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Physical education and sport anxiety state scale: psychometric properties of the Chinese version

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Purpose: This study aims to translate the Physical Education State Anxiety Scale (PESAS) into a Chinese version and conduct an empirical analysis using existing research methods

Methods: The subjects of this study were 755 college students, consisting of 222 males and 533 females (SD = 2.3). This study translated PESAS into Chinese using standard forward and backward translation procedures to ensure strong consistency between the translated and original versions. Confirmatory factor analysis (CFA) was carried out using Mplus 8 software.

Results: The CFA results of the hypothesis model of PESAS-C were consistent with those of the original PESAS. The fit indices of RMSEA and SRMR were within acceptable ranges, and no items were excluded from the three dimensions. The composite reliability of the Chinese version of PESAS ranged from 0.912 to 0.931.

Conclusion: The PESAS-C is valid and reliable, and the 18-item content in the three dimensions of this version is suitable for assessing motor anxiety in Chinese students.

Key Words: Physical education and sport anxiety; Psychometric properties; Confirmatory factor analysis; Chinese language

Introduction

Anxiety is usually manifested by physical symptoms, such as rapid heartbeats, muscle contractions, worry, and restlessness, often accompanied by

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negative emotions (American Psychiatric Association, 2013). This negative emotion directly affects the physical or psychological factors of the body, leading to the emergence of motor coordination disorder, the decline of cognitive ability, the disruption of physiological function, and the rapid change of emotion (Liew et al., 2019; Mesquita & Todt, 2000; Weinberg et al., 2016). Many common factors, such as exams, sports, speech, and social networking, usually cause anxiety. These factors typically give people a certain amount of pressure, which leads to anxiety. Sports anxiety is the negative emotion experienced by athletes or people with sports pressure – a feeling of anxiety or tension defined by exercise – such as sports standard tests (Martens, 1977).

Although sport anxiety is caused by exercise stress, the impact of sport anxiety is multi-faceted; thus, the evaluation of sport anxiety needs to be evaluated from multiple dimensions. The multidimensional theory of sports anxiety evaluation has been acknowledged by scholars. However, in the early stages of the research, sports anxiety was considered to be one dimension. Later, multidimensional research focused on the two dimensions (somatic dimension and cognitive dimension) (Burton, 1998; Martens et al., 1990; Smith et al., 2006). However, a three-dimensional scale appeared during the same period: the Sports Anxiety Scale (SAS). Smith et al. (2006) identified the three dimensions of SAS as worry (7 items), physical anxiety (8 items), and inattention (5 items). These three dimensions were generated for specific sports, and the sports anxiety experienced by sports people due to the stress of the particular sports (Smith et al., 1990). Subsequently, Tsorbatzoudis et al. (2001) created the Physical Education Trait Anxiety Scale (PETAS), a three-dimensional scale for cognitive anxiety, somatic anxiety, and worry (Tsorbatzoudis et al., 2001). The Physical Activity and Sports Safety Scale was later proposed (Norton et al., 2004). Barkoukis et al. (2005) developed the Physical Education State Anxiety Scale (PESAS), which includes three dimensions: somatic anxiety, worry, and cognitive processes. It is noteworthy that the development of PESAS is inspired by the multidimensional anxiety theory (Martens et al., 1990), which comprises two dimensions: somatic anxiety and cognitive processes. These two dimensions effectively assess anxiety in physical education classes. However, since physical education involves both sports activities and education, Barkoukis et al. (2005) added the dimension of worry to PESAS. With the inclusion of the worry dimension, capable of assessing individuals' anxiety states before engaging in physical activities. PESAS can not only detect anxiety in physical education classes but also evaluate anxiety in general sports activities effectively.

Although anxiety scales developed by other authors appeared later in the literature, they were less innovative and less widely used. The PESAS is

an effective and reliable scale for evaluating sports anxiety, and the evaluation tool is essential for sports. After years of research, PESAS has become an effective tool for assessing students' anxiety, relying on three dimensions: dependable and newest (Abbassi et al., 2022). The original version of PESAS demonstrates sufficient validity and reliability (CFI = .92; RMSEA = .06; Cronbach's alphabetween .79 and .83). PESAS has been applied to many countries or groups with different language backgrounds, resulting in many versions, such as the Finnish language version (Yli-Piipari et al., 2009) met the criteria for validity and reliability (CFI = 0. 93; RMSEA = 0.07; Cronbach's alphabetween 0.76 and 0.88), the Portuguese language version (Lima et al., 2015) possessed excellent validity and reliability (CFI = 0. 90; RMSEA = 0.57; Cronbach's alphabetween 0.82 and 0.88), and the Arabic language version (Abbassi et al., 2022) also exhibited strong validity and reliability (CFI = 0. 94; RMSEA = 0.04; Cronbach's alphabetween 0.87 and 0.92). Most of these studies used exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to obtain their validation results, which were consistent with the population in the region. Therefore, PESAS was applied in this study to analyze sport anxiety in Chinese people.

In 2020, according to China's seventh census results, the number of people in China exceeded 1.4 billion (Bulletin of the Seventh National Population Census, 2021). As a country with a large population, the research of China's sports anxiety is of significant importance to the academic community. In China, the physical education curriculum has been promoted to the third main primary and secondary school curriculum, accounting for 10–11% of the total curriculum (Compulsory Education Curriculum Plan, 2022).

According to the "2020 National Fitness Activities Survey Report" released by the China National Fitness Monitoring Center in 2022, the proportion of residents aged 7 and above who regularly participate in physical exercises is 37.2%. In urban areas, this proportion is 40.1%, while in rural areas, it is 32.7%. The percentage of people regularly participating in physical exercises has increased by 3.3% compared to the survey conducted six years ago. Although the increase in urban areas is relatively small, there has been a substantial increase in the proportion of people in rural areas engaging in regular physical exercise. For children and adolescents aged 7 to 18, the primary sports activities are running (15.6%), skipping rope (11.2%), badminton (10.3%), brisk walking (9.9%), and table tennis (6.6%). Among adults, walking and running are the top two participation activities, accounting for 22.7% and 19.8%, respectively. Other activities include badminton (8.9%), cycling (7.3%), and basketball (5.4%). As for the elderly, the main sports activity is brisk walking, accounting for 41.6%. Other activities in-

clude running (14.7%), square dancing (8.0%), cycling (3.8%), and badminton (3.1%) (National Fitness Activities Survey Report, 2022).

The increase in sports participation also leads to a rise in the proportion of sports anxiety. This is because sports participation inevitably involves factors such as exercise intensity, duration, type, and environment, all of which impact psychological health outcomes (Chi & Wang, 2022). Therefore, the sports anxiety faced by the Chinese people has been increasing. Given the robust validity and reliability of the original PESAS, as well as the stability of its three dimensions, translating the PESAS into Chinese language can be considered a mature initiative. This endeavor not only enhances its validity and reliability but also amplifies the impact of the PESAS through its utilization by a broader population. This will be advantageous for expanding the influence of the original version of PESAS and for advancing scientific research aimed at mitigating sports anxiety among the Chinese population.

Verifying the use of PESAS in China is essential for assessing the sports anxiety faced by Chinese sports people. This research aims to translate PESAS into a Chinese version and conduct an empirical psychometric evaluation study using existing research methods. The Chinese version of PESAS (PESAS-C) needed to be adapted in language translation but also translated in combination with the Chinese cultural background. The validity and reliability of the PESAS-C, which consists of three dimensions (cognitive processes, worry, and somatic anxiety) with a complete set of 18 items, was confirmed through CFA and composite reliability.

Methods

Participants

A total of 755 Chinese college students were invited to participate in the questionnaire survey. The mean age was 20 years. There were 222 males (29.4%) and 533 females (70.6%).

Questionnaire Translation

Standard forward and backward translation procedures for cross-cultural research (Brislin, 1970; Kuan et al., 2019) first, this study identified a translation committee consisting of two professional translators and five experts proficient in English and Chinese. Second, one of the professional translators performed forward translation, while the other professional translator performed backward translation. The translation procedure on the 18 items of the original version of PESAS ensured consistency between PESAS-C and the original version of PESAS. Third, the committee reviewed the translation results and evaluated the PESAS-C

content to ensure that the PESAS-C met the Chinese population's geographical, linguistic, and cultural requirements. Lastly, this study pre-tested PESAS-C among 10 college students who were asked to comment on the questionnaire. The comments mainly reflected the clarity of the questionnaire, the error rate of text or grammar, and the understanding of the presented paragraphs. The pilot participants found the pre-test results ideal, indicating that the 18 items of the PESAS-C were straightforward and easy to understand, needing no modification.

Data Collection

Participation in this study was entirely voluntary, and data collection was conducted according to the ethical standards of the 1975 Declaration of Helsinki (Office of the Historian, 1975). Before the distribution of the questionnaire, this study conducted a questionnaire teaching for the participants to ensure that each college student could fully understand the essential contents of the questionnaire. In addition to the 18 items of the original study, the PESAS-C questionnaire included the gender and age of the students. The questionnaire was designed to be completed anonymously to ensure the security of the participants' information. No rewards were offered to the participants for participation. The researchers distributed 1055 questionnaires and received 955 questionnaires, of which 755 were usable for data analysis.

Measures

Demographic Information

The study administered several demographic inquiries to assess the personal attributes of the participants, such as their age and gender.

Physical Education and Sport Anxiety Scale (PESAS)

PESAS-C is the Chinese translation version of PESAS. The original version of the PESAS has satisfactory reliability and validity. PESAS-C continues to use the three dimensions (18 items) of the original version of PESAS: cognitive processes (6 items), worry (6 items), and somatic anxiety (6 items). The cognitive processes dimension was mainly used to assess participants' cognitive abilities, such as memory and attention, under the pressure of exercise. The worry dimension considered participants' negative information about motor tasks when they were under exercise pressure. In these three dimensions, PESAS contributes by effectively distinguishing cognitive processes and worry. In the original questionnaire, cognitive processes can effectively detect sport anxiety in physical education. It is worth noting that worry, as a component of PESAS, can assess individuals' anxiety states before engaging in sports activities, such as tests, competitions, exams, training, and even general sports activities (Lima et al., 2015). The somatic anxiety dimension was used to assess the tension of participants in somatic anxiety under the pressure of exercise. This questionnaire used a 5-point Likert scale. The project score was 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree.

Statistical Analysis

Mplus 8 software was used for the statistical analysis in this study. All the questionnaire values were confirmed three times to ensure that the values were correct and that there were no missing values. There are 18 items with three factors in the PESAS-C measurement model. A standardized factor loading of more than 0.5 in CFA is considered acceptable (Hair et al., 2009).

The CFA model fitness of PESAS-C was checked using several fit indices. The Tucker and Lewis index (TLI) > 0.90 (Kim et al., 2020), the root mean square error of approximation (RMSEA) was < 0.08 (McNeish et al., 2018), and the standardized root mean squared residual (SRMR) <0.08 (Lee et al., 2021). Convergent validity was assessed using composite reliability (CR) and average variance extracted (AVE). CR, based on Raykov's method, is computed for the final measurement model (Raykov & Marcoulides, 2016). The acceptable range of CR is 0.70 and above (Hair et al., 2009), and the AVE is 0.50 and above (Fornell & Larcker, 1981).

Discriminant validity was checked by inspecting the correlation between the factors in the final measurement model of PESAS-C. Discriminant validity is achieved when the correlation coefficients between factors are not too high ≤.85 (Brown, 2015).

Results

Basic Description of Confirmatory Factor Analysis

As can be seen in Table 1, CFA was carried out for a total of 3 dimensions and 18 items. The adequate sample size for this analysis was 755, which met the research requirements.

Assumption Checking of CFA (Normality of Data Distribution)

Before conducting the CFA, the researcher ensured that the assumptions were checked in Mplus 8. Table 2 presents the descriptive statistics of all 18 items and their values on skewness and kurtosis. The results of the

Table I
Basic Description of CFA

Variables	Items
Somatic anxiety	6
Worry	6
Cognitive processes	6
Total	18
Sample size	755

TABLE II
Descriptive Statistics, Skewness, And Kurtosis For PESAS-C

N	Mean	SD	Skewness	Kurtosis
Q1	2.52	1.074	.503	-.193
Q2	2.32	1.109	.864	-.212
Q3	2.78	1.134	.346	-.479
Q4	2.51	1.111	.610	-.177
Q5	2.21	1.016	.887	.605
Q6	2.75	1.147	.342	-.523
Q7	2.50	1.066	.598	.037
Q8	2.21	1.061	.940	.484
Q9	2.75	1.158	.331	.544
Q10	2.43	1.074	.668	.091
Q11	2.22	1.055	.972	.626
Q12	2.74	1.143	.363	-.465
Q13	2.50	1.094	.516	-.295
Q14	2.14	.997	1.061	1.023
Q15	2.74	1.155	.316	-.516
Q16	2.53	1.081	.550	-.098
Q17	2.32	1.029	.890	.566
Q18	2.69	1.115	.345	-.420

Mardia multivariate skewness and kurtosis test, with a p-value less than 0.05, indicated that the assumption of multivariate normality was not met. To address this issue, we used the MLR estimator, which provides maximum likelihood parameter estimates with standard errors and a chi-square test statistic that is robust to the non-normality and non-independence of observations (Rosseel, 2010). Thus, subsequent CFA analyses were performed using the MLR estimator.

CFA was carried out in this study to examine the relationship between the latent and observable variables of this model. The three dimensions were latent variables, and the 18 items of the instrument were observable variables. This study reports standardized factor loading coefficient values to represent the correlation between latent and observed variables (items). Figure 1 shows that the factor loading coefficient range is between 0.681-0.931. The loading coefficient values indicate a strong correlation between the latent and observed variables in this model.

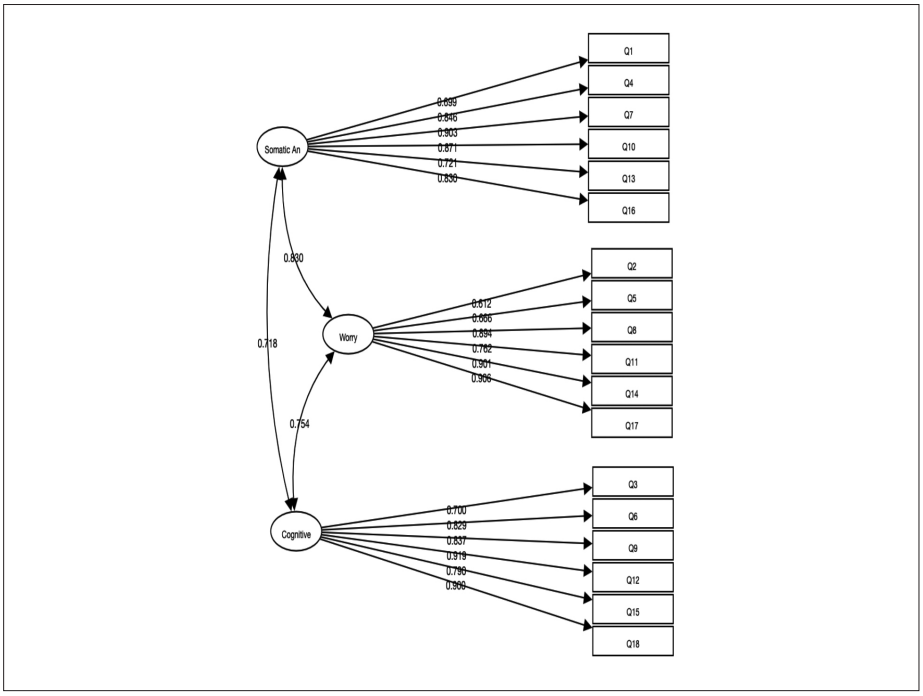

Fig. 1. - *PESAS-C measurement model*

The model fits the data well, with the majority of the fit indices within the acceptable range (CFI = 0.947, TLI = 0.932, SRMR = 0.049) (Table 3). No problematic items were found during the CFA analysis; thus, no items were removed.

Table 4 shows that the AVE values for the three dimensions were 0.665, 0.638, and 0.693, respectively. The CR values were 0.922, 0.912, and 0.931, respectively. The AVE values of PESAS-C were greater than 0.5, and the CR value was higher than 0.7, which indicates that the PESAS-C model had a solid convergent effect. Thus, the evidence supports the convergent validity of the PESAS-C measurement model.

TABLE III
Fit Indices of the Final Measurement Model for PESAS-C

Model	RMSEA (90%CI)	SRMR	CFI	TLI
PESAS-C	0.079(0.073 ~ 0.084)	0.042	0.947	0.939

TABLE IV
Average Variance Extracted (AVE) and Composite Reliability (CR)

Variables	AVE	CR
Somatic anxiety	0.665	0.922
Worry	0.638	0.912
Cognitive processes	0.693	0.931

The factor correlations were 0.755 between somatic anxiety and worry, 0.670 between somatic anxiety and cognitive processes, and 0.728 between worry and cognitive processes. All correlation values were below 0.85, indicating good discriminant validity of the final PESAS-C measurement model.

Discussion

The purpose of this research is to translate PESAS into the Chinese version and conduct empirical research using existing research methods. The PESAS-C was developed as a mature tool for the Chinese region to assess the sports anxiety of people in this region. According to previous studies, the original PESAS has often been verified as effective and reliable. This study translated PESAS into Chinese through standard forward and reverse translation procedures to ensure strong consistency between the translated and original versions. After the participants completed the PESAS-C, CFA was carried out using Maples 8 software. According to the statistical analysis of the PESAS-C model's entire data, this study confirms that the model is valid and that the factor structure is robust. PESAS-C fills the gap of the original PESAS in the assessment of sports anxiety in China and provides an effective sports anxiety assessment tool for people or scholars in China so that experts or scholars can more comprehensively and effectively evaluate the sports psychological state of the population. Through the examination using CFA in this study, it is indicated that PESAS-C can be effectively applied within the context of China. However, in future research, there is potential to expand the assessment of sports anxiety among diverse Chinese populations using PESAS-C. While the original version of PESAS has undergone numerous validations, affirming its stable validity and reliability, PESAS-C would benefit from further empirical support through additional data.

CFA ensures a definite model architecture, which is verified by calculation using a formula that assesses whether the model architecture is reasonable and appropriate (Thompson, 2004; Kuan et al., 2020). Therefore, prior

to CFA, the model architecture must exist (Preedy & Watson, 2010). The dimensions of PESAS are known and confirmed, and each variable is also well-determined, justifying the use of CFA in this study. In the confirmatory examination, this study demonstrated that 18 items in three dimensions fit well with the data and confirmed the validity and reliability of PESAS-C, indicating that the factor analysis results of the PESAS-C model were satisfactory. According to the CFA results, this study determined that PESAS-C effectively distinguishes among the three dimensions. This outcome aligns with the original author's findings, providing support for the inclusion of the "worry" dimension in the original version of PESAS as an enhancement for differentiating anxiety states. Furthermore, it illustrates that "worry" can more accurately detect individuals' anxiety states related to general sports activities and, of course, can also assess sports anxiety manifested during sudden physical challenges in physical education classes. This constitutes a significant contribution to PESAS. Another notable contribution is the capability of "Cognitive processes" to precisely measure sports anxiety during physical education classes.

In PESAS cross-cultural research, most other versions of PESAS use Cronbach's alpha reliability analysis. The present study used the reliability analysis of the CR formula in the PESAS-C version (Raykov & Marcoulides, 2016) because Cronbach alpha may give a wrong value for scale reliability in use, such as a value that is too high or too low (Raykov, 1998); thus, scholars have recommended including the CR in the CFA model reliability test (Wang & Wang, 2012). In this study, the data results of the PESAS-C version were as follows: somatic anxiety (CR = 0.922, AVE = 0.665), worry (CR = 0.912, AVE = 0.638), and cognitive processes (CR = 0.931, AVE = 0.693). The AVE values of the three dimensions in this study were greater than 0.5, and the CR values were more significant than 0.7 (Hair et al., 2009), indicating that this measurement scale's data had excellent convergent validity. This implies that PESAS-C not only exhibits convergent validity similar to the original version but also suggests that PESAS-C is highly applicable for use among the Chinese population. The PESAS-C version of this study retained 18 items and three dimensions of the original PESAS. The PESAS-C is comparable with other PESAS versions, such as the Bosnian language version (Orlić et al., 2018), the Finnish language version (Yli-Piipari et al., 2009), the Portuguese language version (Lima et al., 2015), and the Arabic language version (Abbassi et al., 2022), which were based on data analysis, with almost all items and dimensions preserved. All original PESAS dimensions and items were retained in this study. In the factor loading factor analysis, a standardized loading factor value greater than 0.7 indicates good convergent validity (Nu-

sair & Hua, 2010).This implies that PESAS-C further substantiates PESAS as a reliable tool for assessing sports anxiety.

The results of PESAS-C were satisfactory. It can effectively evaluate the state of sports anxiety in the Chinese population and provide data support for psychological interventions for people with sports anxiety. However, it must be acknowledged that this study has certain limitations. First, the population China has exceeded 1.4 billion in 2019, but the sample size of this study was 755. Thus, the overall sample size does not represent the population of 1.4 billion people in China. Therefore, follow-up studies should expand to include a larger sample size. Additionally, PESAS-C could explore expanding the scope of the PESAS studies. Leveraging the specificity of its three dimensions, the research can not only assess sports anxiety during physical education classes but also investigate participants' sports anxiety in general sports activities within comparable environments. This would make a substantial contribution to the ongoing development of the PESAS.

Second, there was no comparison between men and women in this study, although men and women are known to have different sports anxiety states (Correia & Rosado, 2019)specifically its relations with sociodemographic variables, has been fruitfull in sport psychology research. This study aimed to investigate athletes' sport anxiety regarding differences in gender and sport played. An application of structural equation modeling was made, with 601 Portuguese athletes. From them 172 (28.6%, and the proportion of men and women in this study was quite different. Thus, future studies should further validate the PESAS-C regarding differences in sports anxiety between men and women. Third, this study investigated only 18–22-year-olds; substantial differences have been reported in different age groups (Dias et al., 2010). Therefore, future research should explore the differences in sports anxiety among other age groups. Finally, due to its nature, this cross-sectional study lacks longitudinal assessments that follow time-dependent changes, which can consolidate the stability of the findings (Koch et al., 2014). Future studies should consider longitudinal assessments of the strength of PESAS-C.

Conclusion

This study demonstrates the reliability and validity of the PESAS-C. The PESAS-C model retained the original three dimensions (18 items) and did not exclude any of the items from the original PESAS. In the future, PESAS-C can be used as an assessment tool for sports anxiety among local populations in China.

Availability of Data and Materials

Data can be made available from the corresponding author upon reasonable request.

Consent To Participate

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Authors' Contributions

ZL, GK, & YCK made substantial contributions to the conception or design of the work and drafted the work. ZL, GK, KZ, & YCK made substantial contributions to the conception or design of the work and revised the work critically for important intellectual content. All authors gave their final approval for the publication of this manuscript and agreed to be accountable for all aspects of the work to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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