

A Preliminary Psychometric Investigation of a Chinese Version of Athlete Engagement Questionnaire (AEQ)

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Received October 10, 2022; Revised November 18, 2022; Accepted December 23, 2022

Cite This Paper in the Following Citation Styles

(a): [1] Chuantong Jiang, Norsilawati Abdul Razak, Nelfianty Mohd Rasyid, "A Preliminary Psychometric Investigation of a Chinese Version of Athlete Engagement Questionnaire (AEQ)," *International Journal of Human Movement and Sports Sciences*, Vol. 11, No. 1, pp. 103 - 111, 2023. DOI: 10.13189/saj.2023.110112.

(b): Chuantong Jiang, Norsilawati Abdul Razak, Nelfianty Mohd Rasyid (2023). A Preliminary Psychometric Investigation of a Chinese Version of Athlete Engagement Questionnaire (AEQ). *International Journal of Human Movement and Sports Sciences*, 11(1), 103 – 111. DOI: 10.13189/saj.2023.110112.

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Abstract Athlete engagement is one of the key indicators of athletes' positive psychology. It plays a crucial role in coping with burnout and disengagement, creating a flow experience, and improving their competitive ability and performance. In the last two decades, a mountain of literature has focused on engagement in different research settings. In the world of sports, the Athlete Engagement Questionnaire (AEQ) has been proven to be a reliable instrument to access athletes' engagement at both amateur and elite levels. The aim of this study is to investigate the psychometric properties of the Chinese version of AEQ. The original English athlete engagement questionnaire was translated into Chinese using the method of back-translation for data collection. Subsequently, 379 samples were performed for data analysis, mainly focusing on confirmatory factor analysis to examine the four-factor and second-order factor structures of 16 items measuring athlete engagement. The results reproduced four components of AEQ, which included a total of 16 items. The instrument demonstrated acceptable composite reliability (.887 to .905) and convergent validity (> 0.5), except that the discriminant validity was slightly insufficient. The results showed that the Chinese version of AEQ as a second-order factor structure is better than the four-factor structure, that is, athlete engagement as an overarching construct composed of four factors: confidence, dedication, enthusiasm, and vigor. The findings offer a useful and reliable instrument for athlete engagement, which helps researchers better capture the experience and engagement of athletes in the

Chinese sports context.

Keywords Athletes, Engagement, Athlete Engagement Questionnaire, Psychometric Properties, Validity, Reliability

1. Introduction

In the last two decades, more and more literature has focused on engagement in the context of different research fields [1]. The concept of engagement originated from employee engagement in organizational psychology [2]. In the organizational psychology literature, there are two perspectives for understanding and evaluating engagement. One theory is that engagement is seen as the opposite of burnout, and the opposite score pattern of the burnout scale is used to measure engagement [3,4]. Another is that engagement is treated as a separate concept, measured by the famous Utrecht Work Engagement Scale [5]. Either way, however, researchers generally agree that increased engagement can provide a positive environment to prevent burnout [6,7]. In sports, although the contemporaneous sports psychology literature rarely mentions athlete engagement, the concept of engagement has been widely adopted in practice for a long time [4,8,9]. Therefore, researches on athlete engagement also prove to be crucial and are receiving increasing attention with the development of the positive psychology movement

[10,11].

Research on athlete engagement in sports settings can provide a framework for reducing athlete burnout [4], optimizing athlete potential [11], and promoting a more positive sports experience [12]. Athlete engagement is often represented as "an enduring, relatively stable sports experience, which refers to generalized positive effect and cognitions about one's sport as a whole" [13,14]. Previous research has found that athlete engagement is related to athlete flow [15], peak athletic performance [16], resilience [17], and motivation [18,19].

However, most of these studies have focused on elite sports contexts, with the target population being either elite athletes or national and regional level athletes. Undeniably, studies on the engagement of elite athletes seem to attract more attention from researchers, such as the athlete engagement questionnaire is a measurement instrument developed for elite athletes [13,14]. Similarly, it is quite necessary to investigate the applicability of the notion of engagement to athletes of all levels, because their athletic performance also comes from systematic, long-term, and intentional field training [20]. Therefore, the antecedents and results of participation of athletes of different competitive levels are also crucial.

Most previous studies of sports participation viewed it as a multidimensional construct, similar to participation in the workplace environment, but at the same time adopted a more extensive interpretation of the notion [21]. In the field of organizational management, three factors (i.e., dedication, absorption, and vigor) have been proposed to define the concept of job engagement [22], with a slight difference that in the sporting context, athlete engagement reflects four interrelated factors (i.e., confidence, dedication, enthusiasm, and vigor) [13,14]. Specifically, Lonsdale and Hodge [13] carried out an exploratory study on 15 elite athletes from New Zealand who had participated in international competitions and developed the AEQ. In subsequent studies, the proposed four-factor structures of athlete engagement were preliminarily validated among elite athletes in New Zealand and Canada [14]. In addition, AEQ has also shown good psychometric properties in Spanish and Portuguese athletes and proved to be a reliable instrument for assessing athlete engagement at both the amateur and elite levels [21,23]. However, considering the cultural differences in different countries and regions, it is likely to limit the item interpretation and factor structure, future studies using AEQ in different contexts should further validate the instrument [14,24].

Considering that only three versions of the existing athlete participation questionnaire are available in English, Portuguese, and Spanish, it is essential to further validate the questionnaire in the context of Chinese sports. In addition, the majority of previous studies centered around the engagement of elite athletes, and few of them focused on the engagement of high school football players. In particular, in the context of the urgent need to improve the

level of campus football participation in the Medium and Long-term Development Plan of Chinese Football (2016-2050), it is found that the enthusiasm of high school students for football began to fade, and even a phenomenon of disengagement occurred. Therefore, it is important and significant to further investigate the engagement of Chinese high school football players. In view of this, the present study aims to preliminarily test the reliability and validity of AEQ among Chinese high school football players, to provide a reliable instrument for the evaluation of the engagement behavior in the Chinese sports context. At the same time, this also provides supporting evidence for the reliability and validity of AEQ in different cultural contexts.

2. Method

2.1. Participants

According to the type of schools and gender of athletes, a group of 500 athletes from 36 academic high schools and 9 vocational high schools was selected by proportional stratified random sampling method. We then collected data on players from 45 men's and 27 women's football teams. All participants volunteered to join the survey under the condition of anonymity. Before completing the informed consent form, all participants (including their parents) were informed of the objectives and procedures of the study. A total of 385 samples were collected and considered suitable for data analysis, they were 228 boys (59.2%) and 157 girls (40.8%) with mean age 16.07, $SD = (1.15)$ years old. In addition, the study was carried out after receiving ethical approval from the Human Research Ethics Committee of Sultan Idris Education University.

2.2. Instrument

The original Athlete Engagement Questionnaire consisted of 16 items evenly distributed in four factors: confidence, dedication, enthusiasm, and vigor [14]. Confidence represents an athlete's belief in his or her ability to perform well and achieve a set goal (e.g., I believe I am capable of accomplishing my goals in sport). Dedication refers to the athlete's desire to put in energy and time in order to achieve his or her goals (e.g., I am determined to achieve my goals in sport). Enthusiasm means that the athlete has a sense of excitement and a high level of enjoyment (e.g., I feel excited about my sport). Vigor refers to the energy or liveliness that an athlete releases physically, mentally and emotionally (e.g., I feel alive when I participate in my sport). Responders rated each item from 1 (strongly disagree) to 5 (strongly agree) on a 5-point Likert scale, with higher values indicating higher level of athlete engagement.

2.3. Procedure

Based on the back-translation method of Brislin [25], the original Athlete Engagement Questionnaire was translated into Chinese. Specifically, the AEQ was translated into Chinese by an experienced Chinese sports psychologist and three PhDs in the field of sports, and the content of the Chinese version was evaluated. The next step was a back-translation by two bilingual translators to ensure the equivalence of the questionnaire items. Subsequently, the differences between the original items and back-translation items were evaluated and compared, showing that the two texts were equivalent in terms of item interpretation. Finally, after further evaluating the content validity of these items through a pilot study, confirmatory factor analysis (CFA) was used to test the construct validity of the Chinese version of the AEQ questionnaire.

2.4. Data Analysis

This study used SPSS Statistics 25.0 and AMOS 24.0 to analyze the obtained data, including descriptive statistics and CFA for athlete engagement. Firstly, the collected sample data were screened, including data entry errors, missing values, outliers, and normality. Based on the suggestion of Hair et al. [26], six cases with univariate outliers were found and removed. Then, CFA was performed, and the maximum likelihood (ML) method was employed to determine the parameter estimation of the CFA model to test the psychometric properties of AEQ instruments. The validation of the measurement model depends on the acceptable levels of fit validity and construct validity [26].

Specifically, the standardized factor loading estimates should ideally be .70 or above, and the average variance extracted (AVE) should be .50 or above to indicate sufficient convergence effectiveness. Also, the composite reliability (CR) should be .70 or above to indicate adequate convergence or internal consistency. The arithmetic square root of the AVE estimate should also be greater than the bivariate correlation to indicate the discriminant validity [27]. Additionally, according to the suggestions of Hair et al. [26], Kline [28], and Jackson et al. [29], the multiple goodness-of-fit indexes were selected to test fit statistics, including chi-square (χ^2), degrees of freedom (df), normed chi-square (χ^2/df), root-mean-square error of approximation (RMSEA), standardized root mean residual (SRMR), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), Tucker-Lewis index (TLI), and comparative fit index (CFI). Cut-off values for fit measures were based on recommendations by Hair, Black [26] to assess whether the model fits the data well.

3. Results

3.1. Descriptive Analysis

As shown in Table 1, descriptive statistical analysis was conducted for each item of AEQ. The mean values for all items ranged from 4.140 to 4.449, demonstrating a high level of engagement among Chinese high school football players. The standard deviation ranged from .737 to .951. Moreover, the skewness ranged from -1.243 to -.522, and the kurtosis ranged from -.746 to 1.099. Hair et al. [26], and Byrne [30] suggest that the absolute values of skewness and kurtosis are less than 2 and 7, respectively, which can be regarded as normal distribution for sample data.

3.2. Confirmatory Factor Analysis (CFA)

The main study was initiated by estimating the four-factor model of athlete engagement proposed by Lonsdale and Hodge [14], namely, the four sub-constructs of confidence, dedication, enthusiasm, and vigor, with a total of 16 items (see Figure 1). Upon checking multiple fit indices, the four-factor model yielded the following fit statistics, $\chi^2 = 234.804$, $p = .000$, $\chi^2/df = 2.396$, GFI = .927, AGFI = .898, CFI = .970, TLI = .963, NFI = .949, RMSEA = .061, SRMR = .038. Although the χ^2 test was significant ($p < 0.05$), meaning that the model was rejected [31], this should be due to the large sample size ($n = 379$) used in the current study [32]. Additionally, the AGFI value did not exceed the cut-off value of .90. Nevertheless, according to Doll, Xia [33] and MacCallum and Hong [34], an AGFI value between .80 and .89 indicates a reasonable fit, while a value of .90 or above is considered evidence of a good fit. Taken together, the results suggested that the athlete engagement measurement model fit the sample data well, and thus the construct validity was further examined.

As shown in Table 2, the results of parameter significance estimation showed that all factor loadings were significant ($p < .001$) and met the requirements of convergent validity. The standardized factor loading estimates ranged from .758 to .885, exceeding the suggested threshold of .70. Also, the square multiple correlations (SMC) ranged from .575 to .783, exceeding the 0.5 standard and indicating an acceptable level of reliability for each item. Next, the composite reliability (CR) values ranged from .887 to .905, all exceeding the .70 cut-off and suggesting adequate reliability for each construct. The average variance extracted (AVE) estimates ranged from .652 to .706, all exceeding the .50 standard. As a result, this evidence supports the convergent validity of the AE measurement model.

Table 1. Descriptive statistics of athlete engagement (n = 379)

Factor	Item	Mean	Standard deviation	Skewness	Kurtosis
Confidence	1. I believe I am capable of accomplishing my goals in sport	4.216	.833	-.783	-.184
	2. I feel capable of success in my sport	4.156	.876	-.736	-.114
	3. I believe I have the skills/technique to be successful in my sport	4.198	.852	-.701	-.363
	4. I am confident in my abilities	4.140	.863	-.522	-.746
Dedication	1. I am dedicated to achieving my goals in sport	4.348	.839	-1.243	.912
	2. I am determined to achieve my goals in sport	4.359	.825	-1.092	.318
	3. I am devoted to my sport	4.277	.951	-1.098	.146
	4. I want to work hard to achieve my goals in sport	4.367	.851	-1.272	1.099
Enthusiasm	1. I feel excited about my sport	4.396	.771	-1.093	.458
	2. I am enthusiastic about my sport	4.406	.737	-.968	.063
	3. I enjoy my sport	4.361	.832	-1.065	.148
	4. I have fun in my sport	4.282	.856	-.883	-.262
Vigor	1. I feel energized when I participate in my sport	4.417	.826	-1.330	.977
	2. I feel energetic when I participate in my sport	4.417	.773	-1.082	.211
	3. I feel really alive when I participate in my sport	4.449	.748	-1.098	.194
	4. I feel mentally alert when I participate in my sport	4.449	.755	-1.101	.149

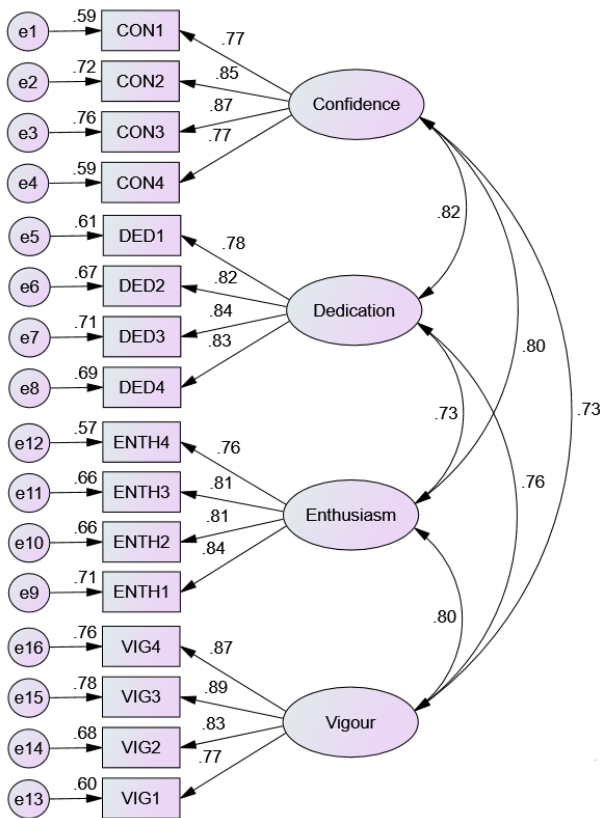


Figure 1. Measurement Model of Athlete Engagement

using the square root of AVE, which can be interpreted as the correlation coefficient of the data within the latent variable. According to Fornell and Larcker [27], if the arithmetic square root of the AVE is greater than the absolute value of the bivariate correlation coefficient, the internal correlation is greater than the external correlation, meaning that there are differences and discriminant validity between variables. As shown in Table 3, the results showed that all diagonal values (bold) were greater than their row and column values, except that the square root of AVE of confidence (.815) was less than the correlation coefficient between confidence and dedication (.816). This indicated that the discriminant validity between confidence and dedication was not sufficient.

3.3. The Second-order Factor Model

Considering that the discriminant validity for certain factors was not supported, and the correlation coefficient of the four factors was between .735 and .816, it reflects that there was a strong or very strong correlation strength between the components measured. Therefore, this indicated that there may be a high-order factor model in this factor model [28]. De Francisco and Arce [23] found that a second-order model of athlete engagement, where the four factors of the AEQ were grouped into a single higher-order factor, also fit the data well. Therefore, the second-order measurement model was also analyzed in the same procedures as the first-order model.

The next step was to assess the discriminant validity

Table 2. The Convergent Validity for Athlete Engagement

Factor	Item	Parameter Significance Estimation				Convergent Validity			
		Unstd.	S.E.	t-value	P	Std.	SMC	CR	AVE
Confidence	Con1	1.000				.766	.587	.887	.664
	Con2	1.162	.067	17.385	***	.847	.717		
	Con3	1.167	.065	18.022	***	.874	.764		
	Con4	1.036	.067	15.452	***	.766	.587		
Dedication	Ded1	1.000				.779	.607	.890	.669
	Ded2	1.032	.061	16.968	***	.817	.667		
	Ded3	1.228	.070	17.622	***	.843	.711		
	Ded4	1.084	.063	17.327	***	.831	.691		
Enthusiasm	Enth1	1.002	.059	16.889	***	.843	.711	.882	.652
	Enth2	.925	.057	16.243	***	.814	.663		
	Enth3	1.041	.064	16.201	***	.812	.659		
	Enth4	1.000				.758	.575		
Vigor	Vig1	.971	.053	18.445	***	.773	.598	.905	.706
	Vig2	.972	.047	20.628	***	.827	.684		
	Vig3	1.007	.043	23.271	***	.885	.783		
	Vig4	1.000				.871	.759		

Note: Unstd = unstandardized factor loading estimates; S.E. = standard error; t-value = critical ratios; *** $p < .001$; Std = standardized factor loading estimates; SMC = item reliability; CR = Composite reliability; AVE = average variance extracted

Table 3. Discriminant Validity and Correlation Coefficients

	Confidence	Dedication	Enthusiasm	Vigor
Confidence	.815			
Dedication	.816	.818		
Enthusiasm	.799	.729	.807	
Vigor	.735	.760	.804	.840

Note: The value of the lower triangle is the Pearson correlation coefficient between constructs and the value on the diagonal is the square root of AVE

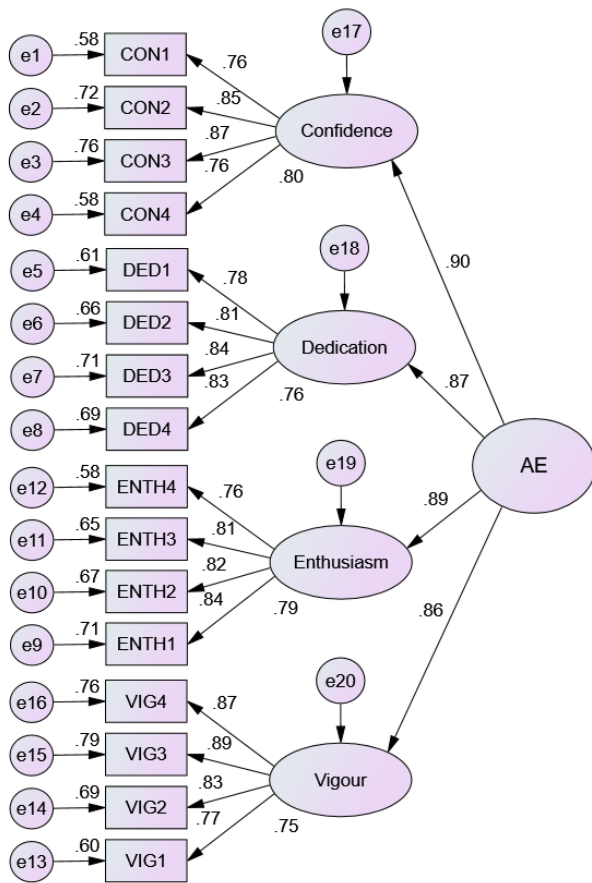


Figure 2. Second-order Model for Athlete Engagement

As shown in Figure 2, standardized factor loading estimates for confidence, dedication, enthusiasm, and vigor ranged between .86 and .90 in the second-order model of athlete engagement. Moreover, the second-order factor model yielded the following fit statistics, $\chi^2 = 255.660$, $\chi^2/df = 2.557$, GFI = .920, AGFI = .891, CFI = .965, TLI = .958, NFI = .945, RMSEA = .064, SRMR = .042. By comparing the first-order construct and the second-order construct, it is found that the fit indices of the two models all meet the requirement of the recommended value, and there is no actual difference. Therefore, the results showed that both models are feasible to evaluate athlete engagement. Nevertheless, the target coefficient (χ^2 ratio of first-order model and second-order model) indicated that 91.8% ($234.804 / 255.660 = .918$) of covariation among the first-order constructs can be accounted for by the second-order construct. Based on Doll, and Xia [33], if the target coefficient is closer to 1, the second-order factor structure can represent the first-order factor structure, making the model more simplified [35]. Therefore, a more parsimonious second-order measurement model can be used to operate athlete engagement preferentially in future studies.

4. Discussion

This study preliminarily investigated the psychometric properties of athlete engagement questionnaires translated into Chinese among Chinese high school football players. CFA results showed that the four-factor structure for athlete engagement fit sample data well. The analysis results in Figure 1 and Table 2 also showed that the factor loading and item reliability of all items, as well as the composite reliability and AVE of four factors, all met the requirements of convergence validity, representing good psychometric properties. The findings of this study are consistent with the results of the initial validity test in English and subsequent validity tests in Portuguese and Spanish [14,21,23,24].

According to the evaluation of discriminant validity using the AVE method, it was found that the discriminant validity between confidence and dedication was not supported. This is mainly due to the very strong correlation between confidence and dedication, with the correlation coefficient between the two factors ($r = .816$) exceeding .7 [28]. Similarly, in the study of Martins, Rosado [24], and De Francisco, Arce [23], there was a very strong correlation ($r = .77$) and a strong correlation ($r = .63$) between confidence and dedication. Given that the two values used to test the discriminant validity were very close (see Table 3) and other results of construct validity, it can still be considered that the Chinese version of the athlete engagement questionnaire had similar psychometric properties to the original version. However, the insufficiency of discriminant validity also proved the necessity of testing the second-order model of athlete engagement.

This finding provides empirical evidence support for the second-order factor structure model of athlete engagement. Comparing the first-order construct and the second-order construct of athlete engagement, the results showed that the target coefficient was close to 1 [33,36], which indicated that athlete engagement can be represented as a single second-order latent construct with four first-order factors: (1) confidence, (2) dedication, (3) enthusiasm, and (4) vigor. Therefore, the results of this study support the conclusion that the second-order measurement model can be used as a whole latent construct of athlete engagement.

Contributions and Implications

The current study extends the literature on athlete engagement by verifying the validity of the Chinese version of the AEQ instrument and also makes it potentially applicable in the Chinese sports context. To the best of our knowledge, the AEQ instrument may only be available in English, Portuguese and Spanish. Considering that each new application of measuring instruments is a contribution to enhancing the theoretical value of this field of study, AEQ should be translated into different languages

and validated in different socio-cultural contexts, thus making cross-cultural comparisons possible.

As an important indicator of athletes' positive psychology, athlete engagement plays an important role in enhancing their competitive ability and improving their sports performance [16]. Previous research has showed that athletes between the ages of 15 and 19 are prone to burnout and even disengagement [37-40]. Given that the original AEQ instrument was developed to investigate elite athlete engagement in a competitive sports setting [13], studies of engagement levels in high school athletes could help identify low-engagement individuals and intervene early before burnout and disengagement risk occurs. Therefore, based on the importance of improving athletic performance and early engagement of athletes, the measurement tools tested in this study are of key significance for strengthening the engagement of Chinese high school football players.

Limitations and Future Research

There may be several limitations to the current study that can be addressed in future research. Firstly, this research only focused on the engagement of Chinese high school football players. In future studies, the applicability of AEQ can be further verified by combining the reality of different groups of athletes in the Chinese social context. Secondly, although the study samples were obtained by proportional stratified random sampling, the samples were from one province in China, and the results may not be universal. Therefore, future research can consider collecting different levels of samples of the target population across the country, or even sample data of athletes from other countries, to compare the validation of the instrument in cross-cultural backgrounds. Thirdly, the gender invariance test was not carried out in this study, which means it is hard to assert that the factor structure of AEQ is the same for different genders. In general, in the Chinese sports context, the validation of AEQ is necessary to provide evidence of consistency between different groups (e.g., gender, competitive level), so as to provide a well-grounded measuring instrument for further research on the antecedents and consequences of athletes' engagement.

5. Conclusions

In conclusion, the preliminary validation of the Chinese version of AEQ can allow investigators to better evaluate the experience and engagement of athletes in the Chinese sports context. This study offers empirical evidence support for the second-order measurement model of athlete engagement, showing that athlete engagement can be expressed as a single second-order latent construct with four first-order factors, namely confidence, dedication, enthusiasm, and vigor. Therefore, the compact second-order factor structure is proved to be a useful and

reliable instrument for the evaluation of athlete engagement. The data from AEQ might provide early warning for burnout and disengagement among Chinese high school football players, and provide basic support for further exploration and implementation of effective intervention measures. In the future, the reliability and validity of AEQ in the Chinese sports context need further research, such as the psychometric investigation of different genders and wider groups.

Acknowledgments

The authors would like to thank all the athletes who participated in the collection of survey data for this study, and also gratefully acknowledge the support of their coaches and schools.

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