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Research on the Construction and Application of an Extension Evaluation Model for the Competitive Ability of Excellent Latin Dancers in China

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Abstracts

A comprehensive understanding and grasp of the Latin dance dominant competitive ability is a prerequisite for the realization of scientific training. Based on the current development trend of Latin dance and combined with the characteristics of Latin dance events, this study established the evaluation index systems for the competitive ability of excellent male and female Latin dance players in China, covering five first - level indicators including body shape, body function, physical fitness, skill, and psychology, by using methods such as literature review, expert interview, Delphi method, testing method, and mathematical statistics. The weight values were determined by combining subjective and objective methods, and a matter - element extension model based on the combination weighting method was established. The weights of the first - level indicators in the evaluation index system of the competitive ability of excellent Latin dance players in China are as follows: body shape (0.186), body function (0.074), physical fitness (0.196), skill (0.450), and psychology (0.094). Finally, this paper applies the evaluation model to conduct an empirical analysis of the overall competitive ability and the development level of each sub - ability of Chinese Latin dance champion players, and calculates the evaluation grade of the players' comprehensive competitive ability. Currently, the evaluation grades of the comprehensive competitive ability of excellent Chinese Latin dance players are all higher than the level variable values. The players' comprehensive competitive ability has not fully reached the current evaluation grade. If the training arrangement is unreasonable and lacks pertinence, there is a possibility that the comprehensive competitive ability of the players will be downgraded. By further evaluating the differences among elements at all levels, the weak abilities affecting the development of players' competitive ability can be found, which provides a reference for players to formulate training plans and improve training quality and efficiency.

Keywords

Extenics; Latin dance; Competitive ability; Evaluation model

1 Introduction

With the accelerated globalization of sport dance and the significant increase in China's comprehensive competitive strength, a systematic study of sport dance competitive ability and each sub-competency is a re-conceptualization of the sport attributes and essential characteristics of the program. At present, the level of competitive strength of the traditional advantageous regions of the world Latin dance has shown a "convergence" trend, the competitive pattern of the group of competitors has taken shape, and Chinese Latin dance has become a new force competing for medals[1]. Comprehensive understanding and grasping of the dominant competitive ability of Latin dance is a prerequisite for realizing scientific training. In view of this, the existing competitive ability evaluation index system and evaluation method are improved, and a set of index system for the evaluation of Latin dance competitive ability is proposed. Aiming at the characteristics of Latin dance events, this study constructs an evaluation index system for the competitive ability of outstanding Latin dance players in China. By combining the combined weighting method with the matter - element extension theory, a matter - element extension model based on combined weighting is constructed and applied in research, providing a reference for the scientific training and talent selection of Latin dance in China.

2 Establishment of the evaluation index system for the competitive ability of excellent Latin dancers in China

2.1 Screening and determination of the evaluation index system of competitive ability of excellent Latin dancers in China

Competitive ability is a complex system, which is an organic aggregate composed of elements such as physical fitness, technique, tactics, psychology, and intelligence, with these elements being interconnected, mutually restrictive, and mutually promotive. Drawing on the "purpose tree" analysis method and the research requirements of the Delphi method, this study, through the collation of literature and expert interviews, combined with the characteristics and development trend of Latin dance specialties, takes "the competitive ability of Latin dancers" as the general objective layer and combines "body shape", "body function", " physical fitness ", "skill", "psychology" and "motor intelligence" as the criterion layer for the evaluation of competitive ability, and on the basis of which the corresponding constituent elements were deduced, and a hierarchical model of the evaluation index system of Latin dance players' competitive ability was preliminarily established. It contains 6 first-level indicators (criterion level) of body shape, body function, physical quality, skill, psychology and motor intelligence, 18 second-level indicators (element level) and 46 third-level indicators (indicator level). In accordance with the relevant requirements of the Delphi method, the above preliminary pre-selected indicators were designed to complete the questionnaire of experts' opinions, and the five-level scale of LIKERT was adopted to invite experts to evaluate the importance of each indicator respectively. On the basis of relevant research results[2-5], "the degree of concentration of expert opinions" and "the degree of coordination of expert opinions" were used as important bases for the selection of indicators in this study. After the statistical analysis of the results of the second round of expert

consultation, the expert concentration (*Mj*) and expert coordination (*Vj*) of the indicators at all levels meet the criteria for the selection of the indicators, and the consistency test of Kendall'W coefficient is $P < 0.01$, which meets the statistical requirements. The "Evaluation index system of the competitive ability of China's outstanding Latin dancers", which consists of 5 first-level indexes, 19 second-level indexes and 40 third-level indexes, was initially established.

2.2 Optimization of evaluation indexes of competitive ability of excellent Latin dancers in China

In order to fully and effectively utilize the data, this study takes the test data as the original data, and uses factor analysis to screen out a few unrelated composite variables to reflect as much information as possible about the original variables, thus achieving the purpose of data simplification. Through the analysis of the structural analysis of the competitive ability of China's outstanding Latin dance players can be seen, the competitive ability of the outstanding players is a comprehensive and coordinated development in all sub-competencies have their superior and excellent performance. However, except for the two indicators of physical fitness and skill, there are fewer indicators of other sub-capacities with significant differences between groups of different levels, which cannot comprehensively and accurately reflect the structural characteristics of the competitive abilities of China's outstanding Latin dancers. The skill evaluation indicators are proposed based on the new scoring rules. According to the technical characteristics and dance styles of each dance type, quantitative evaluations are given from five aspects: "technical quality", "musical rhythm sense", "partner cooperation skill", "routine choreography", and "artistic expression", so as to objectively and comprehensively reflect the technical requirements of Latin dance. Therefore, this study retains all the indicators of skill evaluation and uses the test data as the original processing data. Factor analysis is employed to statistically optimize the statistically significant indicators in the physical fitness evaluation indicators and all the indicators of other sub - abilities. The overlapping indicators are eliminated, and the representative and independent typical indicators are selected to further optimize the evaluation index system of the competitive ability of Latin dance players. Among them, single test indicators of body shape are easily affected by factors such as height and weight. Therefore, derived indicators are used for factor analysis. According to the significance of factor analysis, the following three principles are followed to delete the indicators that do not meet the requirements until the typical indicators meeting the statistical requirements are screened out: firstly, deleting the indicators that have close factor loadings in two or more common factors (deletion criterion: the first digit after the decimal point of the factor loading value is the same); secondly, the common factors that contain only one indicator, that indicator needs to be deleted; thirdly, deletion of indicators with maximum loadings less than 0.35 and commonality less than 0.4 on the common factor[6]. According to the preliminary selection of indicators, expert screening and statistical analysis, the evaluation index system of the competitive ability of China's outstanding Latin dancers was finally determined (see Table 1).

Table 1 Evaluation index system of competitive ability of excellent Latin dancers in China

	Typical Indicator	
	Male Player	Female Player
Body Shape	Ankle Circumference/Achilles Tendon Length × 100	(Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A × 100
	Body Fat Percentage（%）	Body Fat Percentage（%）
	(Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A × 100	Pelvic Width/Shoulder Width × 100
	Pelvic Width/Shoulder Width × 100	Finger Distance - Height（cm）
Body Function	Relative Mean Anaerobic Power（W/kg）	Relative Mean Anaerobic Power（W/kg）
	Relative Maximal Oxygen Uptake（$ml \cdot min^{-1} \cdot kg^{-1}$）	Relative Maximal Oxygen Uptake（$ml \cdot min^{-1} \cdot kg^{-1}$）
Physical Fitness	Y Balance Test / Right Leg Support (Score)	Barcelli/Left (Second)
	Barcelli/Left (Second)	10s Cowboy Bouncing Kick/Right (Rep)
	Right Ankle Flexion (Degree)	Vertical Jump In Place（cm）
Skill	Technical Quality	
	Musical Rhythm Sense	
	Partner Cooperation Skill	
	Routine Choreography	
	Artistic Expression	
Psychology	Achievement Motivation Score	Physical Anxiety
		Independence

3 Construction of an extension evaluation model for the competitive ability of excellent Latin dancers in China

Extenics is a new discipline founded by Chinese scholars. It uses formal models to study the possibility of the expansion of things from both qualitative and quantitative perspectives and is applied to solve contradictory problems. Based on the matter - element Extenics theory, this study aims to establish an evaluation model for the competitive ability of outstanding Latin dance players in China. By calculating their comprehensive correlation degree, the overall competitive level of Latin dance players is quantitatively analyzed, providing objective and accurate analysis results for the scientific diagnosis of players' physical training status.

3.1 Determination of the weights of the evaluation indexes of the competitive ability of China's outstanding Latin dancers

3.1.1 Determination of subjective weights - Analytical Hierarchy Process (AHP)

Based on the optimized evaluation index system for the competitive ability of excellent Latin dance players in China, this study constructs a progressive hierarchical structure for evaluating the competitive ability of Latin dance players, which is mainly divided into three levels: the target layer - the competitive ability

of Latin dance players; the criterion layer (category indicator) - body shape, body function, physical fitness, skill, and psychology; the scheme layer (test indicator layer) - the typical evaluation indicators selected through expert screening and statistical analysis.

In this round of survey, 12 questionnaires were distributed and 9 valid questionnaires were recovered, with an effective recovery rate of 75%. The recovered valid questionnaires were statistically analyzed, the weights of the indicators were calculated, and the matrix consistency was compared two by two. The weight values of the nine experts on the indicators of the Latin dance guidelines layer were calculated respectively. Although there are differences in the level of value perception of the experts, the results of the questionnaire passed the consistency test and the reliability of the questionnaire was established. The calculation of mean values was used to derive the geometric mean weight values of the indicators (see Table 2).

Table 2 Indicator weights of the criterion layer (category indicator) for evaluating the competitive ability of Latin dancers

Criterion Layer (Category Indicator)	Weight
B1 Body Shape	0.186
B2 Body Function	0.074
B3 Physical Fitness	0.196
B4 Skill	0.450
B5 Psychology	0.094

3.1.2 Determination of objective weights - Factor Analysis Method

In practical application, the subjective assignment method is vulnerable to the influence of human factors, and the determination of the weight of the evaluation indexes should take a combination of subjective and objective methods for assignment. Therefore, in this study, factor analysis was used to determine the weight coefficients for the program level (test indicator level). Based on the results of the factor analysis, the variance contribution/cumulative contribution of each indicator was finalized to determine the weight coefficients of the individual test indicators (see Tables 3 and 4).

Table 3 A summary of the weights of indicators at all levels in the evaluation index system for the competitive abilities of elite Latin dancers in China

	Male Player		Female Player	
	Indicator	Weight	Indicator	Weight
Body Shape（0.186）	Ankle Circumference/Achilles Tendon Length × 100	0.269	(Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A × 100	0.274
	Body Fat Percentage（%）	0.262	Body Fat Percentage（%）	0.252
	(Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A × 100	0.254	Pelvic Width/Shoulder Width × 100	0.248
	Pelvic Width/Shoulder Width × 100	0.215	Finger Distance - Height（cm）	0.226

	Male Player		Female Player	
	Indicator	Weight	Indicator	Weight
Body Function（0.074）	Relative Mean Anaerobic Power（W/kg）	0.594	Relative Mean Anaerobic Power（W/kg）	0.674
	Relative Maximal Oxygen Uptake（$ml \cdot min^{-1} \cdot kg^{-1}$）	0.406	Relative Maximal Oxygen Uptake（$ml \cdot min^{-1} \cdot kg^{-1}$）	0.326
Physical Fitness（0.196）	Y Balance Test / Right Leg Support (Score)	0.356	Barcelli/Left (Second)	0.377
	Barcelli/Left (Second)	0.351	10s Cowboy Bouncing Kick/Right (Rep)	0.329
	Right Ankle Flexion (Degree)	0.293	Vertical Jump In Place（cm）	0.294
Skill（0.450）	（S）Technical Quality	0.040	（S）Technical Quality	0.040
	（S）Musical Rhythm Sense	0.040	（S）Musical Rhythm Sense	0.040
	（S）Partner Cooperation Skill	0.040	（S）Partner Cooperation Skill	0.040
	（S）Routine Choreography	0.040	（S）Routine Choreography	0.040
	（S）Artistic Expression	0.040	（S）Artistic Expression	0.040
	（R）Technical Quality	0.040	（R）Technical Quality	0.040
	（R）Musical Rhythm Sense	0.040	（R）Musical Rhythm Sense	0.040
	（R）Partner Cooperation Skill	0.040	（R）Partner Cooperation Skill	0.040
	（R）Routine Choreography	0.040	（R）Routine Choreography	0.040
	（R）Artistic Expression	0.040	（R）Artistic Expression	0.040
	（P）Technical Quality	0.040	（P）Technical Quality	0.040
	（P）Musical Rhythm Sense	0.040	（P）Musical Rhythm Sense	0.040
	（P）Partner Cooperation Skill	0.040	（P）Partner Cooperation Skill	0.040
	（P）Routine Choreography	0.040	（P）Routine Choreography	0.040
	（P）Artistic Expression	0.040	（P）Artistic Expression	0.040
	（J）Technical Quality	0.040	（J）Technical Quality	0.040
	（J）Musical Rhythm Sense	0.040	（J）Musical Rhythm Sense	0.040
	（J）Partner Cooperation Skill	0.040	（J）Partner Cooperation Skill	0.040
	（J）Routine Choreography	0.040	（J）Routine Choreography	0.040
	（J）Artistic Expression	0.040	（J）Artistic Expression	0.040
	（C）Technical Quality	0.040	（C）Technical Quality	0.040
	（C）Musical Rhythm Sense	0.040	（C）Musical Rhythm Sense	0.040
	（C）Partner Cooperation Skill	0.040	（C）Partner Cooperation Skill	0.040
	（C）Routine Choreography	0.040	（C）Routine Choreography	0.040
	（C）Artistic Expression	0.040	（C）Artistic Expression	0.040
Psychology（0.094）	Achievement Motivation Score	1.000	Physical Anxiety	0.629
			Independence	0.371

Note: The skill evaluation indicators “S, R, P, J, C” represent the five dance styles of “Samba, Rumba, Paso Doble, Jive, and Cha-cha” respectively.

3.2 Development of the evaluation grades for the competitive abilities of outstanding Latin dancers in China

Based on the constructed evaluation index system for the competitive ability of excellent Latin dance players in China, and according to the measured values of each index of excellent players (Note: the skill indicators are determined by the measured values of all players), the percentile method is used to determine the evaluation standard ranges for male and female Latin dance players respectively. The specific calculation formula is as follows:

$$P_x = L_x + \frac{i}{f_x}\left(\frac{x \cdot n}{100} - C_x\right) \tag{3.1}$$

Where: P_x represents the X-th percentile, L_x represents the lower limit of the group where the X-th percentile is located, i is the class interval, f_x represents the frequency of the group where the X-th percentile is located, X is the rank of all percentiles (X= 1, 2, 3, …… 100), n is the sample size, and C_x is the cumulative frequency of groups with values less than L_x.

According to the above formula, the percentiles of P_0, P_{10}, P_{30}, P_{70}, P_{90}, and P_{100} were calculated respectively. Then, based on the grade evaluation criteria of the percentile method (see Table 4), the evaluation grade intervals were determined.

Table 4 Single-item grade assessment criteria

Percentile Method	High-Quality Superior Indicator Level	Low - Superior Indicator Level
$> P_{90}$	Level 5	Level 1
P_{70}—P_{90}	Level 4	Level 2
P_{30}—P_{70}	Level 3	Level 3
P_{10}—P_{30}	Level 2	Level 4
$< P_{10}$	Level 1	Level 5

3.3 Construction of the evaluation model for the competitive ability of outstanding Latin dance players in China based on Extension theory

3.3.1. Quantitative processing of evaluation indicators

In the process of modeling practical problems, due to the diversity of the forms of evaluation indicators, the measurement units, dimensions, and orders of magnitude of each indicator vary, and there is no comparability among the indicators. Therefore, it is necessary to use mathematical models to perform dimensionless processing on the numerical values, unify the evaluation criteria of each indicator, and eliminate the influence of the dimensions of the original indicators.

In the constructed evaluation index system for the competitive ability of excellent Latin dance players in China, indicators such as “body fat percentage”, “pelvic width/shoulder width × 100”, “somatic anxiety”, and “(lower limb length B - lower leg length A)/lower leg length A × 100” are all reverse-type indicators, while the remaining indicators are all positive-type indicators. The process of data dimensionless processing is as follows:

Suppose in a certain evaluation system, x_{ij} (i=1,2, …, n; j=1, 2, …, m) represents the observed value of the i-th evaluated unit on the j-th indicator, and it is the standardized observed value after dimensionless processing. x_{ij}^{*} is the standard observation after the dimensionless treatment.

$M_j = \max_i \{x_{ij}\}$ represents the maximum value of the j-th indicator for the i-th evaluated unit; $m_j = \min_i \{x_{ij}\}$ represents the minimum value of the j-th indicator for the i-th evaluated unit.

Calculation formula for dimensionless processing of positive-type indicators:

$$x_{ij}^{*} = \begin{cases} x_{ij}^{*} = 0 & x_{ij} \le m_j \\ x_{ij}^{*} = \dfrac{x_{ij} - m_j}{M_j - m_j} & m_j < x \quad M_j \\ x_{ij}^{*} = 1 & x_{ij} \ge M_j \end{cases} \tag{3.2}$$

Calculation formula for dimensionless processing of reverse-type indicators:

$$x_{ij}^{*} = \begin{cases} x_{ij}^{*} = 0 & x_{ij} \ge M_j \\ x_{ij}^{*} = \dfrac{M_j - x_{ij}}{M_j - m_j} & m_j < x \quad M_j \\ x_{ij}^{*} = 1 & x_{ij} \le m_j \end{cases} \tag{3.3}$$

According to Formulas (3.2) and (3.3), the dimensionless processing is carried out on the evaluation levels of the competitive abilities of excellent Latin dance players in China.

3.3.2 Determination of classical domain, nodal domain, and matter - element to be evaluated

3.3.2.1 Determination of the classical domain

The evaluation grade domain refers to the evaluation grades of competitive ability, and the evaluation factor set refers to the index system for evaluating the competitive ability of players. Suppose there are n evaluation indices for the competitive ability of excellent Latin dance players in China, namely C_1, C_2,…, C_n. If the evaluation criteria for competitive ability are divided into m grades, then the evaluation matter - element model is:

$$R_{oj} = \left(N_{oj},\ C\ V_{ojk}\right) = \begin{bmatrix} N_{oj} & C_1 & V_{oj1} \\ & C_2 & V_{oj2} \\ & \cdots & \cdots \\ & C_n & V_{ojm} \end{bmatrix} = \begin{bmatrix} N_{oj} & C_1 & \left[a_{oj1},\ b_{oj1}\right] \\ & C_2 & \left[a_{oj2},\ b_{oj2}\right] \\ & \cdots & \cdots \\ & C_n & \left[a_{ojm},\ b_{ojm}\right] \end{bmatrix} \tag{3.4}$$

Among them, R_{oj} represents the matter - element model of the j-th level of competitive ability; N_{oj} represents the evaluation index of the j-th level of competitive ability.

$V_{ojk} = \left[a_{ojk}, b_{ojk}\right]$ (k=1, 2, …, m) represents the quantitative value range of the k-th evaluation index c_k at the j-th level of athletic ability, which is called the classical domain.

3.3.2.2 Determination of the nodal domain

The expression for the nodal domain is:

$$R_p=\left(N_p,\ C\quad V_p\right)=\begin{bmatrix} N_p & C_1 & V_{p1} \\ & C_2 & V_{p2} \\ & \vdots & \vdots \\ & C_n & V_{pn} \end{bmatrix}=\begin{bmatrix} N_p & C_1 & \left[a_{p1},\ b_{p1}\right] \\ & C_2 & \left[a_{p2},\ b_{p2}\right] \\ & \vdots & : \\ & C_n & \left[a_{pn},\right. \end{bmatrix} \tag{3.5}$$

Among them, R_P represents the matter-element of the allowable value range of the evaluation index system for competitive ability; N_P represents the grade of the comprehensive evaluation of competitive ability. V_{P1}, V_{P2}, …, V_{Pn} are the value ranges of N_P with respect to C_1, C_2, …,C_n respectively, that is, the nodal domain of N_P, denoted as $V_{pi}=\left[a_{pi},b_{pi}\right]$, i=1,2, …, n.

3.3.2.3 Determination of matter - element to be evaluated

The expression of the matter-element to be evaluated is:

$$R_0=\left(N_0,\ C\quad V\right)=\begin{bmatrix} N_0 & C_1 & V_1 \\ & C_2 & V_2 \\ & \vdots & \vdots \\ & C_m & V_m \end{bmatrix} \tag{3.6}$$

Among them, N_0 represents the level of competitive ability; V_1, V_2,…, V_m represent the specific test values of the C_1,C_2,…,C_m indicators of the object to be evaluated, respectively.

3.3.3 Determination of correlation function

In extension theory, the correlation function is used to represent the degree to which an object in the universe of discourse possesses a certain property. The correlation function on the real domain is established to quantitatively and objectively reflect the degree to which the object possesses a certain property and the process of its qualitative change and quantitative scale. The value range is （-∞, +∞）. The specific expression of the correlation function is as follows:

$$k_j\left(c_{ik}\right)=\begin{cases} \dfrac{-\rho\left(v_{ik},\ V_j\right)}{\left|V_{ji}\right|}, & v_{ik}\in V_j \\ \dfrac{\rho\left(v_{ik},\ V_j\right)}{\rho\left(v_{ik},\ V_u\right)-\rho\left(v_{ik},\ V_j\right)}, & v_i\notin V_j\text{且}\rho\left(v_{ik},\ V_u\right)-\rho\left(v_{ik},\ V_j\right)\neq 0 \\ -\rho\left(v_{ik},\ V_j\right)-1, & v_i\notin V_j\text{且}\rho\left(v_{ik},\ V_u\right)-\rho\left(v_{ik},\ V_j\right)=0 \end{cases} \tag{3.7}$$

$$\rho\left(v_{ik},\ V_j\right)=\left|v_{ik}-\frac{a_{ji}+b_{ji}}{2}\right|-\frac{1}{2}\left(b_{ji}-a_{ji}\right) \tag{3.8}$$

$$\rho\left(v_{ik},\ V_u\right)=\left|v_{ik}-\frac{a_{ui}+b_{ui}}{2}\right|-\frac{1}{2}\left(b_{ui}-a_{ui}\right) \tag{3.9}$$

Among them, $K_j(c_{ik})$ represents the correlation degree of the k-th secondary indicator in the i-th primary indicator with respect to the evaluation level j.

3.3.4 Multi-level extension evaluation

According to the calculated weight vector of the secondary evaluation indicators, multiply it by the correlation matrix of each level of the competitive ability evaluation to obtain the correlation matrix of the evaluation levels of the primary indicator for competitive ability:

$$K\left(b_i\right)=\left(k_j\left(c_i\right)\right)=\left[w_{i1},\ w_{i2}\ \ldots\ \ w_{ip}\right]\begin{bmatrix}k_1\left(c_{i1}\right) & k_2\left(c_{i1}\right) & \ldots & k_m\left(c_{i1}\right)\\ k_1\left(c_{i2}\right) & k_2\left(c_{i2}\right) & \ldots & k_m\left(c_{i2}\right)\\ \vdots & \vdots & \ldots & \vdots\\ k_1\left(c_{ip}\right) & k_2\left(c_{ip}\right) & \ldots & k_m\left(c_{im}\right)\end{bmatrix} \tag{3.10}$$

Similarly, the weight vector of each first - level index (calculated by the AHP method) is multiplied by the correlation matrix of each grade to obtain the correlation matrix of the object to be evaluated in each grade:

$$K\left(N\right)=\left[w_1,\ w_2\ \ldots\ \ w_n\right]\begin{bmatrix}k_1\left(b_1\right) & k_2\left(b_1\right) & \ldots & k_m\left(b_1\right)\\ k_1\left(b_2\right) & k_2\left(b_2\right) & \ldots & k_m\left(b_2\right)\\ \vdots & \vdots & \ldots & \vdots\\ k_1\left(b_n\right) & k_2\left(b_n\right) & \ldots & k_m\left(b_n\right)\end{bmatrix} \tag{3.11}$$

The evaluation level corresponding to the maximum value in $K(N)$ is the evaluation level of the criterion layer for the player's competitive ability assessment. The expression is:

$$\overline{K}_j\left(N\right)=\frac{K_j\left(N\right)-\min K_j\left(N\right)}{\max K_j\left(N\right)-\min K_j\left(N\right)} \tag{3.12}$$

To further analyze the bias degree of this evaluation grade, calculate the characteristic value j^* of the level variable. The calculation formula is as follows:

$$j^*=\frac{\sum_{j=1}^{m} jg\overline{K}_j\left(N\right)}{\sum_{j=1}^{m}\overline{K}_j\left(N\right)} \tag{3.13}$$

3.4 Back-substitution test of the extension evaluation model for the competitive ability of excellent Latin dancers in China

To verify the accuracy and effectiveness of the extension evaluation model for the competitive ability of excellent Latin dance players in China, the test data of all players in the excellent group and some players in the ordinary group were respectively substituted into the corresponding extension evaluation models according to gender for back-substitution verification. The specific steps are as follows:

First, organize the original test data of each contestant and conduct dimensionless processing.

Second, establish the classical domain, nodal domain, and matter - elements to be evaluated (i.e., the quantified values of each contestant's test data) based on the evaluation criteria established for different genders.

Third, calculate the correlation degrees between each test index and the evaluation levels according to the correlation function formula, and establish a correlation degree matrix.

Fourth, multiply the weights of the secondary indicators by the correlation matrix of the secondary indicators corresponding to each primary indicator to obtain the correlation matrix of each primary indicator.

Fifth, multiply the weights of the first-level indicators by the correlation matrix of the first-level indicators to obtain the comprehensive evaluation grade correlation of each player's competitive ability. Determine the comprehensive evaluation grade of the player's competitive ability according to the grade interval where the maximum value lies.

Table 5 Results of the back-substitution test for the comprehensive evaluation of the competitive abilities of Latin dancers at different levels

Level	Male Player				Female Player			
	Excellent Group		Normal Group		Excellent Group		Normal Group	
Level 5	2	14.29%	0	0.00%	2	15.38%	0	0.00%
Level 4	2	14.29%	3	12.00%	4	30.77%	2	8.00%
Level 3	8	57.14%	4	16.00%	7	53.85%	5	20.00%
Level 2	2	14.29%	10	40.00%	0	0.00%	13	52.00%
Level 1	0	0.00%	8	32.00%	0	0.00%	5	20.00%
Total	14	100%	25	100%	13	100%	25	100%
Chi-Square Test	$P < 0.05$				$P < 0.01$			

The back-substitution test of the evaluation of the competitive ability of male Latin dance players shows (see Table 5): the number of players in the excellent group reaching the third - level or above accounts for 85.72%, while that in the ordinary group is 28.00%. The chi - square test reveals a significant difference ($P < 0.05$). The back-substitution test of the comprehensive evaluation of female Latin dance players shows (see Table 5): all players in the excellent group reach the third - level or above, and players in the ordinary group are mainly distributed at the second - level. The chi - square test shows a significant difference ($P < 0.01$).

This indicates that the extension evaluation models of the competitive ability of excellent male and female Latin dance players in China can objectively and accurately reflect the real competitive level of Latin dance players, with high validity.

4 Application of the extension evaluation model for the competitive ability of outstanding Latin dancers in China

To objectively reflect the application value of the extension evaluation model for the competitive ability of outstanding Latin dance players in China and accurately understand the overall competitive ability and the development levels of various sub - abilities of the current outstanding players in China, this study selected two top domestic players for case analysis. The aim was to comprehensively evaluate the development levels of the players' competitive ability, provide targeted goals for future training practices, and improve the quality and effectiveness of training. The basic information of the players is shown in Table 6.

Table 6 Basic Information of Individual players

Name	Gender	Competition Results
HY	Male	Third place in the WDSF world professional Latin dance championships, champion of the domestic professional Latin dance group
ZT	Female	

The male Latin dancer HY's skill and psychological ratings were at the level of four with a tendency to shift towards five; his body shape was at the level of three, but from the value of the level variable, the competitor reached a level of 3.65, which is more in line with the requirements of the Latin dance-specific body shape. In addition, the evaluation results of the player's body function and physical fitness were not satisfactory, which should draw the player's attention. Specifically (see Table 7), the aerobic and anaerobic capacity tests of physical function were evaluated at the second - level. Although the three indicators of physical fitness all reached the third - level or above, the evaluation level variable value of physical fitness was 2.46, indicating that the player's physical fitness did not fully reach the third - level. It is recommended to further strengthen the training of ankle flexibility and the control ability of dynamic and static balance, and focus on improving the player's glycolytic energy supply ability and aerobic metabolism ability.

There is an imbalance in the development of various sub - abilities of the competitive ability of the Latin dance female player ZT. Her skill and psychological performance are relatively outstanding, while the development levels of body shape, body function, and physical fitness are seriously imbalanced. In terms of body morphology, limb length and width indicators are greatly affected by congenital factors and are not easy to change. However, body fat percentage can be improved through post - natal training, thereby enhancing the player's physical function level and competitive ability. Player ZT's physical function is rated at level three, and the level variable value shows that it only reaches 2.86. It is recommended to further consolidate and improve the player's aerobic and anaerobic metabolic capabilities. In terms of physical

fitness, the player is rated at level two, but the actual level has exceeded level two and shifted towards level three, with a level variable value of 2.73. Further analysis (see Table 7) shows that the player's lower - limb explosive power level is the key factor affecting the development of her physical fitness. It is recommended to change the training concept and strengthen physical training in future training, especially the training for lower - limb explosive power, speed endurance, and aerobic capacity.

Skill is the key factor that determines the development level of Latin dance players' competitive ability. With the continuous improvement of the skill level of the players, the technical gap between the excellent players is gradually narrowing, and physical fitness has become the core element that affects the improvement of the competitive ability of the players. Through the case analysis of our current outstanding players, it can be seen that the problem of insufficient physical reserve of the current domestic top players has begun to show. Therefore, it is necessary to break the single technical training in the past, strengthen the shaping of basic competitive ability of the players, and reduce the occurrence of sports injuries; secondly, pay attention to the special physical training, especially to strengthen the lower limb explosive force, coordination, balance and aerobic endurance training; it is recommended to reasonably use high-tech means to effectively monitor and scientifically regulate the training process of the excellent players, and establish the excellent players' data-based information database to comprehensively assess the players' performance. It is recommended to make reasonable use of high-tech means to effectively monitor and scientifically control the training process of excellent players, to establish a data-centered information database of excellent players, to comprehensively assess the overall development level of the players, to consolidate the advantages, to make up for the deficiencies, to emphasize the balanced development, and to realize the maximization of the excavation of the sports potential.

Table 7 Grade evaluation results of the index at the evaluation program level of the competitive ability of Latin dance players HY & ZT

Criterion Layer	Program Level (Male Player)	Level of Affiliation	Program Level (Female Player)	Level of Affiliation
B1 Body Shape	B11 Ankle Circumference/Achilles Tendon Length × 100	Level 3	B11 (Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A 100	Level 3
	B12 Body Fat Percentage (%)	Level 4	B12 Body Fat Percentage (%)	Level 2
	B13 (Lower Limb Length B - Lower Leg Length A) / Lower Leg Length A × 100	Level 4	B13 Pelvic Width/Shoulder Width × 100	Level 2
	B14 Pelvic Width/Shoulder Width × 100	Level 3	B14 Finger Distance - Height (cm)	Level 1
B2 Body Function	B21 Relative Mean Anaerobic Power (W/kg)	Level 2	B21 Relative Mean Anaerobic Power (W/kg)	Level 3
	B22 Relative Maximal Oxygen Uptake ($ml \cdot min^{-1} \cdot kg^{-1}$)	Level 2	B22 Relative Maximal Oxygen Uptake ($ml \cdot min^{-1} \cdot kg^{-1}$)	Level 3
B3 Physical Fitness	B31 Y Balance Test / Right Leg Support (Score)	Level 4	B31 Barcelli/Left (Second)	Level 4
	B32 Barcelli/Left (Second)	Level 4	B32 10s Cowboy Bouncing Kick/Right (Rep)	Level 3
	B33 Right Ankle Flexion (Degree)	Level 3	B33 Vertical Jump In Place (cm)	Level 2

Criterion Layer	Program Level （Male Player）	Level of Affiliation	Program Level （Female Player）	Level of Affiliation
B4 Skill	B41(S) Technical Quality	Level 4	B41(S) Technical Quality	Level 4
	B42(S) Musical Rhythm Sense	Level 5	B42(S) Musical Rhythm Sense	Level 5
	B43(S) Partner Cooperation Skill	Level 5	B43(S) Partner Cooperation Skill	Level 5
	B44(S) Routine Choreography	Level 4	B44(S) Routine Choreography	Level 4
	B45(S) Artistic Expression	Level 4	B45(S) Artistic Expression	Level 4
	B41(R) Technical Quality	Level 4	B41(R) Technical Quality	Level 4
	B42(R) Musical Rhythm Sense	Level 4	B42(R) Musical Rhythm Sense	Level 4
	B43(R) Partner Cooperation Skill	Level 4	B43(R) Partner Cooperation Skill	Level 4
	B44(R) Routine Choreography	Level 4	B44(R) Routine Choreography	Level 4
	B45(R) Artistic Expression	Level 4	B45(R) Artistic Expression	Level 4
	B41(P) Technical Quality	Level 4	B41(P) Technical Quality	Level 4
	B42(P) Musical Rhythm Sense	Level 5	B42(P) Musical Rhythm Sense	Level 5
	B43(P) Partner Cooperation Skill	Level 4	B43(P) Partner Cooperation Skill	Level 4
	B44(P) Routine Choreography	Level 4	B44(P) Routine Choreography	Level 4
	B45(P) Artistic Expression	Level 4	B45(P) Artistic Expression	Level 4
	B41(J) Technical Quality	Level 5	B41(J) Technical Quality	Level 5
	B42(J) Musical Rhythm Sense	Level 5	B42(J) Musical Rhythm Sense	Level 5
	B43(J) Partner Cooperation Skill	Level 4	B43(J) Partner Cooperation Skill	Level 4
	B44(J) Routine Choreography	Level 4	B44(J) Routine Choreography	Level 4
	B45(J) Artistic Expression	Level 5	B45(J) Artistic Expression	Level 5
	B41(C) Technical Quality	Level 5	B41(C) Technical Quality	Level 5
	B42(C) Musical Rhythm Sense	Level 5	B42(C) Musical Rhythm Sense	Level 5
	B43(C) Partner Cooperation Skill	Level 4	B43(C) Partner Cooperation Skill	Level 4
	B44(C) Routine Choreography	Level 5	B44(C) Routine Choreography	Level 5
	B45(C) Artistic Expression	Level 5	B45(C) Artistic Expression	Level 5
B5 Psychology	B51 Achievement Motivation Score	Level 4	B51 Independence	Level 3
			B52 physical Anxiety	Level 3

Note: The skill evaluation indicators “S, R, P, J, C” represent the five dance styles of “Samba, Rumba, Paso Doble, Jive, and Cha-cha” respectively.

5 Conclusion

Based on existing research, this paper analyzes the characteristics of the competitive ability of excellent Latin dance players and establishes the evaluation index systems for the competitive ability of outstanding male and female Latin dance players in China respectively. In terms of the evaluation method, this paper improves the previous traditional evaluation methods, overcomes the limitations of the subjective weighting method, and determines the weight values by combining subjective and objective methods, thus establishing a matter - element extension model based on the combination weighting method. Finally, this paper conducts an empirical study on Chinese Latin dance champion players using this evaluation model. Through calculation, the comprehensive competitive ability evaluation grades of the players are obtained, and the differences among various levels of elements are further analyzed, providing references for players to formulate training plans and improve the quality and effectiveness of training.

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