ORIGINAL RESEARCH ARTICLE

Music performance for stress regulation and psychosomatic well-being among female Chinese students

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Abstract

This study addressed stress and mental health challenges among female Chinese university students, stemming from academic pressures, societal expectations, and impacts on reproductive health. It investigated music performance as a non-pharmacological intervention to improve psychological well-being and reproductive health. Guided by the Biopsychosocial and Transactional Model of Stress, a mixed-methods design was employed, including a quasi-experiment, a survey (n=900), and interviews (n=40). An 8-week music program was implemented. Data analysis (t-tests, ANOVA, SEM) showed a significant reduction in stress and improved health outcomes. Stress reduction was a key pathway, while SEM revealed a complementary pathway involving social bonding and emotional expression. Demographic factors like income were moderators. Qualitative data emphasized music's role in emotional release and self-care. We conclude that music is a potent, sustainable, and culturally relevant intervention for student well-being. *(Afr J Reprod Health 2026; 30 [3]: 114-130).*

Keywords: Music Performance, Stress Reduction, Psychological Well-Being, Reproductive Health

Résumé

Cette étude a examiné le stress et les problèmes de santé mentale chez les étudiantes chinoises, liés aux pressions académiques, aux attentes sociétales et aux impacts sur la santé reproductive. Elle a exploré la pratique musicale comme intervention non pharmacologique pour améliorer le bien-être psychologique et la santé reproductive. Guidée par les modèles biopsychosocial et transactionnel du stress, une méthodologie mixte a été utilisée, incluant un quasi-expériment, une enquête (n=900) et des entretiens (n=40). Un programme de musique structuré de 8 semaines a été mis en œuvre. Les analyses (tests t, ANOVA, SEM) ont montré une réduction significative du stress et une amélioration des résultats de santé. La réduction du stress était un mécanisme clé, tandis que les analyses SEM ont révélé une voie complémentaire impliquant le lien social et l'expression émotionnelle. Des facteurs démographiques comme le revenu familial étaient des modérateurs. Les données qualitatives ont souligné le rôle de la musique dans la libération émotionnelle et les soins personnels. L'étude conclut que la musique est une intervention puissante, durable et culturellement pertinente pour le bien-être des étudiantes. *(Afr J Reprod Health 2026; 30 [3]: 114-130).*

Mots-clés: Pratique Musicale, Réduction du Stress, Bien-Être Psychologique, Santé Reproductive

Introduction

Stress and mental health among university students have recently been recognized as rising issues worldwide[1]. This trend has also been observed in China, where higher education has been rapidly expanded and extensively transformed[2]. A vulnerable position has been occupied by female students in higher education, as they have been subjected simultaneously to the pressures of academic competition, the weight of family expectations, and the demands of entering adulthood within a rapidly evolving socioeconomic society. Stress in this group has been understood as extending far beyond a mere academic nuisance, since chronic psychological stress has been demonstrated to be harmful to both mental and physical health, including adverse reproductive health outcomes[3].

Sustained stress has been linked to menstrual irregularities, hormonal imbalances, and related symptoms such as fatigue, sleep disturbances, and mood changes, through which academic performance and quality of life among female students have been disrupted. In light of this recognition, growing interest has been directed

toward holistic and multipurpose interventions for stress and well-being, with music performance increasingly positioned as a promising candidate. Within both Western and Chinese traditions, music has long been accepted for its aesthetic and therapeutic qualities, and in more recent year it has been investigated as a tool for stress management[4].

While much of the prior research has been concentrated on music listening or clinical forms of music therapy, music performance has been acknowledged for offering unique benefits through the interplay of emotional expression, physiological regulation, and social bonding. Unlike passive listening active participation has been required in music performance whereby avenues for self-expression, creativity and communal engagement have been opened, and these processes have been suggested to amplify stress reduction and health promotion[5]. The Chinese higher education context has been regarded as a particularly compelling site for such inquiry, since collectivist cultural values emphasizing harmony and group belonging have been emphasized. Within this setting, music performance has been described both as a coping strategy undertaken on an individual level and conversely, as a socially embedded practice that reinforces peer networks and provided culturally resonant relief from academic pressures.

Despite mounting evidence linking various types of musical interventions to stress reduction, certain crucial gaps in the literature remain. Much of the previous research on music in relation to certain health outcomes in clinical settings with the focus being on patients who are suffering from chronic illness, psychiatric conditions, or recovery from operations[6-8]; hence, such studies can hardly be generalized to populations that are not patients, such as university students. In China, female students' experiences of stress and their coping strategies vary greatly from one location to another, depending on geographic location, academic atmosphere, and family background[9], given that the higher education system is very large. That heterogeneity is rarely captured in previous studies; thus, it is uncertain how interventions through music may work on different student populations. Another limiting factor is that the majority of studies are descriptive or exploratory and tend not to have an explicit conceptual framework that explains how and why music interventions affect health outcomes. Without grounding in models such as the Transactional Model of Stress and Coping[10] and the Biopsychosocial Model of Health[11], findings risk becoming fragmented rather than joining the broader theoretical discussion on stress, coping, and health.

The present study aims to fill the identified gaps by investigating music performance to promote stress reduction, psychological well-being, and reproductive health of female students across higher education institutions through a theory-driven nationally representative framework. The first objective is to evaluate the effects of music performance on stress and well-being. Secondly, it evaluates whether ameliorations in stress reduction relate to reproductive health outcomes. The third goal is to assess various demographic trends of effectiveness of performance-based music interventions, intervening factors such as region, institution type, year of study, family income, etc. This study is presented as a response to the immediate need for addressing aspects of stress and reproductive health challenges encountered by female students in Chinese higher education through the exploration of music performance as a non-pharmacological intervention. By linking stress reduction to reproductive health outcomes, situating the findings within strong theoretical frameworks, and employing a nationally representative mixed-methods approach, contributions are made by the study to both academic knowledge and the implementation of solutions. An emphasis is called for on research that goes beyond small-scale, clinical or descriptive studies toward more comprehensive, theory-driven investigations that take into account the diversity of student experiences within the vast higher education landscape of China. Ultimately, the entire study area is sought to be innovated by this research, with the aim of integrating arts, health and education. The study also demonstrates that culturally feasible practices such as music performance can significantly promote student well-being and further contribute to national health policy objectives.

Literature review

The increase in studies examining the relationship between music interventions and mental health outcomes in many populations now intends to include university students, who are generally

affected by high degrees of stress and anxiety. He et al.[12] have looked at the rising levels of anxiety and depression in Chinese university students with a focus on using music education strategies as a therapeutic intervention option. A combined FAHP-Fuzzy-TOPSIS approach was adopted to evaluate and rank music interventions according to their ability to relieve psychological distress. The FAHP application gave weights to the main stress factors that included academic pressures, social relationships, and cultural norms, whereas the fuzzy TOPSIS ranked the effectiveness of the music education strategies according to the weighted criteria. The study concludes that both the mental health stigma and academic pressures rank among the very highest contributors to student anxiety. Based on the research, music-based interventions, particularly those focusing on music appreciation and music-oriented self-care, emerged as the most effective way of addressing psychological distress. Through this process, the significance of culturally contextualized music interventions in tackling mental health issues in the university setting in China was displayed by the findings.

Zhao and Gao[13] were engaged in an attempt to understand how stress reduction and academic performance among Chinese young adults aged 18 to 24 were affected by music. By means of a mixed-methods design a structural questionnaire was answered by 367 participants, while semi-structured interviews were undertaken with 257 participants. Quantitative data were subjected to descriptive statistics, reliability testing, correlation analyses, and hypothesis testing whereas qualitative data were analysed thematically to provide insights into participants lived experiences. It was shown by the results that music listening, particularly instrumental music, significant lowered stress levels. Slightly greater reductions in stress were achieved through live performances of music compared to recordings. when combined with music, exercise was found to reduce stress further and an implication was therefore provided that active engagement or multisensory participation should be emphasized in practices involving music. Music was further stressed by the study as an active coping strategy for psychological wellness and academic functioning rather than a form of passive recreation. The mediating and moderating roles of music engagement in mindfulness, subjective well-being (SWB), and academic performance were further explored by Wang[14] among Chinese university students, with hypotheses tested through SEM. Positive effects of student's mindfulness on their SWB and academic performance were found in the study. SWM was also found to serve as a partial mediator in the relationship between mindfulness and academic performance, whereby psychological well-being was stressed as being functional only when translated into cognitive practice. Although student's music engagement was not found to moderate the relationship between mindfulness and SWB, a positive moderating role was identified in the associated between SWB and academic performance. From these results, it was suggested that functional outcome of well-being such as academic achievement could be actively facilitated by music engagement, thereby reinforcing the role music as an agent in promoting both psychological and functional health.

Further cross-cultural and mode-specific studies in the field of music therapy were conducted and the potential of this therapy for stress management was endorsed. In a pre-post randomized controller design, comparisons between Chines Five Element Music Therapy (FEMT) and western Art music Therapy (WAMT) were carried out by Liao et al.[15] across Chinese and Canadian cultural settings. Thirty-five individuals were randomly assigned to the respective interventions. Self-rated was measured using a 10-point numeric rating scale. Significant reduction in self-rated stress across both interventions and cultural groups after four weeks were indicated by the result ($p=0.001$). FEMT interventions distinguished by significant reduction in anxiety and depressive levels ($p<0.001$) and the greater potential of cultural embedded music therapies in relieving psychological distress was thereby adeptly displayed by the findings, the design of interventions for university students in China was emphasized as needing to take such cultural aspects into account.

Liu et al.[16] examined developments in technology-mediated music interventions and compared the efficacy of traditional and VR-enhanced music therapy in a sample of 270 senior undergraduate students. Well-being and anxiety were assessed using the Chinese versions of the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) and Test Anxiety Scale (TAS).

Effectiveness results revealed that traditional music therapy led to increases in well-being by 3.81 points and reductions in anxiety by 3.53 points, while VR-enhanced music therapy seemingly had greater effects, increasing WEMWBS scores by 7.48 points and decreasing TAS scores by 6.36 points ($p < 0.001$). In line with these results, it was suggested through further research into immersive and interactive music interventions that such modalities can lessen the psychological burden by means of increased engagement, heightened sensory stimulations, and emotional regulation. The doors were opened by this study for the emerging role of digital technology-enhanced music intervention in higher education settings, particularly among technologically inclined student populations.

Ba et al.[17] studied retrospectively the effects of music therapy on depression, anxiety, and stress. Among 218 patients, those receiving music therapy for three months, along with routine management, showed significant decreases in depression (SDS) and anxiety (SAS) compared with the control group ($p < 0.05$ Psychological, physiological and social stress dimension were reduced to a much larger extent, and higher general satisfaction was also shown in the music therapy group. Even with a clinical sample, evidence for the generalizability of music intervention for stress management was provided, given its multifactorial effects on emotionality, socialization, and physiology. An explorative setting was provided by Feng and Wang[18] in which an eight-week music therapy intervention was studied with respect to the emotional resilience, well-being and employability of 256 participants. Increase in emotional resilience were observed under music therapy, and improvements in well-being and employability were subsequently achieved.

Well-being mediated the relationship between emotional resilience and employability, with age and level of education apparently moderating the outcome Greater benefits in emotional resilience for the enhancement of well-being were experienced by younger persons and those with higher education. The extended psychosocial benefits of music interventions were indicated by the findings and an implication was made that music may be used as a developmental tool for the promotion of life skills among young adults.

It has been established that reproduction is negatively affected by stress, particularly among women of fertile age. Ozimek et al.[19] performed an online survey of 210 women between the ages of 18 and 45 to study alterations in the menstrual cycle during the COVID-19 pandemic. More than half of those surveyed reported changes in the duration of the menstrual cycle, menses, and premenstrual symptoms, all positively correlated to their scores on perceived stress. In the same vein, Martins et al.[20] found that the long-term effects of psychological distress during adolescence influenced menstrual symptoms through a woman's childbearing years. Their findings show that more highly distressed 16-year-olds have an increased risk for adolescent and adult menstrual irregularities. Singh et al.[21] studied lifestyle factors in connection with menstrual irregularity among 574 women. These lifestyle factors refer to diet, exercise, and stress. It was found that an increase in stress levels was significantly associated with a decrease in menstrual regularity, whereas a good diet and regular exercise promoted regular menstrual cycles. Shim et al.[22] carried out a study of 2,418 female workers, ascertaining physiological, psychological, and situational determinants of menstrual regularity. They came to the conclusion that stress, depressive mood, shift work schedules, and lower educational levels were associated with menstrual irregularities. The important of psychological stress in relation to reproductive health has been emphasized by these studies, and it has been suggested that interventions aimed at stress reduction among young women in tertiary education could be beneficial.

Mindfulness-based music interventions were regarded as promising for the management of stress enhancement of well-being. Mindfulness-based breathing combined with music therapy was studied by Yildirm and Yildiz[23] among nurses caring for COVID-19 patients. Reduced stress and work strain, along with increased psychological well-being ($p < 0.05$), were shown by their randomized controlled trail. It is therefore implied that coping resource could be promoted, emotional responses regulated, and psychological resilience built in populations experiencing high stress through combined interventions that integrate mindfulness and music.

By extension such integrative have been considered relevant for female university students

whose academic and social activities generate stress and whose reproductive health may be threatened by chronic stress. From the literature reviewed some common recurrent patterns were observed: from one perspective, positive effects on stress regulation, and well-being as well as functional outcomes such as work or academic performance, or VR combinations, Second, interference with reproductive health, particularly stress. Third, enhanced outcomes were associated with culturally embedded music interventions, Such as Chinese Five Elements Music Therapy, as well as with active engagement in music activities, highlighting the importance of context and participation. Fourth, benefits were further increased by technological innovations, such as VR and immersive modalities, through additional engagement and emotional, income, and institutional context, moderated intervention efficacy, thereby illustrating the need for strategies to be designed for specific student groups. Altogether, a convincing empirical and theoretical groundwork was established for the use of music performance as a targeted intervention to reduce stress, enhance well-being and promote reproductive health among female students in Chinese higher educational; institutions. While earlier studies addressed the psychological effects of music interventions, very few direct correlations with reproductive health outcomes in large, heterogeneous student populations were examined. Moreover, a more holistic perspective for understanding music as a tool for alleviation and health promotion was provided by combining quantitative indicators with qualitative insights into how music interacts with emotional, cultural, and social dimensions.

Building on the existing knowledge base, this study will strive to cover the identified research gaps and provide nationally relevant evidence toward the healthfulness of music performance for female university students in China.

Theoretical framework and hypothesis development

The Transactional Model of Stress and Coping

The study is premised on the Transactional Model of Stress and Coping[10, 24], which understands stress as a process that evolves when an individual perceives environmental demands as surpassing his or her coping resources. In this model, coping strategies are seen as either problem-focused, whereby they bring about a change in the stressor, or emotion-focused, which regulate the emotional responses to stress[24]. Female students in higher education in China find the academic scene particularly demanding, with competition, high family expectations, economic insecurity, and pertinent social changes[25]. Often, these pressures are more than the coping resources available to an individual, causing higher stress levels and various health complaints, including menstrual irregularities and sleep disruptions, as well as fatigue, taken together as reproductive health problems. Here comes the use of music performance as an adaptive coping tool that provides a wider range of options for students to cope with stress. Through singing in groups, students might manage their negative emotions; through instrument practice or rhythm-based performance, the reappraisal of stress becomes positive, thus increasing the resilience toward academic and social pressures. Thus, according to this model, music performance is identified as an emotion-based coping strategy that alleviates stress directly while supporting well-being indirectly.

The Biopsychosocial model of health

Complementing the stress-coping approach, a holistic framework for understanding how psychological, biological, and social factors interact to influence health outcomes was provided by the Biopsychosocial Model of Health[11]. In reproductive health, it has been well established that biological events, such as hormonal regulation and menstrual cycle regularity are affected by psychological stress and disturbances of an emotional nature. From this perspective, effects in all three spheres were observed for music interventions. Psychologically, stress was reduced, and a positive oral culture was instilled; socially peer bonding, emotional sharing and a sense of placement within students' community were fostered. In China, the social dimension of this model is highlighted, as collectivist traditions emphasize group activities aimed at harmony, shared experience and cooperation. Music performance was regarded as a vehicle for self-expression and, at the same time, as a communal activity that binds the community together. In this respect, by providing psychological stress relief social connectedness and biological

regulation, the performance of music is considered a multidimensional disease-prevention activity, fully aligned with the biopsychosocial model, which posits health as the outcome of interacting systems.

Hypothesis development

The two models-the transactional and the biopsychosocial form the formulation of hypotheses for this study connecting music-therapeutic interventions with stress reduction and improvement of well-being and reproductive health among female students in higher education. The transactional model indicates that when an environmental demand phenomenon exceeds the coping or adaptation resources, the stress may be reduced by adaptive coping strategies. On the other hand, the biopsychosocial model holds that this stress reduction induces cascaded improvements in psychological and biological health status. Building on the above, the following hypotheses are proposed:

H1: Participation in music-performance intervention reduces perceived stress among female higher education students in China, in comparison to controls.

H2: Participation in music-performance intervention improves the psychological well-being of female higher education students in China, in comparison to controls.

H3: Improvements in self-reported reproductive health outcomes (including menstrual regularity, reduced fatigue, better sleep quality, etc.) among female higher education students in China are expected to be achieved through participation in a music-performance intervention, as compared to control groups..

Methods

A mixed-method design was adopted in the current study, integrating quantitative and qualitative approaches to examine the examine the effects of music performance on stress, psychological well-being and female reproductive health among Chinese higher education students. The quantitative component was conducted using a quasi-experimental pre-post design with control and intervention groups, in addition to a large-scale survey, while in-semi-structured interviews were carried out in the qualitative arm to capture participant's subjective experience. Space for both casual inference and interpretative depth was provided by this design triangulation, thereby enhancing the validity and reliability of the findings. Female students enrolled in Chinese higher education institutions were identified as the populations of interest, and a stratified sampling strategy was applied to ensure representativeness for key demographic variables. stratification was based on region type of institution (985/211 universities, local universities/colleges, and vocational colleges), year of study. Within each stratum, participants were randomly sampled, resulting in 900 respondents for the quantitative follow-up. Wide geographical, institutional, and socioeconomic representation, upon which the study's external validity rests, was reflected in the demographic profile presented in Table 1.

For measurement, three validated instruments were employed, including a self-reproductive health scale. Stress was assessed using the Chinese version of the Perceived Stress Scale (PSS-10), which captures subjective feelings of unpredictability, uncontrollability, and overload in everyday life. Scores on the scale range from 0 to 49, with higher values indicating greater levels of stress. In contrast, the psychological well-being measure was provided by the World Health Organization Five Well-Being Index (WHO-5), a short, validated measure that ranges from 0 to 25, with higher values representing higher well-being. The composite scores were rated on a scale of 1-5, with higher scores indicating better reproductive health outcomes. Demographic variables (age, income, institution type, year of study, region) were introduced into the statistical models as covariates. Reliability tests produced Cronbach's alpha values over 0.80 for all the scales; thus, indicating internal consistency.

The intervention involved a structured program of musical activities in the treatment setting, composed of one group music performance session per week, each lasting 60 minutes, for a period of 8 weeks, including choral singing, instrumental ensembles, and collaborative music-making. The sessions were headed by skilled music educators and were designed to encourage active engagement, emotional expression, and social interaction, rather than passive listening. The control

group underwent regular university activities with no exposure to the music intervention. Both groups were surveyed before and after the intervention period (baseline and post-intervention), thereby allowing for statistical comparison of changes in stress, well-being, and reproductive health.

Quantitative data analysis took place in stages. Firstly, the descriptive statistics served to describe the sample characteristics, including the baseline measures. Secondly, parametric statistics, i.e., paired t-tests and one-way ANOVA, were conducted to examine differences within and between experimental and control groups from pre- to post-intervention. Thirdly, multiple regressions were run in order to ascertain the various predictors of reproductive health and well-being outcome variables whilst controlling for demographic variables. The general form of the regression equation can be expressed as:

$$Y_i = \beta_0 + \beta_1 Intervention_i + \beta_2 Stress_i + \beta_3 Wellbeing_i + \sum_{k=4}^{n} \beta_k X_{ki} + \varepsilon_i$$

Where Y_i is the reproductive health score of individual i, $Intervention_i$ is a dummy variable, 1 for the treatment group, or 0 for the control group, $Stress_i$ denotes the PSS score, $Wellbeing_i$ the WHO-5 score, X_{ki} stands for demographic covariates (age, family income, institution type, region, year of study), and ε_i is the error term. This regression equation was actually run iteratively in nested models, starting with demographic controls and adding intervention, stress, and well-being variables step by step, thereby testing mediation and incremental variance explained.

To formally test mediation, structural equation modelling (SEM) was applied with bootstrapped procedures in the measurement of indirect effects.

The hypothesized mediation model proposed that the music intervention alleviates stress, thereby enhancing reproductive health, along with possible direct effects of this intervention on reproductive health. Mathematically, the mediation model is expressed as follows:

$$Stress_i = \alpha_0 + \alpha_1 Intervention_i + \sum_{k=2}^{n} \alpha_k X_{ki} + \mu_i$$

$$Reproductivehealth_i = \gamma_0 + \gamma_1 Intervention_i + \gamma_2 Stress_i + \sum_{k=3}^{n} \gamma_k X_{ki} + \upsilon_i$$

The indirect effect was calculated as $\alpha_1 * \gamma_2$, and its significance was tested with bias-corrected bootstrap confidence intervals using 5,000 bootstrap resamples. An additional moderation analysis was also carried out to see if the intervention effects varied among demographic subgroups such as family income, type of institute, and region. Moderation was tested with interaction terms in regression models.

$$Y_i = \beta_0 + \beta_1 Intervention_i + \beta_2 Demographics_i + \beta_3 (Intervention_i * Demographics_i) + \sum_{k=4}^{n} \beta_k X_{ki} + \varepsilon_i$$

If the interaction term coefficient β_3 turned out to be significant, it would signal that the intervention effect changes as the demographic of the students change. The same interaction models were tested for region, type of institution, and year of study, respectively. To combined multiple candidate moderators simultaneously, multimodal moderation models were specified within an SEM framework using a multi-group comparison, setup, which allowed the invariance of pathways across demographic groups to be tested. The question of whether greater health benefits were provided to disadvantaged groups by music interventions was thereby explored, which is considered highly important from an equity perspective in relation to the health China 2030 policy on health promotion.

Thematic analysis was conducted on qualitative data obtained from 40 interviews. Experiences with music performance, perceived changes in stress, emotional expression, menstrual health, and social connections were described by the interviewees.

Transcripts coding was carried out from both explicative and implicative perspectives, which ultimately produced codes such as music as emotional release, music for peer bonding, and music for self-care. Triangulation of the interviews,

descriptive analysis and qualitative findings with quantitative results was performed to further explain statistical patterns through rich narrative accounts. The mediating effects of stress reduction was illustrated by participants who described music as "a safe space to let go of pressure", while a few students highlighted the moderating effects of socioeconomic status indicated that music participation was valuable for those fewer wellness for paid wellness activities.

Ethical permission was obtained from the relevant institutional review board, and informed consent was provided by all participants. Confidentiality was ensured through the anonymization of data, and voluntary participation with the right to withdraw at any time was maintained. Data were processed for descriptive and inferential statistics using SPSS 27, while SEM mediation and moderation analyses were conducted with AMOS 24, and qualitative coding was carried out using NVivo 12.

Ethical considerations

Ethical approval for this study was granted by the Ethics Committee of Taiyuan University (Approval No. TYU-IRB-2025-041), on 12 March 2025.The study adhered to the ethical principles of the Declaration of Helsinki.

Written informed consent was obtained from all participants prior to data collection. Data anonymization, voluntary participation, and the right to withdraw at any stage were ensured throughout the research process.

Results

Quantitative results

Crucial insights regarding the representativeness of the sample were provided by the demographic profile of respondents in Table 1, and a foundation was thereby established for considering the effects of music intervention on stress, well-being and reproductive health outcomes among Chinese female students in higher education.

An equitable distribution of regional representation was inclusion of 900 participants from all four major regions of China: East (27.8%), Central (24.4%), west (23.3%), and Northeast (24.5%), ensuring that geographic bias was minimized and that the findings could be more generally applied. Academic resource disparities, campus environment, and social context, which may act as stressors and influence coping behaviour's, were further illustrated by classification according to types of universities: premier universities under 985/211 (35.6 %), local universities (38.9%), and vocational colleges (25.5%). Diversity in academic ranking was also reflected, with freshmen (22.2%), sophomores (23.3%), juniors (20.0%), seniors (22.2%), and postgraduates (12.3%) represented, highlighting those stressors and coping strategies are likely to change across different stages of higher education. Socioeconomic stratification was mirrored in the income distribution-lower (31.1%), middle (46.7%), and higher class (22.2%) providing a meaningful point of analysis for examining moderating effects, as students from lower-income families may have fewer coping resources, thereby amplifying the potential benefits from music interventions. Taken together, these demographic distributions affirm that a heterogeneous and representative sample was employed in the study, thereby enhancing the external validity of subsequent findings.

Table 2 shows baseline measures of stress, well-being, and reproductive health before intervention, providing a benchmark against which program impact can be assessed. The mean PSS (Perceived Stress Scale) score is 24.5 with a standard deviation of 6.8, which indicates respondents are experiencing moderate to high levels of stress. This finding is consistent with earlier studies among Chinese female college students, who are generally perceived to be under considerable psychological strain. The mean score according to the WHO-5 Well-being Index is 11.8 with a standard deviation of 3.6, which suggests that baseline psychological well-being was relatively low.

A score of less than 13 implies poor well-being or a predisposition toward depressive tendencies, which again marks this group as vulnerable. The mean value on reproductive health self-report was 2.9 (SD = 0.8) on a 1-to-5 scale, indicating that only moderate reproductive health outcomes were reported.

Table 1: Demographic profile of respondents (N = 900)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Region	East	250	27.8
	Central	220	24.4
	West	210	23.3
	Northeast	220	24.5
Institution Type	985/211 Universities	320	35.6
	Local Universities	350	38.9
	Vocational Colleges	230	25.5
Year of Study	Freshman	200	22.2
	Sophomore	210	23.3
	Junior	180	20.0
	Senior	200	22.2
	Postgraduate	110	12.3
Family Income	Low	280	31.1
	Middle	420	46.7
	High	200	22.2

Table 2: Baseline stress, well-being, and reproductive health scores

Measure	Mean (M)	Standard Deviation (SD)	Range
Perceived Stress Scale (PSS)	24.5	6.8	0–40
WHO-5 Well-being Index	11.8	3.6	0–25
Reproductive Health (Self-report)	2.9	0.8	1–5

Perhaps this is the result of stress, whereby menstrual cycles, fatigue, and overall vitality might be affected. These baseline statistics reinforce the need for the group to be studied with regard to stress reduction and health promotion and justify the use of music as an intervention, since people obviously need non-pharmacological resources with which to cope.

Pre-post comparisons in Table 3 provide strong support for the efficacy of music performance in improving the health outcomes of the students. In perceived stress, the experimental group had a significant decrease in perception of stress from a mean of 24.6 (SD = 6.7) for the pre-test to a mean of 19.3 (SD = 5.9) for the post-test, with a mean difference of –5.3 following testing ($t = 8.42$, $p < .001$). Virtually no changes in score (-0.6) were observed in the control group, and statistical significance was not reached= (p=.223).

A sharp difference was attested to, indicating that efficacy as a stress reduction mechanism was demonstrated by musical performance, and an adaptive coping style was legitimized in accordance with the Transactional Model of Stress and Coping. The WHO-5 well-being outcomes were found to parallel this trend: an increase and recorded in the experimental group, reflecting a mean improvement of +3.5($t=7.65$, $p < .001$), whereas only an insignificant increase of +0.4 (p=327) was observed in the control group.

Strong support for these findings was provided by the Biopsychosocial Model of Health, through which it was suggested that simulation of mind and sociality by music leads to a significant enhancement in subjective well-being. Improvement was also recorded in reproductive health outcomes, with a shift from 2.8(SD=0.8) to 3.4 (SD=0.7) observed in the experimental group, yielding a mean increase of +0.6 ($t=6.51$, $p<.001$), while the control group remained insignificantly altered (+0.1).

The significance of this was underscored by the fact that reproductive health is typically regarded as sensitive and complex, yet positive measurable effects were produced by the intervention, suggesting that reductions in stress may have contributed to improvements in menstrual health, sleep quality and energy balance.

Taken in aggregate the result presented in Table 3 were shown to support the instrumental in sustaining individual health.

Table 3: Pre-Post intervention comparisons (experimental vs control)

Outcome Variable	Group	Pre-test M (SD)	Post-test M (SD)	Mean Difference	t / F-value	p-value
Perceived Stress Scale (PSS)	Experimental	24.6 (6.7)	19.3 (5.9)	-5.3	8.42	<0.001
	Control	24.4 (6.9)	23.8 (6.8)	-0.6	1.22	0.223
WHO-5 Well-being Index	Experimental	11.7 (3.7)	15.2 (3.9)	+3.5	7.65	<0.001
	Control	11.9 (3.5)	12.3 (3.6)	+0.4	0.98	0.327
Reproductive Health (Self-report)	Experimental	2.8 (0.8)	3.4 (0.7)	+0.6	6.51	<0.001
	Control	2.9 (0.9)	3.0 (0.8)	+0.1	1.11	0.266

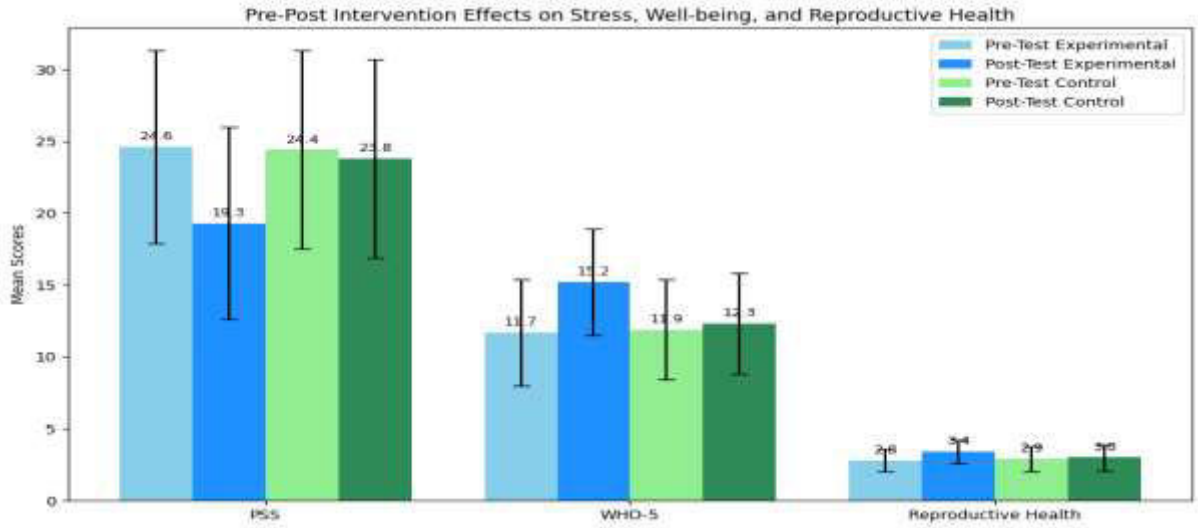

Fig 1: Pre-post music intervention effects

Table 4: Mediation analysis (SEM)

Pathway Tested	β (Standardized)	SE	t-value	p-value	Mediation Supported?
Music Intervention → Stress Reduction	-0.45	0.06	-7.50	<0.001	Yes
Stress Reduction → Reproductive Health	0.39	0.07	5.57	<0.001	Yes
Music Intervention → Reproductive Health (direct)	0.14	0.05	2.80	0.005	Partial
Indirect Effect (via Stress Reduction)	0.18	0.04	4.50	<0.001	Yes

In Table 4, the mediation analysis using structural equation modelling (SEM) was presented, providing a finer-grained mechanism by which improvements in reproductive health may be translated through music interventions.

A highly significant pathway was identified from music intervention to stress reduction (β =-0.45, t =-7.50, p<.001), by which it was indicated that stress is directly reduced through music. A subsequent significant effect was observed from stress reduction to reproductive health (β =0.39, t =5.57, p < .001) as well, indicating that a drop in stress results in better biological outcomes.

The direct effect of music on reproductive health remained significant but weaker (β = 0.14, p = .005), suggesting partial mediation. Importantly, the indirect effect, through the reduction of stress (β = 0.18, p < .001), was significant, thus confirming that stress reduction mediates the relationship between music and reproductive health.

Table 5: Multimodal regression analysis predicting reproductive health outcomes

Variables	Model 1: Control Variables	Model 2: + Intervention	Model 3: + Stress	Model 4: Full Model (Mediation)
Control Variables				
Age	-0.05 (0.04)	-0.04 (0.04)	-0.03 (0.03)	-0.02 (0.03)
Family Income	0.08* (0.03)	0.06* (0.03)	0.05* (0.02)	0.04* (0.02)
Institution Type	0.07 (0.05)	0.06 (0.05)	0.05 (0.04)	0.04 (0.04)
Region (dummy-coded)	0.04 (0.04)	0.03 (0.04)	0.03 (0.04)	0.02 (0.04)
Year of Study	-0.06 (0.05)	-0.05 (0.05)	-0.04 (0.04)	-0.04 (0.04)
Key Predictors				
Intervention (Music Performance = 1)	—	0.28*** (0.05)	0.20*** (0.05)	0.12** (0.04)
Perceived Stress (PSS)	—	—	-0.35*** (0.04)	-0.25*** (0.04)
Psychological Well-being (WHO-5)	—	—	—	0.31*** (0.05)
Model Fit				
R^2	0.06	0.18	0.32	0.41
ΔR^2	—	0.12***	0.14***	0.09***
F-statistic	2.45*	8.12***	15.23***	19.34***

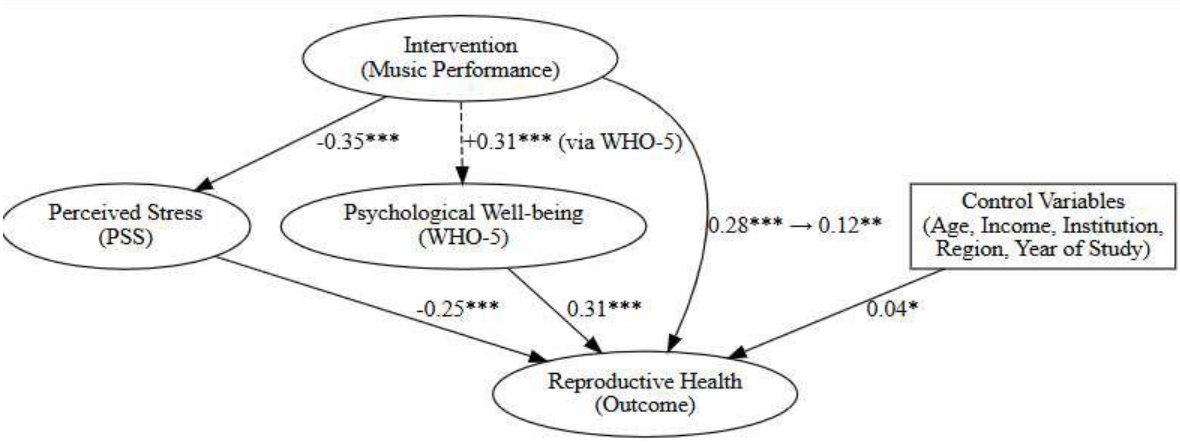

Figure 2: Pathway diagram predicting reproductive health

These findings integrate the two proposed theoretical frameworks: the Transactional Model of Stress and Coping, explaining music as an emotion-focused coping strategy, while the Biopsychosocial Model explains how stress relief translates into biological and social health outcomes.

From the perspective of both frameworks, partial mediation implies additional pathways-such as social bonding or the cultural significance of music-that may independently direct reproductive health improvements aside from stress reduction.Regression analyses shown in Table 5 further clarify the predictors of reproductive health outcomes. In Model 1, the control variables were primarily significant for family income ($\beta = 0.08$, $p < .05$), suggesting that socioeconomic status has some bearing on reproductive health.In the expanded models, intervention and stress were observed to stand out as pivotal predictors. In model 2, music intervention was shown to be a significant predictor of predictor of reproductive health ($\beta = -0.28$, $p < .001$) when demographic variables were accounted for.

In model 3, perceived stress was found to be negatively related to reproductive health ($\beta = 0.35$, $p < .001$), and the intervention coefficient was thereby reduced to $\beta = 0.20$, where was indicated of partial mediation.

Table 6: Multimodal regression analysis predicting psychological well-being (WHO-5)

Variables	Model 1: Control Variables	Model 2: + Intervention	Model 3: + Stress	Model 4: Full Model (Mediation)
Control Variables				
Age	-0.03 (0.04)	-0.02 (0.04)	-0.01 (0.03)	-0.01 (0.03)
Family Income	0.09** (0.03)	0.08** (0.03)	0.07** (0.02)	0.06** (0.02)
Institution Type	0.06 (0.05)	0.05 (0.05)	0.04 (0.04)	0.03 (0.04)
Region (dummy-coded)	0.04 (0.04)	0.03 (0.04)	0.03 (0.03)	0.02 (0.03)
Year of Study	-0.07 (0.05)	-0.06 (0.05)	-0.05 (0.04)	-0.04 (0.04)
Key Predictors				
Intervention (Music Performance = 1)	—	0.30*** (0.05)	0.22*** (0.05)	0.18*** (0.05)
Perceived Stress (PSS)	—	—	-0.42*** (0.04)	-0.35*** (0.04)
Reproductive Health (Self-reported)	—	—	—	0.26*** (0.05)
Model Fit				
R^2	0.07	0.19	0.34	0.42
ΔR^2	—	0.12***	0.15***	0.08***
F-statistic	2.61*	8.46***	16.12***	20.25***

In the full Model 4, the variables of intervention (β = 0.12, p < .01), stress (β = –0.25, p < .001), and well-being (β = 0.31, p < .001) were significantly associated with reproductive health, with an increase in R^2 to 0.41 It was pointed out the joint effects of stress reduction and psychological well-being explained a high proportion of variance in reproductive health outcomes, thereby confirming the recently theorized models. The hierarchical R^2 was boosted in the models and it was established that greater predictive accuracy was achieved through the inclusion of the intervention and stress variables.

In Table 6, the result for regressions predicting psychological well-being were shown. Once again, family income was identified as a significant control variable (β = 0.09, p < .01), through which the health disparities arising from socioeconomic status were revealed. In model 2, psychological well-being was predicted quite well statistically by the intervention (β =0.30, p < .001), and immediate psychological benefits from music performance were thereby indicated. In model 3, group stress was added and was found to be strongly negatively correlated with well-being (β = -0.42, p < .001), thus indicating that decreased in stress are highly consequential for well-being.

Lastly, well-being was significantly predicted by intervention (β = 0.18, p < .001), stress (β = −0.35, p < .001), and reproductive health (β = 0.26, p < .001) in the full Model 4, with R^2 increasing to 0.42. It was shown that well-being is affected by music interventions through both direct and indirect paths via stress and reproductive health, in line with the biopsychosocial perspective, with the interdependence among health domains being emphasized.

Thematic analysis results

Right insights into lived experiences with music performance as a coping strategy and a health-promoting practice were gleaned through qualitative interviews conducted with female higher education students across China. From the thematic analysis, four interrelated themes were given rise to: (1) Music for Emotional Release and Stress Regulation; (2) Music for Social Bonding and Collective Identity; (3) Music for Self-Care, in Terms of Reproductive and psychosexual Health; and (4) Cultural and personal Meaning of Music in Women's Lives.As reported by participants, one of the prominent themes was identified as Music as Emotional Release and Stress Regulation, through which the idea from Lazarus and Folkman's[24]

Transactional Model of Stress and Coping was described, wherein coping is defined as an interaction of appraisal and response. Academic lives were described by students as a "constant cycle of stress", with exams, heavy coursework, and uncertainties about future careers being emphasized, particularly in the case of those enrolled in reputable universities and vocational colleges where high job insecurity was experienced. Many participants spoke of music performance, whether singing in the choir, playing an instrument, or making music in informal jam sessions, as a way of "breathing out the pressure" and "finding a temporary shelter from overwhelming demands." A participant from a local university in Central China explained that after long days studying, playing the guitar was a way to "release emotions without needing to explain them to anyone." To another, rhythmic drumming or dancing to the beat served to "channel frustration into movement" and "reset the mind" after a stressful academic encounter. Better sleep quality and reduction of premenstrual tension, as well as improved ability to focus during the day, were suggested by the few participants, hinting at emotional regulation through music having effects beyond just the immediate physical or psychological effects on an individual. The narratives from all the regions were consistent-the performance of music was a popular means of emotional regulation, whereas the urban students tended to associate it with countering digital overload and their rural counterparts with community and traditions.

The second thematic concern, Music as Social Bonding and Collective Identity, was deeply embedded within the narratives and fit within the sociological sphere of the Biopsychosocial Model of Health. It was mentioned by numerous students that a space for the deepening of friendships and the reaffirmation of belonging was created through musical performance. Choir rehearsals, concerts, jam sessions in the campus music club, and impromptu performances in dormitories were regarded as vital social activities within an environment otherwise dominated by academic competition and individual achievement. A student from a 985 University in East China related how performing in a student band helped in "finding sisters who understood the same struggles," while another recounted music-making session in dormitories in vocational colleges as "a way of surviving loneliness far from home." Participants developed a kind of consensus on the social values of music, stressing music as more than anything about the shared experience, inclusive of everybody, regardless of skill level. Some participants chose to associate it with reducing insomnia and social embarrassment, always explaining how friendships among mothers in a musical group would provide constant emotional support during menstrual pain, exam stress, or family worries.

The Third Theme: Music and Self-Care for Reproductive and Psychological Health cover the biological and psychological interworking processes that Engel's Biopsychosocial Model describes. Several participants actually reported marked improvements in their menstrual and reproductive health cases after continuous engagement in music performance activities. It was recalled by one of the graduate students those irregular cycles were tended to be kept in check through singing in the choir, as they were linked with stress, whereas it was recollected by other students from Western China that premenstrual cramps were eased by drumming, which was described as a way to "distract the mind and relax the body". Music was also described by participants as a "pain killer" for "emotional fatigue" and as a "mood stabilizer" for hormonal changes. Although it was affirmed by many that medical treatment cannot be replaced by music, its supportive role alongside other health practices in fostering psychological resilience was invariably emphasized. The fourth theme, Cultural and personal Meaning of Music in Women's Lives, was situated within a role that is symbolic and identity-forming, thereby extending the discourse beyond coping mechanisms and health outcomes into the cultural realm of women's lived experienced with music. Music was regarded by many performers not merely as a stress reduction technique but as something central to both identity and cultural. Folk songs and dances were associated by participants from rural areas with the continuity of family traditions and ancestral practices, whereas globalized music was described by urban students as a medium for expressing individualism and modern aspirations. By a graduate student based in Northeast China, it was stated that music provided "a language for expressing emotions that cannot be articulated in academic or familial contexts." and was thus framed as an essential avenue for self-expression in a society

where female voices are often stifled. It was also stated by others that music performance empowered them to redefine femininity, since visibility and vocal presence were gained in performance settings. A sense of control over their environment was additionally felt by some participants through music, particularly when stressful institutional context imposed an ominous weight that could not be resisted. Through these accounts, it was revealed that music, beyond functioning as a coping strategy, is ingrained in cultural identity, gender expression, and pathways for self-actualization, interwoven with the way in which female students negotiate both challenges and opportunities in higher education.

Discussion

This study provides convergent quantitative and qualitative evidence that music performance can reduce stress, enhance psychological well being, and support reproductive health among female students in Chinese higher education. Guided by the Transactional Model of Stress and Coping, our findings confirm that stress arises when environmental demands such as academic competition, financial strain, and social expectations exceed perceived coping resources.[24] In our sample this imbalance was reflected at baseline in moderate to high perceived stress, low psychological well being, and only moderate reproductive health, which is consistent with previous literature describing the heavy psychological burden among Chinese university students.[12,13]Against this background, music performance emerged as an adaptive emotion focused coping resource that allowed students to reappraise stressors, regulate emotions, and engage in restorative activity. The experimental results showed significant reductions in perceived stress and corresponding gains in psychological well being and reproductive health in the intervention group compared with controls, while the interview data highlighted emotional release, social bonding, and embodied self care as key mechanisms. Together these findings extend stress coping theory by showing that music performance operates not merely as distraction but as an embodied coping resource that integrates emotional, cognitive, and physiological regulation within the specific context of Chinese higher education.

It is strongly suggested by the study that, from Engel's (1977) Biopsychosocial Model of Health perspective[11], music-based interventions are operated at the nexus of psychological, social, and biological domains to improve health outcomes. Psychologically, stress was relived and well-being was uplifted through music-performance, which was found to be consistent with prior studies in which music's effects on lessening anxiety, depression and academic stress were demonstrated[13, 16]. Socially, a context of group performance was created in which collective identity, peer bonding and cultural expression were fostered , as was suggested by the thematic findings, a view also shared by He et al.[12], in which it was argued that self-care and appreciation by means of music are well served to address stigma surrounding mental health and academic pressure. Biologically, reductions in stress were identified as partial mediators of changes in reproductive health, since partial mediation was shown through SEM analysis, thereby attesting to the possibility that stress-buffering effects of music could be translated into actual improvements in sensitive physiological domains such as menstrual regularity, sleep quality and energy balance. Alignment was thereby established between the findings and a range of other studies in which adverse effects of stress on menstrual irregularities and reproductive dysfunction were reported[19-20]. While evidence was also provided that interventions through music may be regarded as valuable in fostering resilience in female reproductive health alongside pharmacological ones. Through the mediation analyses, it was revealed that a significant portion of music's effect on reproductive health was accounted for the stress reduction; however, significant direct effects were also retained, indicating that additional pathways through which music might exert influence such as hormone regulation, emotional catharsis, or the fostering of cultural identity were also possible. In this regard, congruence was shown with Liao et al. [15] study in which it was indicated that both Chinese Five Elements Music Therapy and Western Art Music Therapy significantly reduced stress across cultural contexts. Therefore, in biopsychosocial sense, this framework was operationalized in a reproductive health setting, illustrating how physiological manifestations are interlaced with psychological

stress and social implications brought on by their human constituents, all of which may be addressed concurrently through music.

Theoretically, contributions are made by this to two distinct domains. First, the Transactional Model of Stress and Coping is broadened by the emphasis that music is not only an adaptive emotion-focused coping strategy but also an embodied resource for biological resilience, whereby coping theory is expanded to encompass cultural and performative practices. This study has several important strengths that reinforce the credibility and relevance of its findings. First, it uses a large stratified national sample of 900 female students across regions, institution types, and years of study, which strengthens external validity and moves beyond the small single site samples that dominate much music and mental health research.[12,13] Second, it explicitly links music performance to reproductive health outcomes, a domain that has often been discussed in relation to stress but rarely examined empirically within music based interventions.[19,20,] Third, the mixed methods design combines a quasi experimental approach, large scale survey data, and in depth interviews, which allows statistical patterns to be interpreted through participants own accounts of emotional release, peer support, and self care. Finally, the study is grounded in both the Transactional Model of Stress and Coping and the Biopsychosocial Model of Health,10,11 which prevents fragmented interpretation and situates music performance within a coherent multilevel framework.Such a position is aligned with Wang14, which mindfulness and music engagement were emphasized for their roles in subjective well-being and academic performance, with well-being identified as a mediator of the stress performance link. In a similar manner, it was shown in our findings that psychological well-being functioned as a mediator between stress reduction and both reproductive health and general vitality, thereby highlighting the interconnectedness of coping, well-being, and health. Second, by being positioned within higher education reproductive health contexts rarely situated in conventional health promotion research, music was applied innovatively to the Biopsychosocial Model. In earlier investigations, attention was given to how music affected stress, anxiety, or depression[16, 17], and thus contributions were made to the study of reproductive health as a necessary yet neglected outcome in the identified gaps of biopsychosocial scholarship. Furthermore, while support was provided by our findings to Feng and Wang's [18] conclusion about music therapy's potential to improve emotional resilience and employability, similar benefits were also demonstrated in reproductive resilience and academic vitality among women.

In earlier investigations, attention was given to how music affected stress, anxiety or depression16, and contributions were thereby made to the study of reproductive health as a necessary yet neglected outcome in biopsychosocial scholarship. Support was also provided by our findings to Feng and Wang's18 conclusion regarding music therapy's potential to enhance emotional resilience and employability, while similar benefits were demonstrated in reproductive resilience and academic vitality among women. The practical implications of these findings for universities and student support services are substantial. Music based wellness programs can be systematically integrated into campus health promotion as cost effective, non invasive, and culturally resonant strategies rather than being treated solely as extracurricular cultural enrichment. Our results suggest that structured group music making, which combines choral singing, instrumental performance, and collaborative creativity, can provide a regular setting for emotional regulation, peer bonding, and self care, in line with immersive and technology assisted approaches reported by Liu et al.[16] Particular attention should be given to students from low income families, rural regions, and vocational colleges, since family income emerged as a significant predictor of both reproductive health and psychological well being and these groups may have fewer alternative coping resources. Prior work showing that mindfulness based music interventions benefit high strain occupations such as nursing further supports the case for targeting high stress student subgroups.[23] In practice, music performance sessions can be embedded within counselling services, reproductive health education, and academic stress management workshops so that psychological, social, and reproductive dimensions of student well being are addressed in an integrated way.[13,14,18]

At the policy level, the study speaks directly to national and institutional agendas that emphasise

preventive, non pharmacological approaches to health. In the context of the Healthy China 2030 strategy, which calls for the integration of health promotion into education systems, music based wellness programs could be formally recognised as part of university health policy alongside more traditional medical and counselling services. By resourcing campus based music initiatives that are accessible to students from diverse socioeconomic backgrounds, policymakers can address psychological distress and reproductive health risks among young women in a way that also advances gender equity and reduces health disparities. For universities, incorporating arts based health promotion into strategic planning would involve positioning music performance as a core component of student support rather than as optional entertainment. Public health campaigns can also build on the social and cultural meanings of music in order to destigmatise menstruation and mental health, normalise conversations about stress and reproductive well being, and extend the benefits of music therapy that have been documented in clinical settings to earlier stages of the life course and to educational environments.[17]

It is shed by the present study on the fact that music performance is far from merely a pastime but rather a multidimensional intervention through which stress is alleviated, well-being is improved, and reproductive health among women in higher education is supported, By being embedded into stress-coping and biopsychosocial framework for health, a more integrated account is provided by the current research of how embodied and cultural practices may be employed to address complex and interrelated health needs. Beyond this, it is recommended that future work consider how these dimensions may change longitudinally, with cultural differences in musical preference taken into account, and biological markers of reproductive health such as hormonal measures examined so that understanding of music's biopsychosocial mechanism may be furthered. On the other hand, excellent leverage is already proviSded by the current findings for advancing both theory and application, whereby music is acknowledged as a potent remedial medium in the quest for healthier and more resilient student populations in China and elsewhere.

Conclusion

This study set out to examine whether music performance can be used as an effective stress management and health promotion strategy for female higher education students in China, with particular attention to psychological well being and reproductive health. Using a mixed methods and quasi experimental design, we found that participation in an eight week music performance program significantly reduced perceived stress and improved psychological well being, which indicates that the first study objective was achieved. Mediation analysis further showed that reductions in stress were a key pathway through which music participation supported better self reported reproductive health, including more regular menstrual cycles, better sleep quality and greater overall vitality, thereby addressing the second objective. Analyses across regions, institution types, years of study and family income suggested that while the general pattern of benefit was consistent, students from lower income families gained particular advantage from the intervention, which speaks to the third objective on demographic variation. Taken together, these findings indicate that music performance can be regarded as a promising, culturally grounded and practically feasible resource for improving the psychological and reproductive health of female university students and for guiding future health promotion in higher education settings.

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