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Development of Physical Fitness Evaluation Criteria for Women in Compulsory Isolation for Drug Rehabilitation

Yi Yang,
Research Centre for Exercise Detoxification, College of Physical Education, Southwest University, 400715,Chongqing, China
https://orcid.org/0000-0001-9370-4303
1390330627@qq.com

Corresponding author:
Jiong Luo,
Research Centre for Exercise Detoxification, College of Physical Education, Southwest University, 400715,Chongqing, China.
https://orcid.org/0000-0003-0161-7320
784682301@qq.com

Abstract: Background: The issue of physical and mental rehabilitation for drug users lacks a comprehensive and reliable system for evaluating it difficult to conduct a reasonable assessment of their physical fitness. The establishment of physical fitness evaluation criteria specifically tailored for female drug users serves as the fundamental basis for developing precise and individualized exercise prescriptions. **Methods:** This study used the national physical fitness test method to assess the physical fitness of female drug addicts undergoing mandatory rehabilitation.

The principal component analysis method was employed to calculate the weight of each individual physical fitness test indicator, which was then combined with the indicator T score to obtain a comprehensive evaluation of the physical fitness of these individuals. On this basis, a single physical fitness index T-score scoring equation was determined for two groups of women (with and without diseases) undergoing compulsory isolation and drug rehabilitation, stratified by age (under 30 years old, 31-40 years old, 41-50 years old, 51-60 years old). **Results:** The weights of various indicators and the combined weights of secondary indicators in the physical fitness evaluation index system for female addicts undergoing compulsory isolation for detoxification have been established. **Conclusion:** Based on the total score calculated by combining the T-score of each individual physical fitness indicator with its corresponding weight, a comprehensive rating system with four levels - "excellent, good, qualified, and unqualified" - has been set.

Keywords: Compulsory Isolation for Drug Rehabilitation; Physical Fitness Evaluation Criteria; Physical Fitness Testing; Comprehensive Score

Introduction

The issue of drug abuse is a societal concern that demands urgent attention worldwide. It not only affects the harmony and stability of families of individuals addicted to drugs, but also exerts a serious adverse impact on the global security order. The World Drug Report 2020 indicates that since 2018, approximately 270 million individuals have engaged in drug use within a year, among whom over 35 million suffer from drug addiction and are severely affected by it. This figure represents an increase of 10 million compared to the global drug addicts recorded in 2012, with nearly 600,000 individuals directly dying from drug abuse. In 2019, Kunming, Yunnan hosted the 'International Drug Rehabilitation Forum', during which the focus was on exploring new technologies and methodologies for drug rehabilitation, with exercise-based rehabilitation emerging as a new favorite. According to relevant research reports, exercise intervention exerts a positive effect on both the physical fitness and mental health of students undergoing compulsory detoxification programs[1, 2].High-intensity interval training can effectively enhance the physical health of detoxification trainees, improve their physical fitness and functional status, strengthen the body's antioxidant capacity, and promote positive changes in neurotransmitter levels related to anxiety and depression[3].Regular aerobic exercise can enhance the inhibitory function of the brain in methamphetamine-dependent individuals by regulating neurotransmitters within the brain, maintaining a coordinated activation state of the brain-cardiac system in specific scenarios, and thereby effectively reducing drug craving[4].

The issue regarding the physical constitution of individuals subjected to compulsory rehabilitation has long garnered attention from scholars both domestically and internationally. Relevant research primarily manifests in three aspects:

One aspect concerns the physical characteristics of compulsorily detoxified individuals. Research has revealed that individuals undergoing compulsory detoxification suffer from physiological damage due to drug abuse, characterized by a high prevalence of diseases. There is a significant number of individuals who are obese or overweight, and their physical fitness indicators are comprehensively lower than those of normal individuals[5].

The second aspect pertains to the dual dependency on the physical and mental levels of compulsorily rehabilitated individuals, especially the damage to their nervous, respiratory, motor, and cardiovascular systems[6].Scholars Liao Junhui et al[7](2020) found that the overall pass rate for physical fitness among individuals undergoing compulsory rehabilitation in Fujian Province was only 78.5%, which is lower than the 87.6% pass rate for males observed in the Fujian Provincial National Physical Fitness Monitoring conducted in 2014.Scholars such as Guo Weishuai have discovered that male detainees who underwent forced detoxification exhibit superior flexibility and strength, yet their endurance and agility are comparatively inferior[8].

The third aspect pertains to the relationship between the physical fitness level of compulsory rehabilitation trainees and their drug rehabilitation. The level of physical fitness is closely associated with drug abuse. Long-term drug use will impair the nervous and locomotor systems of the human body, subsequently resulting in a comprehensive decline in the physical health of drug users[9].The forced detoxification program has inflicted severe damage to the digestive, respiratory, and central nervous systems of the detainees, with approximately 60% experiencing convulsions, insomnia, oral ulcers, sweating, and pain in the waist and legs[10].Scholars such as Tong Yongqing have found that individuals with superior speed and agility qualities exhibit lower levels of drug craving when undergoing forced detoxification[11].Indicators such as endurance, upper limb muscle strength, speed, and agility are correlated with a reduction in craving and relapse rates among detoxification trainees. Regular exercise not only improves physical function but also exerts positive benefits on mental health status[12].Aerobic exercise reduces the urge to use drugs by improving the physical attributes of drug users, such as lung capacity, flexibility, strength, and balance, while also regulating their emotional states, including anxiety and depression[13].

The fourth aspect involves the construction of a physical fitness evaluation system for individuals undergoing compulsory rehabilitation. The national physical fitness testing in our country monitors and evaluates the physical constitution of our citizens through three major components: body shape, physiological function, and physical fitness. After continuous improvement and revision, it demonstrates strong applicability and operability[14].Scholars conducted a physical fitness assessment on 2,100 male and 580 female individuals undergoing compulsory rehabilitation in Guangdong Province. By identifying risk factors, they determined the weighting of test items and established a scoring norm, thereby constructing an evaluation system tailored for the physical fitness of compulsory rehabilitation participants in Guangdong Province. The test items and their respective weights (male/female) are as follows: 6-minute walk test (0.167), grip strength (0.067/0.246), vertical jump (0.154/0.186), push-ups (male, 0.248), 1-minute sit-ups (female, 0.063), choice reaction time (0.086/0.211), and single-leg standing with eyes closed (0.278/0.126)[15].Currently, there are no research reports on the physical fitness evaluation system for individuals undergoing forced detoxification in other regions. Scholars such as Jia Dongming (2020) contend that the physical fitness, physique testing, and data processing of compulsory rehabilitation trainees constitute the focal points of daily rehabilitation training work. These data represent significant characteristics that distinguish them from other groups[16].Although there have been numerous studies on the construction of regional physical fitness evaluation systems for compulsory rehabilitation trainees, these studies have correspondingly emphasized the urgency of improving the evaluation of their physical health.

Additionally, some evaluation criteria have been established. However, due to factors such as the lack of unified certification, limited scale, and partial results, it is impossible to carry out large-scale promotion.[14, 15, 17].

In summary, the intervention of compulsory isolation and rehabilitation trainees primarily through non-pharmacological exercise-based interventions is a green, economical, and efficient option. Besides assisting the trainees in achieving dual detoxification, both physically and psychologically, scientifically enhancing their physical health levels is also a key aspect in promoting the effective implementation of drug rehabilitation efforts. Concurrently, effective monitoring of physical fitness levels is a prerequisite and key to formulating and implementing a reasonable exercise regimen. Furthermore, research on the physical fitness of compulsory rehabilitation participants serves as the foundation for developing exercise-based drug rehabilitation programs. However, for a long time, our country has adhered to the "National Physical Fitness and Health Standards" as the criterion for assessing the physical fitness of compulsory rehabilitation trainees, lacking specific physical fitness testing standards for particular populations. Concurrently, drug rehabilitation centers encounter two major challenges. Firstly, regarding rehabilitation, the absence of a comprehensive and credible physical fitness indicator system and baseline standards hinders the establishment of exercise volume. Secondly, there remains a deficiency in the standards for physical fitness upon exiting rehabilitation centers. Consequently, the development of a physical fitness index system and baseline standards tailored to local characteristics for compulsory rehabilitation trainees will provide a significant reference for the formulation of exercise-based drug rehabilitation prescriptions, carrying substantial theoretical and practical application value.

1. Research Objectives And Methodology

1.1. Research Object

This study focuses on the construction, validation, and standardization of a physical fitness evaluation index system for female individuals undergoing compulsory isolation for drug rehabilitation. A study was conducted to collect physical fitness test data from compulsorily isolated drug rehabilitation center residents (hereinafter referred to as "compulsorily isolated residents") at a specific women's center. The physical fitness tests were carried out from October to November 2023, with 742 valid data samples participating in this monitoring. Based on their individual disease risk status, 114 individuals were categorized, all of whom were elderly aged between 50 and 60 years old. The sample size for the "compulsorily isolated residents" was 628. The specific inclusion criteria are as follows: 1) Not illiterate, with no history of brain diseases, and in a normal mental state; 2) Female compulsory rehabilitation participants aged between 18 and 60 years; 3) Free of cardiac functional diseases; 4) Without physical disabilities or medical conditions that prohibit participation in moderate-intensity aerobic exercise; 5) All participants voluntarily participated in this study after recruitment and signed the informed consent form. This study has been approved by the Ethics Review Committee of Southwest University Hospital in China (No. 202403) Written informed consent form was obtained from all participants before enrolling them in the study.

1.2 Research method

1.2.1 Literature review method

Utilizing the rich library and digital book resources of our university, we conducted searches on databases such as VIP, CNKI, PubMed, and Web of Science. We searched for relevant literature using the keywords "physical fitness evaluation standards", "physical fitness baseline", "drug addiction", "drug craving", "rehabilitation of drug addicts", and "mandatory isolation for drug rehabilitation" on databases like PubMed and Web of Science.

1.2.2 Physical fitness measurement method

In 2003, the General Administration of Sport of China issued the "National Physical Fitness Determination Standards" (hereinafter referred to as the "Standards"), which are applicable to individuals aged 18 and above, including children, adults, and the elderly. The "Standards" consist of two main parts: the testing indicator system and the evaluation criteria. The testing method used for this assessment is based on the "2023 National Physical Fitness Assessment Manual (Adult Section)", and several special tests have been tentatively included, such as the innovative addition of a 1600-meter brisk walk for the test group.（Maximum oxygen uptake = 132.853 - 0.0769 × body weight - 0.3877 × age - 3.2649 × time - 0.1565 × heart rate）[18].

The physical fitness assessment in this study encompasses three primary testing indicators: body shape, physical function, and physical fitness, along with 13 secondary testing indicators, as detailed in Table 1.1) Physical morphology indicators: Measure four secondary test indicators: height, weight, waist circumference, and hip circumference, and calculate the corresponding BMI value (weight/height^2, reflecting the overall obesity level of the body) and waist-to-hip ratio (waist circumference/hip circumference, evaluating the degree of central obesity in the human body) for the compulsory rehabilitation trainees, reflecting their body symmetry and degree of central obesity, and evaluating their physical development and nutritional status level .2) Physical function indicators: By measuring heart rate, blood pressure, lung capacity, and conducting step tests or 1.6 KM walking tests, four secondary test indicators, we can fully grasp the physical function and health status of compulsory rehabilitation trainees. 3) Conduct five secondary test indicators, including grip strength, 1-minute sit-ups, sit-and-reach, standing on one leg with eyes closed, and choice reaction time, covering upper limb strength, core strength, flexibility, balance reaction, and other qualities, to grasp the physical fitness of the inmates undergoing compulsory rehabilitation.

Table 1 Overview of Physical Fitness Test Indicators

First level indicator	Secondary indicators	
	Drug users without any diseases	Drug users with illnesses
Body morphology	BMI	BMI
	Waist to hip ratio	Waist to hip ratio
Physical capacity	vital capacity	vital capacity
	Step test	1.6km walking test
Physical fitness	grip strength	grip strength

1-minute abdominal curl	2-minute abdominal curl
Sitting forward reach	Sitting forward reach
Standing on one leg with eyes closed	Standing on one leg with eyes closed
Choice reaction time	Choice reaction time

1.2.3 Mathematical statistics method

Using Excel and SPSS Statistics 27 software, the collected data was organized, entered, and tested, and the summary results were presented in terms of sample mean and standard deviation. Adopt the standard score T-score to formulate the individual scoring equation. Meanwhile, the principal component analysis method is employed to construct normative models for individual indicators, and the percentile method is utilized to establish a comprehensive rating system. The significance level for the parameters of the research data is set to $\alpha=0.05$.

2 Results

2.1 Evaluation criteria for individual indicators

The standard score norm represents the distance between the original score and the average score, expressed in standard deviation. Standard scores share the same unit, but due to the complexity of the calculation process, researchers typically use T scores for conversion[19]. The standard score T-score is used for the formulation - scoring equation: T=70±[((x-mean)/standard deviation)*10][20]. Indicators with a large value indicating good performance are marked with a "+"; indicators with a small value indicating good performance are marked with a "-". 70 points correspond to the average score. If you think this score is too high or too low, it can be adjusted after discussion. Note: T represents the individual score; X represents the test score of the individual indicator. Specific results are shown in the table2,3,4,5.

2.1.1 Evaluation criteria for individual physical fitness items of female compulsory detainees with diseases

Table 2: Body Shape Scoring Table for Female Compulsory Rehabilitation Participants (Drug users with illnesses)

BMI	score value	20	60	100	60	20
	Area value	<19.00	19.00-20.12	20.13-27.12	27.13-27.27	>27.27
waist to hip ratio	score value	20	40	60	80	100
	Area value	0.95-0.92	0.91-0.87	0.86-0.83	0.82-0.80	<0.80

Table 3: Pass thresholds for physical function and physical fitness of female drug rehabilitation personnel(Drug users with illnesses)

Test indicators	Equation：T=70±[（x-mean）/SD]*10					
Vital capacity	T=70+[（X-2002）/545.4]*10					
	T	50	60	70	80	90	100
	X	916	1459	2002	2545	3088	3631
Maximal oxygen uptake	T=70+[（X-41.6）/5.6]*10					
	X	50	60	70	80	90	100
	X	30	36	42	47	53	58
Grip strength	T=70+[（X-22）/5.5]*10					
	T	50	60	70	80	90	100
	X	11	17	22	27	33	38
Abdominal curl	T=70+[（X-10）/8.4]*10					
	T	50	60	70	80	90	100
	X	1	2	10	19	27	35
Sit-and-reach	T=70+[（X-14）/8.4]*10					
	T	50	60	70	80	90	100
	X	3	8	14	20	26	31
Standing on one leg with eyes closed	T=70+[（X-9.8）/12]*10					
	T	50	60	70	80	90	100
	X	1	7	13	19	25	31
Choice reaction time	T=70-[（X-0.70）/0.13]*10					
	T	50	60	70	80	90	100
	X	0.92	0.81	0.70	0.59	0.47	0.36

2.1.2 Evaluation criteria for individual physical fitness aspects of female drug rehabilitation personnel without any diseases

Table 4: Body Shape Scoring Table for Female Compulsory Rehabilitation Trainees （Drug users without any diseases）

	Age (years)	20	60	100	60	20
BMI	≤30	<19.66	19.66-21.60	21.61-26.43	26.44-29.17	>29.17
	31-40	<20.30	20.30-21.85	21.86-24.99	25.00-27.40	>27.40
	41-50	<18.20	18.21-19.30	19.31-25.71	25.72-27.37	>27.37
	＞50	<19.00	19.00-20.12	20.13-27.12	27.13-27.27	>27.27
	Age (years)	20	40	60	80	100
Waist to hip ratio	≤30	0.90-0.83	0.82-0.78	0.77-0.74	0.73-0.70	<0.70
	31-40	0.88-0.83	0.82-0.79	0.78-0.75	0.74-0.69	<0.69
	41-50	0.94-0.90	0.89-0.86	0.85-0.83	0.82-0.80	<0.80
	＞50	0.95-0.92	0.91-0.87	0.86-0.83	0.82-0.80	<0.80

Table 5: Pass thresholds for physical function and physical fitness of female compulsory detainees （Drug users without any diseases）

Test indicators	Age (years)	Equation：T=70±[（x-mean）/SD]*10					
		T=70＋[（X-2277）/747]*10					
	≤30	T	50	60	70	80	90	100
		X	792	1535	2277	3019	3762	4504
		T=70＋[（X-2176）/598]*10					
	31-40	T	50	60	70	80	90	100
Vital capacity		X	980	1578	2176	2774	3372	3970
		T=70＋[（X-2083）/550]*10					
	41-50	T	50	60	70	80	90	100
		X	923	1503	2083	2663	3243	3823
		T=70＋[（X-1956）/612]*10					
	＞50	T	50	60	70	80	90	100
		X	771	1356	1941	2526	3111	3696
		T=70＋[（X-60.2）/10.74]*10					
	≤30	T	50	60	70	80	90	100
		X	39	50	60	71	82	93
		T=70＋[（X-63.0）/11.94]*10					
	31-40	T	50	60	70	80	90	100
Step index		X	40	52	64	76	88	100
		T=70＋[（X-62.0）/13.36]*10					
	41-50	T	50	60	70	80	90	100
		X	36	50	63	76	90	103
		T=70＋[（X-58）/11.25]*10					
	＞50	T	50	60	70	80	90	100
		X	31	45	58	71	84	98
		T=70＋[（X-24.8）/5.7]*10					
	≤30	T	50	60	70	80	90	100
		X	14	19	25	30	36	42
		T=70＋[（X-23.4）/5.2]*10					
	31-40	T	50	60	70	80	90	100
Grip strength		X	13	18	23	29	34	39
		T=70＋[（X-22.8）/5.5]*10					
	41-50	T	50	60	70	80	90	100
		X	12	18	23	28	34	39
		T=70＋[（X-21.9）/5.0]*10					
	＞50	T	50	60	70	80	90	100
		X	11	17	22	27	32	37

		T=70＋[（X-16）/5.50]*10						
	≤30	T	50	60	70	80	90	100
		X	1	9	16	24	31	39
		T=70＋[（X-16）/5.25]*10						
	31-40	T	50	60	70	80	90	100
Abdominal curl		X	4	10	16	22	28	34
		T=70＋[（X-16.97）/7.68]*10						
	41-50	T	50	60	70	80	90	100
		X	2	9	17	25	32	40
		T=70＋[（X-11.25）/4.86]*10						
	＞50	T	50	60	70	80	90	100
		X	2	6	11	16	21	26
		T=70＋[（X-16）/5.8]*10						
	≤30	T	50	60	70	80	90	100
		X	4	10	16	22	28	34
		T=70＋[（（X-15.4）/6.4]*10						
	31-40	T	50	60	70	80	90	100
Sit-and-reach		X	3	9	15	22	28	35
		T=70＋[（X-14.3）/6.3]*10						
	41-50	T	50	60	70	80	90	100
		X	2	8	14	20	27	33
		T=70＋[（X-13）/6]*10						
	＞50	T	50	60	70	80	90	100
		X	0	7	13	20	27	33
		T=70＋[（X-24）/25.7]*10						
	≤30	T	50	60	70	80	90	100
		X	2	14	26	38	50	62
		T=70＋[（X-16.3）/19]*10						
Standing on one leg with eyes closed	31-40	T	50	60	70	80	90	100
		X	2	9	16	23	30	37
		T=70＋[（X-23.1）/11.2]*10						
	41-50	T	50	60	70	80	90	100
		X	1	13	25	37	49	61
		T=70＋[（X-9.）/4.7]*10						
	＞50	T	50	60	70	80	90	100
		X	2	4	9	14	18	23
		T=70-[（X-0.59）/0.08]*10						
Choice reaction time	≤30	T	50	60	70	80	90	100
		X	0.76	0.68	0.60	0.52	0.44	0.36
	31-40	T=70-[（X-0.63）/0.16]*10						

	T	50	60	70	80	90	100
	X	0.95	0.79	0.63	0.47	0.31	0.15
	T=70-[（X-0.65）/0.12]*10						
41-50	T	50	60	70	80	90	100
	X	0.89	0.77	0.65	0.53	0.41	0.29
	T=70-[（X-0.69）/0.15]*10						
＞50	T	50	60	70	80	90	100
	X	0.94	0.82	0.69	0.56	0.44	0.31

2.2 Construction of evaluation index weights

The common dimensions of physical fitness testing for the general population are "morphology, function, and quality", which have been widely applied and confirmed. The data dimensions of this study have not changed significantly, except for replacing the step test for the disease group with a walking test. The weight of an indicator signifies its significance in a comprehensive evaluation. The value of the weight indicates the importance of the indicator. Common methods for assigning weights include the Delphi method, Analytic Hierarchy Process (AHP), expert scoring, and principal component analysis[21-23].

The main component is to convert multiple indicators into a small number of comprehensive evaluation indicators through dimensionality reduction, while sacrificing a small amount of information. The comprehensive evaluation index generated is "principal components", each derived from the original linear combination, and these principal components are uncorrelated with each other. This study utilizes principal component analysis to extract the principal components from the physical fitness indicators of compulsory detoxification trainees, and calculates the mathematical model of linear combinations of the main principal components. Based on the contribution rate of the extracted principal components, weights are assigned according to the variance contribution rate of each principal component, thereby deriving a comprehensive physical fitness evaluation model for students undergoing strict discipline.

2.2.1 Comprehensive physical fitness principal component analysis of female compulsory isolation and forced detoxification personnel

KMO and Bartlett's test of sphericity. To verify whether the comprehensive physical data of compulsory detainees is suitable for principal component analysis, the first step is to check whether the KMO value of the raw data is greater than 0.5. At the same time, the significance of the chi-square test statistic of Bartlett's test of sphericity should be less than 0.01. According to Table 6, the KMO test and Bartlett's test of sphericity for the raw data of normal compulsory detoxification trainees and disease group compulsory detoxification trainees yielded the following results: (KMO=0.66>0.5; F=255.294; p<0.001; F=103.853; p<0.001), respectively. The raw data is suitable for principal component analysis and has a high reliability.

Table 6: KMO and Bartlett's Test of Sphericity

		Drug users without any diseases	Drug users with illnesses
KMO Sampling Adequacy Measure		0.66	0.53
Bartlett's test of sphericity	F	255.294	103.853
	DF	36	36
	P	0.000	0.000

2.2.1.1 The principal component structure of comprehensive physical indicators for drug rehabilitation personnel without diseases.

According to the principle of principal component extraction, the selected characteristic root value needs to be greater than 1. Based on the data presented in Table 7, the characteristic root of principal component 1 is 2.281, contributing 25.342% to the variance; the characteristic root of principal component 2 is 1.234, contributing 13.713% to the variance; the characteristic root of principal component 3 is 1.142, contributing 12.69% to the variance, with a cumulative variance contribution rate of 51.745%.

Table 7 Eigenvalues and Cumulative Contribution Rate

Principal component	Characteristic root value	Variance contribution rate (%)	Cumulative contribution rate (%)
1	2.281	25.342	25.342
2	1.234	13.713	39.055
3	1.142	12.690	51.745

Table 8 shows that the first principal component is primarily composed of grip strength, sit-and-reach, sit-ups, standing on one leg with eyes closed, and choice reaction time, with corresponding load values of 0.64, 0.524, 0.525, 0.510, and -0.465, respectively. These indicators primarily reflect the abilities of students undergoing compulsory drug rehabilitation in terms of strength, flexibility, balance, and reaction speed. Therefore, the principal component 1 is named “physical fitness” .The second principal component is primarily determined by BMI and waist-to-hip ratio, with corresponding load values of 0.712 and 0.532, respectively. This primarily reveals the obesity status and body shape characteristics of compulsory drug rehabilitation students. Therefore, the second principal component is named “Body morphology” .The third principal component is primarily composed of the step index and lung capacity, with coefficients of 0.921 and 0.587, respectively. It primarily reflects the cardiorespiratory function-related indicators of compulsory drug rehabilitation trainees. Therefore, the third principal component is named “Physical capacity”.

Table 8 Component matrix after rotation using the maximum variance method

	Principal component		
	Physical fitness	Body morphology	Physical capacity
BMI	0.227	0.712	-0.047
Waist to hip ratio	-0.170	0.532	0.031
Step index	0.037	-0.048	0.921
Vital capacity	0.310	-0.074	0.587
Grip strength	0.640	0.215	0.089
Sitting forward bend	0.524	0.083	-0.133
Abdominal curl	0.525	-0.075	-0.294
Choice reaction time	0.510	-0.009	-0.168
Standing on one foot with eyes closed	-0.465	0.273	0.048

By calculating the coefficients of the original indicators in different linear combinations of components, we can obtain the matrix of linear combination coefficients for physical fitness, body shape, and bodily function, as shown in Table 8.The comprehensive model coefficients and standardized weight values for each indicator obtained through calculation are shown in Table 9.

Table 9: Summary of coefficients of original principal components in linear combinations of principal components

	principal component		
	Physical fitness	Body morphology	Physical capacity
BMI	0.150299684	0.640864786	0.043976403
Waist to hip ratio	0.112559235	0.478848407	0.029005712
Step index	0.024498186	0.043204368	0.861750357
Vital capacity	0.205255075	0.066606733	0.549237198
Grip strength	0.423752412	0.193519563	0.083274464
Sitting forward bend	0.346947288	0.074707552	0.124443863
Abdominal curl	0.347609401	0.067506824	0.275086433
Choice reaction time	0.337677704	0.008100819	0.157192248
Standing on one foot with eyes closed	0.307882612	0.245724841	0.044912071

Table 10 List of Index Weight Values in the Comprehensive Model

First level indicator		Secondary indicators	The coefficients in the comprehensive model	Comprehensive standardized weight values
Body morphology	0.21	BMI	0.254230050	0.12
		Waist to hip ratio	0.189139179	0.09
Physical capacity	0.23	Step index	0.234784164	0.11
		Vital capacity	0.252870273	0.12
		Grip strength	0.279238967	0.13
		Sitting forward bend	0.220233751	0.10
Physical fitness	0.56	Abdominal curl	0.255593494	0.12
		Choice reaction time	0.206073718	0.10
		Standing on one foot with eyes closed	0.226918931	0.11

Based on the above research results (Table 10), the comprehensive physical fitness scoring model for inmates undergoing intensive rehabilitation can be summarized as follows:Scoring formula = BMI * 0.12 + waist-to-hip ratio * 0.09 + step test index * 0.11 + lung capacity * 0.12 + grip strength *0.13 + sitting trunk flexion * 0.10 + abdominal curl * 0.10 + standing on one foot with eyes closed * 0.11 + selective reaction time *0.10

2.2.1.2 Principal component structure of comprehensive physical indicators for drug addicts with diseases

According to the principle of principal component extraction, the selected feature root values must be greater than 1.Based on the data in Table 11, the eigenvalue of Principal Component 1 is 1.772, with a variance contribution rate of 19.129%. The eigenvalue of Principal Component 2 is 1.52, with a variance contribution rate of 16.888%. The eigenvalue of Principal Component 3 is 1.351, with a variance contribution rate of 15.011%. The cumulative 51.028 percent."

Table 11 Characteristic Values and Cumulative Contribution Rates

Principal component	Initial eigenvalue	Variance contribution rate (%)	Cumulative contribution rate%
1	1.722	19.129	19.129
2	1.520	16.888	36.017
3	1.351	15.011	51.028

The maximum variance method, specifically utilizing the Kaiser standardized maximum variance rotation technique, was employed to rotate the comprehensive physical fitness data of strong abstinence students. According to the data presented in Table , three principal components were extracted from the comprehensive physical fitness of strong abstinence trainees. Among these, Principal Component 1 is primarily comprised of factors with significant loadings, namely 0.51, 0.701, 0.566, 0.639, and -0.648.

Principal Component 2 is mainly composed of 0.818 and 0.839 with larger loadings; Principal component 3 is mainly composed of 0.641 and 0.559 with high loading capacity. Principal Component 1 mainly consists of grip strength, sit ups, forward bending while sitting, standing on one foot with eyes closed, and selective reaction time (corresponding values are 0.51, 0.701, 0.566, 0.639, -0.648, respectively).It mainly reflects the strength, flexibility, balance, and reaction ability of an individual's physique. Therefore, Principal Component 1 is named “Physical Fitness” ; Principal Component 2 is mainly composed of BMI and waist to hip ratio (corresponding values are 0.818 and 0.839, respectively), which mainly reflect the degree of obesity and physical appearance of students who have undergone strict abstinence. Therefore, Principal Component 2 is named “Body morphology”. Principal Component 3 is mainly composed of maximal oxygen uptake and lung capacity (0.641, 0.559), which mainly reflect the relevant indicators of cardiorespiratory function in strong rehabilitation students. Cardiorespiratory endurance and lung function are both important core organ functions of human-computer interaction. Therefore, Principal Component 3 is named “Physical capacity”.

Table 12 Maximum Variance Method rotated component matrix

	Principal component		
	Physical fitness	Body morphology	Physical capacity
BMI	0.011	0.818	0.087
Waist to hip ratio	-0.105	0.839	-0.128
Walk test	0.022	0.052	0.641
Vital capacity	0.461	0.127	0.559
Grip strength	0.510	-0.031	0.295
Abdominal curl	0.701	-0.146	-0.140
Sitting forward bend	0.566	-0.221	0.258
Anding on one foot with eyes closed	0.639	-0.151	-0.079
Choice reaction time	-0.648	-0.187	0.150

Utilizing the loads of the original variables following rotation, we calculated the coefficients of the original indicators across various linear combinations of components, ultimately deriving the linear combination coefficient matrix for physical fitness, body shape, and bodily functions (table 13).The comprehensive model coefficients and standardized weight values of each indicator are calculated and shown in Table 14.

Table 13 Summary of coefficients of original principal components in principal component linear combinations

	Principal component		
	Physical fitness	Body morphology	Physical capacity
BMI	0.008382549	0.663485612	0.074849961
Waist to hip ratio	0.080015242	0.680518862	0.11012408
Walk test	0.016765098	0.042177569	0.551480747
Vital capacity	0.351305017	0.103010602	0.480932508

Grip strength	0.388645463	0.02514432	0.253801592
Abdominal curl	0.53419700	0.118421637	0.120448213
Sitting forward bend	0.431320259	0.17925467	0.22196885
Anding on one foot with eyes closed	0.486949904	0.122477173	0.067967206
Choice reaction time	0.493808353	0.151677029	0.129051657

Table 14 List of Index Weight Values in the Comprehensive Model

First level indicator		Secondary indicators	The coefficients in the comprehensive model	Comprehensive standardized weight values
Body morphology	0.23	BMI	0.244745386	0.11
		waist to hip ratio	0.287612422	0.12
Physical capacity	0.21	Walk Test	0.182473776	0.08
		vital capacity	0.307263357	0.13
		grip strength	0.228675473	0.10
Physical fitness	0.56	Sitting forward bend	0.286312466	0.12
		abdominal curl	0.274880598	0.12
		anding on one foot with eyes closed	0.243072724	0.10
		Choice reaction time	0.273276947	0.12

Based on the research findings (refer to Table 14), a comprehensive scoring model for assessing the physical fitness of rehabilitation trainees in the disease group can be summarized as follows:

The scoring formula is BMI * 0.11+waist to hip ratio * 0.12+maximum oxygen uptake * 0.08+lung capacity * 0.13+grip strength * 0.10+sitting forward bending * 0.12+standing with one foot closed * 0.10+selective reaction time * 0.12+abdominal curl * 0.12

2.2.3 Comprehensive Level Evaluation

Analyze the total score database derived from the scoring norm outlined in the previous section for all samples in this study using SPSS software. In accordance with the National Standards, the total scores corresponding to the th, 65th, and 90th percentiles of the annual sample designated as the grading threshold points, and a four-level grading system is employed for comprehensive rating. It is divided into four levels: Level 1 (excellent), Level 2 (good), Level 3 (satisfactory), and Level 4 (unqualified), as shown in Table 15.

Table 15 Comprehensive Physical Fitness Rating Scale for Female Drug Addicts

Grade	Score A
Level 1 (Excellent)	A≥83 分
Level 2 (Good)	75≤A＜83
Level 3 (satisfactory)	60≤A＜75
Level 4 (Unqualified)	A＜60

3 Conclusion

1）This study developed T-score scoring equations for each individual physical fitness indicator of drug users, regardless of whether they have diseases, based on the baseline physical fitness of female drug users. Drug users without diseases are categorized into four age groups: under 30 years old, 31-40 years old, 41-50 years old, and 51-60 years old, and each group has a corresponding T-score evaluation equation for different physical fitness indicators.2）This study determined the weights of each indicator and the combined weights of secondary indicators in the physical assessment index system for female drug addicts under mandatory isolation.3）Based on the total score calculated the individual physical fitness index T scores and their respective weights of female drug users, a comprehensive rating system of "four levels" was established, including excellent, good, qualified, and unqualified.4）A data model of physical fitness indicators for female inmates undergoing mandatory isolation and rehabilitation in Chongqing was constructed based on disease status and age, and initial evaluation criteria were established.

Author Contributions

This article is written by Yi Yang and Jiong Luo, Luo Jiong is the manager of the project and has approved the author and corresponding author of this study. All authors have read and agreed with the published version of the manuscript.

Authorship declaration

All authors of the article declare that there are no conflicts of interest during the research and writing process of the article.

Ethics Statement

The studies involving human participants were reviewed and approved by Ethics Committee of Southwest University Hospital. The patients/participants provided their written informed consent to participate in this study.

Data Availability Statement

The data presented in this study is available upon request from the corresponding author.

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Conflict of interest

The authors deny any conflict of interest

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