THE COMBINED EFFECTS OF EXERCISE AND MUSIC ON SPORTS ANXIETY, EXERCISE BELIEFS, COPING EFFECTIVENESS, AND MENTAL TOUGHNESS AMONG CHINESE COLLEGE STUDENTS WITH SPORTS ANXIETY

LIU ZHUTANG

UNIVERSITI SAINS MALAYSIA

2025

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by

LIU ZHUTANG

Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy

June 2025

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my main supervisor, Associate Professor Dr. Garry Kuan, my co-supervisors, Associate Professor Dr. Kueh Yee Cheng and Professor Dr. Ke Zhou from Henan University, for their invaluable support throughout my doctoral study. Associate Professor Dr. Kuan, a leading expert in my field, was instrumental in the completion of this research. His unwavering support, comprehensive guidance, and meticulous attention to detail provided me with essential insights and constructive feedback during the entire process. Additionally, Dr. Kuan's expertise in psychology offered critical support during challenging times, giving me the confidence to persevere. His academic rigour, optimistic outlook, and leadership have profoundly influenced my personal and professional development, inspiring me to strive for excellence in my future endeavours.

I am also deeply grateful to my co-supervisor, Associate Professor Dr. Kueh, an expert in statistics who significantly contributed to data collection and analysis. Dr. Kueh's patient guidance helped me navigate complex professional challenges, while her dedication to both her career and family life has greatly inspired me.

Finally, I wish to extend my heartfelt appreciation to my parents, Liu Changzhen and Jiang Meirong; my parents-in-law, Zhang Shiyan and Zhang Yunzhi; my wife, Zhang Jinglin; my daughter, Chloe Liu; my wife's sister and brother-in-law; and other relatives. Their unwavering support has been crucial in enabling me to complete my doctoral degree. This journey has not only deepened my knowledge but also instilled in me a profound sense of gratitude for all who have aided me, past, present, and future.

Thanks to everyone.

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LIST OF ABBREVIATIONS

PESAS	Physical Education Sport Anxiety State
PESAS-C	Chinese Version of Physical Education Sport Anxiety State
EBQ	Exercise Beliefs Questionnaire
EBQ-C	Chinese version of Exercise Beliefs Questionnaire
MTYQ	Mental Toughness for Youth Questionnaire
MTYQ-C	Chinese version of Mental Toughness for Youth Questionnaire
CE	Coping Effectiveness
CE-C	Chinese version of Coping Effectiveness
ANOVA	Analysis of Variance
CFA	Confirmatory factor analysis
CFI	Comparative Fit Index
CI	Confidence interval
CR	Composite reliability
ER	Emotion Regulation
ERQ	Emotion Regulation Questionnaire
RMSEA	Root means square error of approximation
SEM	Structural Equation Modelling
SRMR	Standardized root means square residual
TLI	Tucker and Lewis index

KESAN GABUNGAN SENAMAN DAN MUZIK TERHADAP KEBIMBANGAN SUKAN, KEPERCAYAAN SENAMAN, KEBERKESANAN DAYA TINDAK DAN KETAHANAN MENTAL DALAM KALANGAN PELAJAR KOLEJ CINA YANG MENGALAMI KEBIMBANGAN SUKAN

ABSTRAK

Kebimbangan sukan merupakan isu global yang menjejaskan prestasi atlet dan menghalang bukan atlet daripada menyertai sukan. Di China, dengan populasi melebihi 1.4 bilion dan penekanan yang semakin meningkat terhadap pendidikan jasmani dalam kurikulum sekolah, para pelajar menghadapi cabaran yang semakin bertambah berkaitan penyertaan sukan. Kajian ini terdiri daripada dua fasa. Fasa 1 bertujuan untuk mengkaji kesahihan dan kebolehpercayaan versi terjemahan bahasa Cina bagi Skala Kebimbangan Negeri Pendidikan Jasmani (Physical Education State Anxiety Scale, PESAS), Soal Selidik Kepercayaan Senaman (Exercise Beliefs Questionnaire, EBQ), Skala Keberkesanan Penanggulangan (Coping Effectiveness, CE), dan Soal Selidik Ketahanan Mental untuk Belia (Mental Toughness for Youth Questionnaire, MTYQ) menggunakan Analisis Faktor Pengesahan (Confirmatory Factor Analysis, CFA) dan penilaian kebolehpercayaan konsistensi dalaman. Selain itu, Fasa 1 juga bertujuan membina Model Persamaan Struktur (Structural Equation Modelling, SEM) untuk meneroka hubungan antara kebimbangan sukan, kepercayaan senaman, keberkesanan penanggulangan, dan ketahanan mental dalam kalangan pelajar universiti Cina yang mengalami kebimbangan sukan. Sebanyak 1,055 peserta melengkapkan soal selidik, dan 755 daripadanya adalah sah. Menurut keputusan kajian, model SEM akhir fasa 1 menunjukkan indeks kesesuaian model yang baik: Indeks Keserasian Perbandingan (Comparative Fit Index, CFI) = 0.926, Indeks Tucker

Lewis (Tucker Lewis Index, TLI) = 0.923, Purata Kuasa Residual Berakar Standard (Standardised Root Means Square Residual, SRMR) = 0.029, dan Ralat Purata Berakar Kuasa Dua Pendugaan (Root Mean Square Error of Approximation, RMSEA) (90% CI) = 0.045 (0.041, 0.048), nilai p RMSEA < 0.001. Enam hipotesis khusus SEM (2 hipotesis alternatif tambahan dan 4 hipotesis daripada model awal) menunjukkan hubungan signifikan antara proses kognitif (Cognitive Processes, CP), keberkesanan penanggulangan (CE), kebimbangan somatik (Somatic Anxiety, SA), kepercayaan senaman (Exercise Beliefs, EB), dan ketahanan mental (Mental Toughness, MT) dalam model SEM akhir. CE dan CP merupakan konstruk yang memberi kesan langsung kepada MT. Objektif Fasa 2 adalah untuk mengkaji kesan masa, kesan kumpulan, dan interaksi masa*kumpulan antara kumpulan eksperimen dan kumpulan kawalan dalam kalangan pelajar universiti Cina yang mengalami kebimbangan sukan. Intervensi senaman melibatkan intensiti sekurang-kurangnya 50% hingga 60% daripada kadar denyutan jantung maksimum purata, dengan peningkatan 5% setiap empat minggu. Untuk intervensi muzik, lagu-lagu dengan rentang tempo antara 110 hingga 120 denyutan per minit dipilih. Intervensi muzik dan senaman dijalankan secara serentak. Sebanyak 108 pelajar universiti yang mengalami kebimbangan sukan telah dibahagikan secara rawak kepada dua kumpulan. Intervensi berlangsung selama 12 minggu, dengan sesi dilakukan tiga kali seminggu, setiap sesi selama 40 minit. Peserta melengkapkan PESAS, EBQ, CE, dan MTYQ pada empat titik masa: seminggu sebelum intervensi, pada minggu keempat dan minggu kelapan semasa intervensi, dan selepas intervensi pada minggu kedua belas. Menurut keputusan kajian fasa 2, kumpulan eksperimen menunjukkan skor yang lebih tinggi secara signifikan berbanding kumpulan kawalan bagi kebimbangan sukan, kepercayaan senaman, ketahanan mental, dan keberkesanan penanggulangan dengan

nilai p masing-masing = 0.001, = 0.046, = 0.022, < 0.001. Intervensi gabungan muzik dan senaman mempunyai impak positif terhadap kebimbangan sukan (SA), kepercayaan senaman (SB), ketahanan mental (MT), dan keberkesanan penanggulangan (CE) dalam kalangan pelajar universiti Cina yang mengalami kebimbangan sukan. Penemuan kajian ini menyumbang kepada kepelbagaian alat pengukuran untuk menilai kebimbangan sukan (SA), kepercayaan senaman (EB), keberkesanan penanggulangan (CE), dan ketahanan mental (MT) dalam konteks China, serta menyediakan instrumen yang berkesan untuk memajukan penyelidikan psikologi di China.

THE COMBINED EFFECTS OF EXERCISE AND MUSIC ON SPORTS ANXIETY, EXERCISE BELIEFS, COPING EFFECTIVENESS, AND MENTAL TOUGHNESS AMONG CHINESE COLLEGE STUDENTS WITH SPORTS ANXIETY

ABSTRACT

Sports anxiety is a worldwide concern that impacts athletes' performance and discourages non-athletes from participating in sports. In China, with a population exceeding 1.4 billion and an increasing emphasis on physical education in the school curriculum, students are encountering growing challenges related to sports participation. This study comprises two phases. The aim of Phase 1 is to examine the validity and reliability of the Chinese-translated versions of the Physical Education State Anxiety Scale (PESAS), the Exercise Beliefs Questionnaire (EBQ), the Coping Effectiveness (CE) scale, and the Mental Toughness for Youth Questionnaire (MTYQ) utilizing Confirmatory Factor Analysis (CFA) and internal consistency reliability assessments. Additionally, Phase 1 aims to construct a Structural Equation Modelling (SEM) to explore the relationships among sports anxiety, exercise beliefs, coping effectiveness, and mental toughness in Chinese university students with sports anxiety. A total of 1,055 participants completed the questionnaires, of which 755 responses were valid. According to the research results, the final SEM of phase 1 has a good model fitting index: comparative fit index (CFI)=0.926, tucker lewis index (TLI) = 0.923, standardised root means square residual (SRMR) = 0.029, root mean square error of approximation (RMSEA) (90% CI) = 0.045 (0.041, 0.048), RMSEA p-value < 0.001. The 6 SEM specific hypotheses (2 additional alternative hypotheses and 4 hypotheses from the initial model) were produced a significant interrelationship with

cognitive processes (CP), coping effectiveness (CE), somatic anxiety (SA), exercise beliefs (EB), and mental toughness (MT) in the final SEM. CE and CP were constructs that directly affected MT. The objective of Phase 2 is to investigate time effects, group effects, and time*group effects between experimental and control groups of Chinese university students with sports anxiety. The exercise intervention consisted of an intensity of at least 50% to 60% of the average maximum heart rate, progressing by 5% every four weeks. For the music intervention, tracks with a tempo range of 110–120 beats per minute were selected. The combination of music and exercise interventions were conducted simultaneously. A total of 108 university students with sports anxiety were randomly assigned to two groups. The intervention lasted for 12 weeks, with sessions conducted three times a week, each lasting 40 minutes. Participants completed the PESAS, EBQ, CE, and MTYQ at four time points: one week before the intervention, during the intervention at four weeks, during the intervention at eight weeks, and after the intervention at twelve weeks. According to the research results of phase 2, experimental group significantly exhibited the higher scores than the control group on sports anxiety, exercise beliefs, mental toughness, and coping effectiveness with respectively p-values =0.001, =0.046, =0.022, <0.001. The music and exercise intervention has a positive impact on sports anxiety SA, SB, MT, and CE among Chinese university students with sports anxiety. The research findings contribute to the diversity of measurement tools for assessing SA, sports anxiety, EB, CE, and MT in the Chinese context, offering effective instruments for advancing psychological research in China.

CHAPTER 1

INTRODUCTION

1.1 Background

Anxiety is a negative psychological factor, which manifests itself physically as muscle contraction and increased heart rate and psychologically as worry and uneasiness (American Psychiatric Association, 2013). Anxiety can directly affect a person's body or mind, and this impact can cause a person's cognitive ability to decline, motor coordination disorders, and emotional instability (Mesquita & Todt, 2000; Weinberg et al., 2016). Many factors lead to anxiety, and these factors are easy to appear, such as sports activities, exams, and social interactions. The appearance of anxiety is because the environment will bring certain psychological pressure to the individual, and the size of this pressure also affects the size of anxiety. Sports anxiety is also a kind of anxiety, but sports anxiety mainly occurs in athletes or ordinary people with sports pressure. Sports anxiety is a negative tension caused by sports pressure, such as sports competitions or sports loads (Martens, 1977; Pranoto et al., 2024).

Sports anxiety affects the mental health of individuals. Since sports anxiety has a remarkable impact on athletes or sports individuals, such as unstable sports performance or weakened sports motivation, it has become a global problem. Mental health issues have received widespread attention around the world because they affect not only a wide range of people but also a large part of the people in children and adolescents. Globally, 30-35% of children and adolescents are affected by anxiety disorders. It is worth noting that this problem has not been well solved and tends to

expand (Glover & Fritsch, 2018; Sabiston et al., 2016).

According to the National Fitness Activities Survey Report (2020) released by the China National Fitness Monitoring Center in 2022, 37.2% of people regularly participate in physical exercise, and these people are aged seven and above. However, it is worth noting that there is a significant difference in the level of sports participation between urban and rural areas in China, with a difference ratio of 7.4%. Compared to 2014, sports participation increased by 3% in 2020. It is worth noting that although the level of sports participation in rural areas of China is lower than that in urban, the proportion of rural sports participation has increased significantly compared to six years ago (National Fitness Activities Survey Report, 2020).

The increase in sports anxiety is partly due to increased sports participation. Due to the increased number of sports participants, these individuals face different levels of sports pressure and bear different levels of sports pressure. Therefore, the objective increase in the number of sports participants leads to expanding the proportion of sports anxiety (Chi & Wang, 2022; Martinez et al., 2024). According to the National Fitness Activities Survey Report (2020), due to the continuous rise of the Chinese sports population, the proportion of sports anxiety faced by these groups is also increasing.

Once sports anxiety has a serious negative impact on the group of the Chinese sports population, it may ruin their sports careers. Exercise or music intervention on sports anxiety have been proven to be effective, but the intervention experiment combining exercise and music has not appeared. The background question considered in this study is whether the combination of music and exercise is effective in intervening sports anxiety; Whether the combined exercise and music intervention experiment will affect factors other than sports anxiety, such as exercise beliefs,

coping effectiveness and mental toughness; What is the time and cross relationship between Sport anxiety, exercise beliefs, coping effectiveness and mental toughness?

The researcher examined the reliability and validity of sports anxiety, exercise beliefs, coping effectiveness, and mental toughness because only effective and reliable questionnaires can be valuable for data analysis. The researcher continued by examining the effects of exercise and music combinations on sports anxiety, exercise beliefs, coping effectiveness, and mental toughness among Chinese sports anxiety university students.

1.2 Problem Statement

Sports anxiety is a prevalent issue among athletes and ordinary individuals, particularly among college students who may experience heightened anxiety related to academic performance and sports participation. According to the Bulletin of the Seventh National Population Census in 2020, the total population of China has reached over 1.4 billion. Therefore, research on sports anxiety in China is highly representative and can enrich the theoretical foundation of sports anxiety. Therefore, in China, due to the rapid increase in population, the number of people who exercise has also increased relatively, so the proportion of people with sports anxiety has also increased relatively. The increase in the number of people with sports anxiety is the result of many factors, not only because of the excessive population in China but also because of the Chinese government's emphasis on sports. The Chinese government's emphasis on sports is reflected in competitive, school, and social sports, so the number of people who exercise has increased significantly. The Chinese government has elevated physical education courses to one of the primary curricula (Compulsory Education Curriculum Plan, 2022). In school sports, students' physical education

courses and sports tasks have also increased relatively. Some of these sports tasks, such as 800 and 1000 meters in the national physical fitness test, are mandatory. Some schools also stipulate that students need to run a certain number of sports tasks in school every semester. These mandatory tasks will lead to more students with sports anxiety.

The increase in the number of people suffering from sports anxiety will inevitably lead to the emergence of psychological problems; thus, reducing the sports anxiety of Chinese university students is an important issue. A tool for evaluating sports anxiety is essential to solve this problem. The researcher queried a large number of literatures through a literature review, screened this literature according to quality standards, and finally used PESAS as an evaluation tool for sports anxiety among Chinese university students.

PESAS has been widely used worldwide, and multiple versions have proved its effectiveness and reliability (CFI = .92; RMSEA = .06; Cronbach alphas between .79 and .83). The widespread use of PESAS relies not only on the effectiveness and reliability of this scale but also on its dimension innovation (Abbassi et al., 2022b). The original version of PESAS demonstrates sufficient validity and reliability. The researcher examined the intervention on sports anxiety through the combination of exercise and music with four scales, which are as follows: the Physical Education State Anxiety Scale (PESAS), the exercise beliefs questionnaire (EBQ), the Coping effectiveness (CE), and the mental toughness for youth questionnaire (MTYQ).

In summary, this study identifies the current issues as the prevalence of sports anxiety among Chinese college students and the insufficient research on the potential and application of combining exercise and music as an intervention to reduce sports anxiety and enhance mental health. Therefore, This study thus presents two

challenges:

(1) :The first challenge was to identify valid Chinese versions of assessment tools, assess the reliability and validity of these measurement instruments, and utilise Structural Equation Modelling (SEM) to verify the hypothesised relationships among them.

(2): The second challenge involved intervening in the anxiety of Chinese university students by combining music and exercise while evaluating time, group, and interaction effects.

To address these challenges, the study was conducted in two phases.

(1): In the first phase, the researcher translated the PESAS, EBQ, CE, and MTYQ into Chinese (Mandarin), validated them through Confirmatory Factor Analysis (CFA), and assessed the concurrent validity of PESAS, EBQ, CE, and MTQ-10, followed by SEM analysis.

(2): In the second phase, the researcher examined the effects of the combined music and exercise intervention on PESAS, EBQ, CE, and MTYQ, assessing time, group, and interaction differences between the experimental and control groups.

1.3 Rationale and Significance

It is well known that exercise has many advantages. From the biological mechanism research, exercise can prevent chronic diseases and improve human health (Morville et al., 2020). In the research on human beings, the research on neural plasticity of exercise has been deepened, including the improvement of hippocampal volume and emotional development (Weinberg et al., 2014). Research shows that exercise can improve the immune function, and exercise has played a positive and key role in the experiment of fighting against immune function and chronic diseases

(Nieman & Wentz, 2019). Exercise has a significant effect on nerves. It can reduce the hypothalamic – respiratory – arterial axis, improve the antioxidant capacity, affect the symphonic nervous system and the parallel nervous system. After the exercise intervention experiment, cardiovascular capacity, respiratory function and neuroplasticity are all positively affected (Daniela et al., 2022). Research shows Aerobic exercise can effectively treat patients with clinical anxiety (Aylett et al., 2018). Thus, the exercise intervention experiments were well powered to measure motor anxiety populations.

Music intervention experiments have shown that music can be effective in promoting neurological recovery and heart rate improvement in patients (Xue & Wang, 2022). One study has shown that music can have actual time influences on incremental feeling in intertemporal choices (Zhou et al., 2022). The release of neurotransmitters and dopamine can be stimulated by music, and when stimulated, they can change the chemical composition of the brain to reach the activation of the body's ward and prosocial systems (Speranza et al., 2022). Intervention experiments with music elicited significantly lower proportions of negative affect than when positive affect occurred and were able to enhance ratings of positive affect under the intervention (Huber et al., 2021). A meta-analytic review supplied proof that stress, and anxiety can be relieved by music (De et al., 2022). Music is an important variable that stimulates the development of human function and function, especially in the spirit, and has the effect of relieving stress and reducing anxiety, so the combination of exercise and music to intervene in sports anxiety is important innovative research.

Additionally, both exercise and music produced significant improvements in anxiety, but the combined use of exercise and music together in a single experiment to intervene in sports anxiety would be an interesting innovative experiment, and no

scholars studied this experiment, highlighting the originality of this experiment.

Confirmatory factors analysis (CFA) is a statistical method that can ensure the rationality of the model framework. This rationality is reflected in the verification results of CFA. CFA is used to verify the reliability and validity of the entire process. Another method for verifying the model is exploratory factor analysis (EFA). EFA can be used to verify the newly developed model. For CFA, CFA verifies an existing model. The reliability and validity of this existing model have been proven. However, due to the wide adaptability of the model, different researchers can modify the model in different versions (such as modifications in different languages), and CFA can verify the reliability and validity of the newly modified model. The PESAS used in this study is a mature scale with satisfactory reliability and validity and stable factors. In order to enable PESAS to be used in China, the researcher created a Chinese version of PESAS (PESAS-C) and used the CFA method to verify the reliability and validity of PESAS-C. PESAS-C has good consistency with the original version of PESAS, and PESAS-C retains the 3 factors and 18 items from the original version. The final PESAS-C results are satisfactory, and all values are within the acceptable range. This finding is similar to the results of PESAS. The three factors of the two versions can be well distinguished, which proves the reliability of the results of the original version of PESAS. In the original version of PESAS, the emergence of the worry factors highlights the innovation of PESAS. The original version of PESAS is based on the two-factors structure of somatic anxiety and the recognition process. The innovative addition of the worry factors allows PESAS to not only assess sports anxiety in physical education courses, but also to evaluate sports anxiety in general sports activities.

PESAS is a reliable scale that has been translated into multiple languages, such

as: PESAS of the Bosnian language version verified by Orlić et al. (2018); PESAS of the Finnish language version verified by Yli-Piipari et al. (2009); PESAS of the Portuguese language version verified by Lima et al. (2015); PESAS of the Arabic language version verified by Abbassi et al. (2022). Many of these translated versions of PESAS use Cronbach's alpha reliability analysis. Although the Cronbach's alpha reliability analyses are widely used, the researcher also used reliability analysis of the CR to evaluate the reliability of PESAS-C because Cronbach's alpha may have too high or too low values in use, resulting in erroneous results and affecting reliability (Raykov, 1998). For this reason, many scholars suggest that CR can be used as a verification method of CFA to detect the reliability of the model (Wang & Wang, 2012). In this study, the CR value of somatic anxiety is 0.922, the CR value of worry is 0.912, and the value of cognitive processes is 0.931. It is worth noting that the AVE values (0.665, 0.638, and 0.693) of these three factors are all greater than 0.05. Hair et al. believed in a study in 2009 that AVE values greater than 0.5 and CR values greater than 0.7 indicate that the data has good reliability and convergent validity. According to the results of this study, PESAS-C is the same as the original version of PESAS, and the two have similar convergent validity, and it is proved that PESAS-C has good reliability and validity, so PESAS-C can be used in the Chinese population. It is worth noting that other versions of PESAS retain the three factors and 18 items, PESAS-C also retains these three factors and 18 items, and no factors and items are deleted. In addition, in the standardized loading factors analysis of this study, all values of standardized loading factors are greater than 0.07. This is because values of standardized loading factors greater than 0.07 indicate that the values are within the acceptable range (Nusair & Hua, 2010). The significance of PESAS-C is that provides PESAS with a scale that can adapt to the Chinese population. The validation of this

scale not only provides a psychological scale for measuring sports anxiety for the Chinese population, but also PESAS-C can prove that the reliability and validity of PESAS have good adaptability. China is a representative region. Due to its large population, vast territory, unique culture and diverse environment, PESAS-C can well prove that the original version of PESAS is reliable. In addition, the validation of PESAS-C can give China one more psychological measurement tool, and the increase of psychological measurement tools can better adapt to the diversity of the Chinese population.

Music and exercise are a very meaningful innovation for sports anxiety. The combination of the music and exercise can continuously improve intervention measures and reduce the anxiety level of Chinese university students with sports anxiety. Therefore, the significance of this study is that it used PESAS-C as a measurement tool to detect the anxiety state of Chinese university students. Second, to combine music and exercise intervention to reduce the anxiety state of Chinese university students.

1.4 Defining the Terminology

1. Physical Education State Anxiety Scale (PESAS)

Barkoukis et al. (2005) developed the Physical Education State Anxiety Scale (PESAS), and PESAS has sports anxiety model which has three dimensions factors (somatic anxiety, worry, and cognitive processes). PESAS can well evaluate the level of sports anxiety of individuals and distinguish which dimensions factors cause sports anxiety, such as cognitive processes, worry, and somatic anxiety of sports anxiety. Therefore, somatic anxiety, worry, and cognitive processes can be three sub-dimensions of sports anxiety and represent sports anxiety. The researcher used

PESAS to detect sports anxiety in participants.

2. Mental Toughness for Youth Questionnaire (MTYQ)

Mental toughness is a coping ability that can resist the negative effects of stress (Dagnall et al., 2021). The original MTYQ is effective in assessing the different levels of mental toughness. MTYQ consists of four factors of mental toughness namely, attention control, self-belief, commitment, and desire to success. MTYQ is a useful tool for measuring mental toughness, Therefore, MTYQ was used in this study.

3. Exercise Beliefs Questionnaire (EBQ)

The Exercise Beliefs Questionnaire (EBQ) is a valid questionnaire, the EBQ can measure exercise beliefs. The EBQ is a 21-item questionnaire that measures the effects and consequences of not exercising (Loumidis & Wells, 1998). Exercise beliefs can be a clinical condition, and the level of exercise beliefs affects the individual's physical and mental adjustment (Loumidis & Wells, 1998).

4. Coping effectiveness (CE)

Gottlieb & Rooney, (2004) developed the Coping Effectiveness (CE) scale, which significantly influences perceptions of coping effectiveness, particularly through the dimensions of optimism and self-efficacy. The CE also serves a function in mitigating negative emotions and is instrumental in maintaining mental health and stabilizing negative affect. In addition to assessing the degree of coping with negative emotions such as psychological stress, the CE scale can also have an impact or regulatory effect on emotional and mental health.

5. Confirmatory Factor Analysis (CFA)

CFA is a statistical analysis by using confirmatory approach in validating the factor structure of a questionnaire. The purpose of CFA is to verify the models by analysing the values of models and adjusting the non-standard variable values.

Generally, CFA can verify mature scales and analyse the relationship between observed variables and latent variables. The application scope of CFA is very wide, for example, testing psychological measurement tools, the validity of tool methods and structural equation verification. (Botton et al., 2016).

6. Structural Equation Modelling (SEM)

Structural equation modelling (SEM) is a statistical analysis to examine the inter-relationship between variables and verify the hypothesised model (Hall et al., 2000). The researcher used the SEM method to determine the hypothesized model which consists of relationship between sports anxiety, exercise beliefs, mental toughness, and coping effectiveness.

7. Sports Anxiety

Sport anxiety is the psychological state characterised by feelings of apprehension, nervousness, and unease specifically related to performance in sporting contexts. It manifests through cognitive, physiological, and behavioural responses that are triggered by the anticipation of competition or performance-related situations. In this study, sport anxiety will be assessed using the Chinese versioned Physical Education State Anxiety Scale (PESAS-C), which measures the levels of cognitive anxiety (worry), somatic anxiety (physiological responses such as increased heart rate), and concentration disruption experienced by individuals prior to or during competitive sports.

8. Frequency, Intensity, Time, and Type (FITT)

FITT is divided into four main parts, which are frequency, intensity, time, and type. *Frequency (F),* refers to the number of exercise sessions conducted within a specified timeframe, typically expressed as sessions per week. In this study, frequency will be operationally defined as the number of days per week that participants engage

in structured exercise sessions designed to promote improvements in physical fitness, sports performance, or psychological well-being. *Intensity (1),* is defined as the level of effort or exertion put into each exercise session, often categorised as low, moderate, or high. In this context, intensity will be measured using heart rate monitoring, whereby moderate intensity is defined as 50%-70% of the participant's maximum heart rate, and high intensity is defined as 70%-85% of maximum heart rate. Participants may also report perceived exertion on a standard scale, such as the Borg Rating of Perceived Exertion (RPE), which ranges from 6 (no exertion) to 20 (maximal exertion). *Time (T)* refers to the duration of each exercise session, typically expressed in minutes. In this study, time will be operationally defined as the total number of minutes spent engaged in physical activity during each session. Participants will be required to complete a minimum of 40 minutes of exercise per session to align with recommendations for enhancing fitness and psychological benefits. *Type (T)* denotes the specific mode or kind of exercise performed. This includes categorizing activities based on their nature, such as aerobic (e.g., running, cycling), resistance (e.g., weight training), flexibility (e.g., stretching), or combined exercise. In the current study, the type of exercise will be specified to include both aerobic and resistance training activities to assess the impact of diverse physical activities on the measured outcomes. In this study, Frequency is three times a week; Intensity is forty minutes each time; Time is a period of twelve weeks; Type is jogging with music.

1.5 Research Questions

Phase 1

(1) Are the Chinese translated version of questionnaires for PESAS, EBQ, CE,

and MTYQ Scale valid and reliable?

(2) Are there any significant path relationships between sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among Chinese university students?

Phase 2

(4) Is there any time effect of intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

(5) Is there any group effect of intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

(6) Is there any interaction effect (group*time) of intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

1.6 Research Objectives

1.6.1 General Objective

The general objectives of this study is to examine the effect of twelve-week intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among Chinese university students with sport anxiety.

1.6.2 Specific Objectives

Phase 1

Objective 1: To examine the validity and reliability of the Chinese translated

version of questionnaires for PESAS, EBQ, CE, and MTYQ, by using confirmatory factor analysis and internal consistency reliability.

Objective 2: To develop a structural equation model to explain the relationships between sport anxiety, exercise beliefs, coping effectiveness, and mental toughness.

Phase 2

Objective 3: To examine the changes (within group, time effect) on intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students for experimental and control groups.

Objective 4: To examine the difference between groups (intervention and control groups, group effect) on intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students.

Objective 5: To examine the interaction effect (group*time) of on intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students.

1.7 Research Hypotheses

(1) The Chinese-translated versions of PESAS, EBQ, CE, and MTYQ are valid among university students based on confirmatory factor analysis.

(2) There are significant path relationships between sport anxiety, exercise beliefs, coping effectiveness, and mental toughness in Chinese university students.

Phase 2

(3) There is a significant time effect on intervention of the exercise and music

combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

(4) There is a significant group effect (intervention vs control groups) on intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

(5) There is a significant interaction effect (group*time) on intervention of the exercise and music combination on sport anxiety, exercise beliefs, coping effectiveness, and mental toughness among the Chinese sport anxiety university students?

CHAPTER 2

LITERATURE REVIEW

2.1 Measurement of intervention

2.1.1 Measurement of exercise intervention

The Intensity required for exercise intervention. According to a randomised controlled pilot study of a high-intensity and multimodal exercise intervention, the high-intensity exercise intervention consisted of warm-up exercise (30 minutes), obstruction training (45 minutes), and cardiovascular training (15 minutes), low intensity exercise interventions included relaxation (four times per week, 30 minutes per time), physical awareness and restorative training (one time per week, 90 minutes per time), and massage (two times per week, 30 per time), and high and low-intensity exercise interventions can be cross intervened (Adamsen et al., 2009). The purpose of each study was different, and the subjects targeted varied therefore the intensity of the exercise intervention varied among each investigator. Another study of exercise interventions for high-intensity training was to perform an overall 20-minute training consisting of 5 minutes of warm-up and aerobic exercise (Nybo et al., 2010). Second-to-high-vigorous-intensity interventions include power training, gymnastics, enhanced PE classes and aerobic exercises, secondary-intensity interventions include group sports, bicycle riding, amble and fitness to music, and low-intensity interventions include yoga, Taiji boxing, conditioning or stretching exercises, according to a scoping review of 29 articles which complied with inclusion criteria (Pascoe et al., 2020).

The Frequency required for exercise intervention in the overall intervention

process is a significant means of intervention. In a study of an exercise intervention for neck pain, investigators recommended exercising at least 3 times per week (O'Riordan et al., 2014;Mora-Gonzalez et al., 2024). In a systematic review of exercise interventions, the nine screened papers showed that the frequency of exercise interventions was 3-5 times per week (Batalik et al., 2021). In a systematic review of exercise interventions to reduce visceral fat, findings showed that exercise frequency 3 times per week was effective in reducing visceral fat (Chang et al., 2021).

The time period required for exercise intervention in the overall intervention process is an effective measurement range. Time period required for exercise intervention in the overall intervention process. In a study on exercise self-efficacy and exercise behavior of the elderly during and after the strength training intervention program, the intervention time was 3-12 months (Neupert et al., 2009). Exercise intervention for three to six months found that the exercise intervention had a positive effect on the overall quality of life of rehabilitation patients (Gillison et al., 2009). In a study evaluating an exercise intervention on thigh muscle volume and anatomical cross-sectional area, participants trained and performed a 12-week exercise intervention in strength, endurance, or autogenic training (Hudelmaier et al., 2010). In a meta-analysis, study duration was 12-24 weeks in 13 studies with literature available (Singal & Anand, 2010). In a systematic literature review of exercise interventions, a total of 17 of the included literature analyses yielded valid results for exercise interventions ranging from 4 weeks to 1 year (Sun et al., 2021). In an exercise intervention on anxiety and depression in adolescent patients, the intervention period was 6 weeks (Philippot et al., 2022). In previous literature, the time period of exercise intervention experiments was between 4 weeks and 1 year.

Summarising from the literature, the measurement of exercise interventions

needs to be designed in terms of time, frequency, and intensity. The three aspects of time, frequency, and intensity are not individually present, and a low-intensity exercise intervention can also become a high-intensity exercise intervention if it is involved at the wrong time and frequency Thus, these three aspects need to be combined precisely with the research subjects and the research content to make an appropriate exercise intervention. According to previous literature, the process of exercise intervention can range from 4 weeks to 1 year. Since the objects of the intervention are different, the research objects and research content should be fully considered when designing the exercise intervention time. From the frequency of exercise interventions, a large number of the research literature had an exercise intervention frequency of 3-5 times per week, but from the design of the exercise intervention, it is most appropriate to set the weekly frequency according to the investigator's needs. In terms of the intensity of exercise intervention, high-intensity, medium-intensity, and low-intensity are all effective means of intervention. Different intensities of these interventions can interfere with human bones, muscles, blood, and psychology to varying degrees. Therefore, according to the content of the study and the needs of the investigators are used to determine the most suitable exercise intervention intensity for their own research.

2.1.2 Measurement of music intervention

Multitype music selection is also a weighty consideration when designing music interventions, as inappropriate music may bias intervention effects. In the music intervention design, in order to ensure the integrity of the music intervention, participants can independently choose their favorite type of music (Clark et al., 2006; Hanser & Thompson, 1994; Wilson, 2024). In a study, experimental group 1 was only allowed to use one type of music, while experimental group 2 could choose the type of

music they liked, and finally experimental group 2 achieved better results than experimental group 1 (Ledger & Baker, 2007). Thus, the choice of music type influenced the efficacy of the intervention. When the music type has been determined, the latter steps need to be determined. In a narrative review of the literature in 2010, the music intervention steps can be as follows: mode of delivery, frequency/dose/length of time, study I and controls for environmental factors, application of control groups, and supervision by the study group (Tang & Vezeau, 2010). When the study design and controls for environmental factors, application of control groups, and supervision by the study group p are determined, it is necessary to determine the mode of delivery, frequency/pose/length of time according to the research content when designing music intervention, which is a primary problem to be solved.

In a systematic review of studies, researchers found three types of music interventions: music hearing, interactive musical therapy and extemporaneous music treatment (Mayer et al., 2021). The mode of delivery is also a primary music intervention factor to be addressed. Music intervention can also be divided into active music therapy and passive music therapy (Aalbers et al., 2017; Schneible et al., 2021). Active music therapy refers to the active participation in music, such as active participation in music such as singing and playing musical instruments. Passive music therapy involves passive input of music through headphones by the participant. In the musical intervention form of active music therapy, participants are encouraged to participate in the musical experience. In the music intervention form of Passive music therapy, participants are encouraged to listen to music (Kenyon, 2007). Active music therapy demanded patients to participate in the music rhythmically; by comparison, passive music therapy demanded patients to listen to music (McPherson et al., 2019).

Therefore, when choosing the mode of delivery of music, in order to maximize the intervention effect, it is necessary to choose the mode of delivery of music in combination with the intervention method.

In a literature review study, the music intervention frequency was summarized as three types: (1) one-time intervention frequency, (2) Frequency of multiple interventions in the short term, and (3) Frequency of multiple interventions in the long term (Tang & Vezeau, 2010). In a music intervention experiment, the researchers conducted a total of 10 weeks of exercise intervention on the participants, once a week, 30 minutes each time, a total of 300 minutes (Sakamoto et al., 2013). According to a study, 30 days of music intervention, 30 minutes per day, proved that music intervention has a therapeutic effect on neurocognitive function (Yang et al., 2018). In another study, participants were required to attend a 16-week training course for 45 minutes per week, unlike other experiments, participants were required to maintain music lessons for 30 minutes per day or 3 hours per week for 16 weeks (Bugos, 2019).

Therefore, when designing music intervention, it is necessary to fully consider the multitype music selection, the mode of delivery, frequency, pose, length of time in music intervention. According to the requirements of Multitype music selection, researchers need to try their best to meet the music selection requirements of the participants, so as to maximise the effect of the experimental intervention. The mode of delivery has a variety of intervention methods, such as passive music therapy and active music therapy, which are mainly reflected in music hearing, interactive music therapy and extemporaneous music treatment. In music intervention, the duration of each intervention is generally 30 minutes, and the intervention process is generally 10 weeks or more. The frequency of intervention can be used (1) one-time intervention frequency, (2) Frequency of multiple interventions in the short term, and (3)

Frequency of multiple interventions in the long term. Therefore, when designing the intervention in this study, all factors must be fully considered to ensure the effect of the intervention.

2.1.3 Measurement of the combination of exercise and music intervention

Comparatively, both music and exercise interventions have demonstrated effective outcomes within their respective domains. For instance, both have shown the potential to enhance individuals' mental health, reduce anxiety, and improve physical well-being on psychological and physiological levels (Dingle et al., 2021; Herbert, 2022).

Exercise intervention has shown notable effects on physiological functions (Radak et al., 2019). There are various types of exercise intervention methods, such as high-intensity interval training (HIIT), endurance training, strength training, and combined strength and endurance training. These interventions influence individuals' physiological systems in different ways, including improving cardiopulmonary function, muscle strength, bone health, cardiovascular function, and metabolic efficiency (Mesfen & Melkamu, 2024). Exercise intervention also has beneficial effects on psychological outcomes. It can effectively reduce anxiety and depression levels, enhance mental health, promote a sense of well-being, and significantly improve cognitive function (Ren & Xiao, 2023).

Music intervention also has significant effects on the psychological level (Bradt et al., 2021). It is widely recognized that music intervention can alleviate individual anxiety levels; especially in medical or rehabilitation settings, music intervention can serve as a non-pharmacological method to reduce depression levels (Lorek et al., 2023; Okoro, 2022). Some studies have pointed out that appropriate music intervention can effectively regulate participants' emotions, thereby relieving negative emotions such

as anxiety and improving mental health (Chen et al., 2024; De Witte et al., 2022; Zhang et al., 2022). Music intervention also has many applications on the physiological level, such as improving sleep quality and relieving physical pain (Santos et al., 2012).

Combined intervention refers to the integration of two or more intervention modalities (Villalobos & Chambers, 2023). As a form of multimodal intervention, it works by leveraging the synergy of different intervention methods to act upon the target outcome, thereby promoting better research results (Villalobos & Chambers, 2023). In current research, compared to single-mode interventions, combined interventions are increasingly favored by researchers, as they tend to produce more optimal effects than standalone methods (Roach et al., 2022).

Exercise interventions are primarily oriented toward physiological aspects, influencing not only physical health but also psychological factors (Mesfen & Melkamu, 2024). Conversely, music interventions are more psychologically oriented, often providing soothing or motivational effects (Chen et al., 2024; De Witte et al., 2022; Zhang et al., 2022). Although the combination of exercise and music interventions requires the development of tailored intervention parameters for different populations—such as the frequency, duration, and intensity of exercise, as well as the type, intensity, and rhythm of music—this combined approach remains a critical direction for future research.

Integrating exercise and music interventions provides a more personalized and flexible intervention strategy, offering significant potential in non-clinical and non-pharmacological settings. It opens up broad prospects for development as a viable and effective intervention model in contemporary and future research.

2.2 Physical Education and Sport Anxiety Scale (PESAS)

2.2.1 Definition of PESAS

PESAS is a mature scale for sports anxiety with reliable validity and reliability, and each subscale has good internal consistency. PESAS has three factors and 18 items. This scale can well evaluate the sports anxiety of individuals in general sports activities or school sports activities. This scale can well evaluate the level of sports anxiety of individuals and distinguish which factors cause sports anxiety, such as cognitive processes, worry, and somatic anxiety of sports anxiety. Cognitive processes are part of sports anxiety. Cognitive processes are to evaluate the cognitive ability of individuals to sports training tasks or sports pressure. The cognitive processes include memory and attention. Researchers determine the degree of sports anxiety of individuals by detecting whether athletes have memory loss or whether they can concentrate. Worry is another dimension of sports anxiety. Worry can evaluate the negative emotions of individuals when facing sports training tasks or sports pressure. In addition, worry can also evaluate the degree of sports anxiety of individuals before facing sports activities, which include competitive sports, school sports and general sports activities (Lima et al., 2015; Zheng, 2024). Somatic anxiety is also a dimension of sports anxiety. This dimension mainly evaluates the level of sports anxiety or physical tension when an individual faces sports training tasks or sports pressure. A 5-point Likert scale is used in PESAS, with scoring items ranging from 1 (strongly disagree) to 5 (strongly agree).

2.2.2 The theoretical foundation of PESAS

Anxiety is a negative factor that has both internal and external manifestations. The internal manifestation is that individuals experience negative emotions such as

tension, worry, and uneasiness in their minds, and the external manifestation is that individuals experience muscle contractions and sudden acceleration of heartbeats in their bodies (American Psychiatric Association, 2013). Once an individual's psychology or body is negatively affected, the individual will experience physiological or physical incoordination, such as decreased cognitive ability, emotional instability, physiological function disorders, and sport coordination disorders (Liew et al., 2019; Mesquita & Todt, 2000; Weinberg et al., 2016). For anxiety, the factors that cause anxiety are not only sports pressure, but also general exams, speeches, or social phenomena. However, for sports anxiety, the emergence of sports anxiety is generally caused by sports-related activities (Martens, 1977; Zhang et al., 2024).

The multidimensional theory of sports anxiety has been widely accepted by scholars, but in the early stage of sports anxiety research, scholars believed that sports anxiety was a single-dimensional factor, so people could not distinguish sports anxiety states well in the early stage. As the research continued to deepen, scholars began to believe that sports anxiety was a multidimensional factor, and focused on two dimensions, so they began to distinguish sports anxiety into somatic anxiety and cognitive anxiety (Burton, 1998; Martens et al., 1990; Smith et al., 2006). However, during this period, the three-dimensional factors of sports anxiety also began to appear. Tsorbatzoudis et al. (2001) developed a three-dimensional measurement scale: Physical Education Trait Anxiety Scale (PETAS). The three-dimensional factors of this scale are cognitive anxiety, somatic anxiety, and worry. Worry began to be used as an evaluation standard for sports anxiety. Norton et al. (2004) developed a scale with three dimensions factors: Physical Activity and Sports Safety Scale. Smith et al. (2006) developed a three-dimensional sports anxiety scale: Sports Anxiety Scale