 11              | 33.90          | 7.70                          | 3.08                | 0.70                         |
| Flow and sense of control        | 13              | 45.95          | 5.84                          | 3.53                | 0.45                         |

### 4.3 Comparison of Baseline Psychological State by Demographic Subgroups

To examine whether baseline psychological state differed systematically by demographic factors, group comparisons were conducted for gender and age.

#### 4.3.1 Gender Differences

Independent samples t tests compared total psychological state scores and dimension scores between genders. As shown in Table 3, the total psychological state score for males was 107.77 (SD = 12.60, n = 13) and for females was 107.33 (SD = 15.52, n = 27),  $t = 0.088$ ,  $p = 0.930 > 0.05$ , indicating no statistical difference between groups. Comparisons of dimension scores also showed no statistically significant gender differences. This result suggests that in this sample, male and female cadres had similar baseline psychological states, and gender was not a distinguishing factor for baseline emotion and concentration experience.

**Table 3 Comparison of total psychological state scores by gender**

| Variable                        | Male (n=13) Mean $\pm$ SD | Female (n=27) Mean $\pm$ SD | t value | p value |
|---------------------------------|---------------------------|-----------------------------|---------|---------|
| Total psychological state score | 107.77 $\pm$ 12.60        | 107.33 $\pm$ 15.52          | 0.088   | 0.930   |

#### 4.3.2 Age Differences



For age, the sample was divided into the younger group (18–25 years) and the middle younger group ( $\geq 26$  years). The two groups had a mean difference of about 7.6 points (younger group  $M = 111.67$ , middle younger group  $M = 104.05$ ). The younger group had slightly higher scores and greater within group dispersion ( $SD = 17.50$  vs.  $10.67$ ), but this difference did not reach statistical significance ( $p = 0.117$ ). Therefore, age was also not a key variable determining baseline psychological state in this study. The results are shown in the table 4.

**Table 4 Comparison of total psychological state scores by age group**

| Variable                           | Younger group<br>(n=18) Mean $\pm$ SD | Middle younger group<br>(n=22) Mean $\pm$ SD | t<br>value | p<br>value |
|------------------------------------|---------------------------------------|----------------------------------------------|------------|------------|
| Total psychological<br>state score | 111.67 $\pm$ 17.50                    | 104.05 $\pm$ 10.67                           | 1.618      | 0.117      |

#### 4.4 Quantitative Analysis of Subjective Experience of Music Intervention

##### 4.4.1 Immediate Relaxation and Emotional Regulation Effects

Four quantitative evaluation items used a 5 point Likert scale (1 = not at all, 5 = very much) to assess participants' immediate relaxation experience after listening to binaural beat music. The means and standard deviations of each item are shown in Table 5.

**Table 5 Quantitative indicators of music experience (N=40)**

| Item                                                                                       | N  | Minimum | Maximum | Mean<br>(M) | Standard<br>deviation<br>(SD) | Median |
|--------------------------------------------------------------------------------------------|----|---------|---------|-------------|-------------------------------|--------|
| Q30 Felt physically and<br>mentally relaxed during<br>listening                            | 40 | 3.00    | 5.00    | 3.975       | 0.698                         | 4.00   |
| Q31 My attention was<br>naturally drawn to the<br>music and I was not easily<br>distracted | 40 | 1.00    | 5.00    | 3.925       | 0.829                         | 4.00   |
| Q32 The music helped me<br>temporarily set aside work<br>related stress and worries        | 40 | 2.00    | 5.00    | 3.875       | 0.883                         | 4.00   |
| Q33 After listening, I felt<br>my emotions were more<br>stable than before                 | 40 | 1.00    | 5.00    | 3.925       | 0.888                         | 4.00   |

The means of the four quantitative evaluation items ranged from 3.88 to 3.98 (out of 5), and the medians were all 4, indicating that more than half of the participants gave positive ratings of quite a lot or above. Among them, felt physically and mentally relaxed during listening

(Q30) scored highest ( $M = 3.98$ ,  $SD = 0.70$ ) and had the smallest standard deviation, indicating that relaxation experience was not only the most prominent dimension of the overall effect but also showed high consistency across participants. In contrast, the music helped me temporarily set aside work related stress and worries (Q32) scored slightly lower ( $M = 3.88$ ,  $SD = 0.88$ ) with a relatively larger standard deviation, suggesting some individual differences in the dimension of stress detachment. Some cadres may find it more difficult to briefly disengage from intense work ruminations. The scores for attention was naturally drawn ( $M = 3.93$ ) and emotions more stable ( $M = 3.93$ ) were similar, indicating that the music intervention simultaneously performed dual functions of attention guidance and emotional regulation.

Overall, binaural beat music listening provided immediate physical and mental relaxation, attention attraction, stress relief, and emotional stabilization for the majority of discipline inspection and supervision cadres.

## 4.4.2 Frequency of Open-Ended Question Responses

Responses to the four open ended questions were classified and counted. The results in Table 6 show that 67.5% of participants explicitly expressed positive feelings about the music, 90.0% reported that their anxiety or irritability was noticeably reduced, 77.5% described an emotional change trajectory from anxiety to relaxation, and 92.5% experienced varying degrees of time distortion or immersion. The positive proportions for anxiety noticeably reduced and immersion experience both exceeded 90%, preliminarily indicating that binaural beat music has outstanding potential for relieving immediate tension and inducing immersion.

**Table 6 Positive proportions of subjective experience (N=40)**

| Question number | Content of inquiry                                | Category                                     | Number of participants | Percentage (%) |
|-----------------|---------------------------------------------------|----------------------------------------------|------------------------|----------------|
| 35              | Subjective feeling about the music                | Positive feeling                             | 27                     | 67.5           |
| 36              | Whether anxiety/irritability noticeably reduced   | Yes                                          | 36                     | 90.0           |
| 37              | Emotional change during listening                 | From anxiety to relaxation (positive change) | 31                     | 77.5           |
| 38              | Whether immersion/forgetting time was experienced | Had immersion experience                     | 37                     | 92.5           |

## 4.5 Qualitative Analysis: Thematic Summary

Thematic analysis of the open-ended responses identified four core themes.

### Theme 1: Positive trajectory of emotional change

Most participants described an emotional change process that gradually transitioned from tension and anxiety to calmness and relaxation. This transition did not happen instantaneously but became apparent as the music progressed. Typical descriptions included: from feeling anxious at the beginning to becoming relatively relaxed, first anxious then calmly relaxed, tension gradually eased and the ending was very peaceful. These spontaneous reports of emotional change indicate that binaural beat listening guided participants through a perceptible and directional emotion regulation process.

## **Theme 2: Critical moments of anxiety reduction**

Participants' descriptions of moments when anxiety reduced revealed two typical patterns. The first was physical sensation changes, such as when my shoulders relaxed halfway through, the anxiety significantly diminished, or I felt the pressure release all at once, suggesting that music may produce stress reduction effects by inducing muscle relaxation and other physiological responses. The second pattern was attention shift and cognitive disengagement, such as temporarily thinking only about the music and forgetting real life worries, or a feeling of empathy with the music and a moment of relaxation. The two patterns are not mutually exclusive; some participants reported both physical and cognitive changes simultaneously, suggesting that binaural beat music may exert immediate stress reduction effects through dual pathways of physical relaxation and attention shift.

## **Theme 3: Immersion and time distortion experience**

A total of 92.5% of participants reported immersion experiences involving losing track of time, a core feature of flow state. Typical statements included: I was completely immersed in the middle 5 minutes and forgot the time, after closing my eyes it felt like entering another space, and time felt like it passed faster than usual. Notably, even participants who answered no to obvious relaxation feelings in question 35 also reported occasionally forgetting time, suggesting that immersion and subjective relaxation may not be completely synchronous; immersion may be a relatively independent dimension of the intervention's effects.

## **Theme 4: Acceptability and individual differences**

Despite overall positive feedback, a small number of participants reported no obvious changes. Further analysis of these no feeling participants found that their mean total psychological state score was close to the overall mean, with no significant difference, and their age distribution showed no clear concentration. This result suggests that there are individual differences in the effects of binaural beat music intervention. Future research can further explore potential moderating variables such as personality traits (e.g., openness to sensation), music preferences, expectancy effects, or listening environment.

## **4.6 Effects of Gender and Age on Music Outcomes**

To examine whether the effects of the intervention were influenced by demographic factors, the total music effect score (mean score of Q30–Q33) was used as an indicator, and group differences by gender and age were tested separately. Results showed no significant difference between males ( $M = 3.83$ ) and females ( $M = 3.88$ ) ( $p = 0.78$ ), and no significant difference between the younger group (18–25 years) and the middle younger group ( $\geq 26$  years) ( $p = 0.85$ ).

These results indicate that in this sample, the immediate relaxation effects of digital binaural beat music were generalizable across gender and age, producing similar positive effects for discipline inspection and supervision cadres with different demographic backgrounds.

## 5.0 DISCUSSION

### 5.1 Main Findings

This study preliminarily examined the immediate stress reduction effects of digital binaural beat music intervention in 40 discipline inspection and supervision cadres using a combination of quantitative assessment and qualitative feedback. The main findings are summarized as follows.

First, binaural beat music provided participants with perceptible immediate relaxation experiences. On the four dimensions of physical and mental relaxation, attention attraction, stress relief, and emotional stability, participants' self ratings were all close to 4 (out of 5), with relaxation being the most prominent and showing high consistency across participants. Open ended feedback further supported this result. Ninety percent of participants explicitly stated that their anxiety or irritability decreased during listening, and over ninety percent reported varying degrees of immersion. These results suggest that binaural beat music can provide immediate psychological regulatory benefits for most users.

Second, qualitative analysis revealed the process characteristics and possible pathways of emotional improvement. Participants commonly described an emotional trajectory gradually shifting from tension and anxiety to calm and relaxation, and this shift did not happen instantaneously but unfolded as the music progressed. Descriptions of anxiety reduction moments generally fell into two categories: one pointing to physical relaxation responses, such as shoulder relaxation and a sense of pressure release; the other pointing to attention level shifts, such as temporarily forgetting worries and resonating with the music. This suggests that binaural beat music may exert immediate stress reduction effects simultaneously through the dual pathways of physical relaxation and attention shift.

Third, intervention effects were similar across participants of different genders and age groups. This suggests that this intervention form has broad applicability in the demographically diverse discipline inspection and supervision system, and that the protocol need not be substantially adjusted for different populations when promoting it.

Fourth, the baseline psychological state showed a pattern of flat emotions and significant individual differences. Participants' positive and negative affect were both at moderate levels, showing no clear positive or negative bias, but the distribution of scores was relatively dispersed, reflecting differentiation in psychological adjustment needs within the group. This characteristic may be related to the emotional restraint tendency formed in cadres' work, and may also suggest that this group lacks sufficient positive emotional arousal in daily life.

### 5.2 Comparison with Existing Research

The findings of this study resonate with existing literature in several ways.

At the level of intervention effects, the meta analysis by de Witte et al. (2022) reported a medium to large effect size of music therapy on stress related indicators, with receptive listening interventions being particularly effective. The review by Elnazer (2026) also indicated that binaural beats have significant or moderate effects on reducing anxiety and improving mood. The immediate positive experiences observed in this non clinical high stress occupational group of discipline inspection and supervision cadres are directionally consistent with those findings, providing preliminary empirical support for extending binaural beat music intervention from general anxious populations to high stress occupational groups.

Regarding mechanisms, Xu and Wang (2021) pointed out that attention shift is a core mechanism of music therapy. The qualitative finding in this study that participants reported temporarily thinking only about the music and forgetting real life worries provides direct subjective evidence for this view. Saarikallio and Erkkilä (2007) also emphasized that music's emotion regulation function largely depends on its ability to guide and redirect attention. Meanwhile, the physical relaxation sensations described by some participants are also consistent with the theoretical hypothesis that music intervention can regulate autonomic nervous function through auditory stimulation.

In terms of occupational population applications, the scoping review by Paul et al. (2025) found that workplace music interventions have positive effects on improving employee emotions and reducing perceived stress. Carolan (2018) noted that digital music interventions have higher acceptance in working populations due to their convenience and privacy. A scoping review by Liu et al. (2025) on digital mental health interventions in the Chinese context further indicated that mobile based digital intervention formats are rapidly spreading in China, with most interventions showing significant effects in reducing mental health symptoms, thus providing macro level support for the use of digital stress management tools among working populations. In the present study, participants completed the intervention in their natural work environment using personal devices and reported positive experiences, further supporting the feasibility of digital music intervention as a psychological adjustment tool for occupational populations.

Notably, the present study found that the baseline emotional state of discipline inspection and supervision cadres tended toward flatness, which contrasts with the high rates of anxiety and depression reported among civil servants by He et al. (2023). This difference may be due to differences in measurement tools (the present study used a state self rating scale rather than a clinical screening tool) or may reflect a certain degree of restraint or defensiveness in self reported emotions among discipline inspection and supervision cadres, a finding indirectly reflected in the qualitative study by Liu (2023) on this group's dilemma of having no one to talk to.

### 5.3 Limitations and Future Directions

This study has several limitations. First, it used a single group post test design without a control group, which cannot rule out the confounding effects of placebo effects, expectancy effects, or simple rest effects. The extent to which participants' positive experiences are attributable to the binaural beat music itself versus the act of temporarily stepping away from work to listen quietly cannot be determined in this study. Future research should employ randomized controlled designs with blank control (rest only), ordinary music, or sham binaural beat groups

to more rigorously evaluate the unique contribution of binaural beats. Second, this study only assessed immediate feelings after a single intervention, with no follow up measurements, so the duration of effects and the cumulative effects of repeated listening are unknown. Future research should incorporate longitudinal designs with multiple intervention sessions and follow up assessments to provide a basis for determining optimal intervention frequency. Finally, outcome assessment relied entirely on subjective self report, lacking corroboration from physiological indicators (e.g., heart rate, skin conductance) and objective behavioral indicators (e.g., work performance). Future research could consider incorporating multimodal measurements to build a more comprehensive evaluation system.

Overall, as the first exploration of binaural beat music intervention in the group of discipline inspection and supervision cadres, this study preliminarily verified the acceptability and immediate stress reduction potential of this intervention, laying the foundation for future larger scale, more rigorous confirmatory studies.

## 6.0 CONCLUSION

This study systematically examined the immediate stress reduction effects and subjective experiences of digital binaural beat music in the group of discipline inspection and supervision cadres, providing valuable insights at both theoretical and practical levels. Theoretically, the study found that binaural beat music can bring perceptible immediate relaxation, emotional improvement, and immersion experiences to a high stress occupational group. The qualitative analysis further revealed a positive emotional trajectory from tension to relaxation and a dual pathway of physical relaxation and attention shift, offering direct experiential descriptions from cadres to understand the mechanisms of digital auditory intervention. Practically, the study confirmed that this intervention has general applicability across gender and age, and its digital, convenient, and private characteristics fit the work context of discipline inspection and supervision cadres, showing good potential for dissemination. In summary, this study provides preliminary empirical evidence and practical reference for the application of digital music intervention in mental health services for cadre populations.

## 7.0 FUNDING

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