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Research on high-dimensional rehabilitation data analysis and optimization strategy based on time-series model in sports for disabled people

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Abstract With the rise of national health as a national strategy, the health of disabled people as a special group has been increasingly concerned. Rehabilitation sports for the disabled combines rehabilitation medicine and sports, which helps the disabled to treat physical diseases and adjust mental health. In this paper, we explored the method of analyzing the rehabilitation data of disabled people's sports based on the time series model, which aims to improve the accuracy of predicting the rehabilitation effect and optimize the rehabilitation strategy. The study adopts the ARMA time series model to analyze the rehabilitation data of the disabled, and compares it with the multiple regression model (MRM), stepwise regression model (SRM) and CAR model; at the same time, it constructs a rehabilitation pathway system that includes three dimensions: institutional guarantee, scientific guidance and talent cultivation. The results showed that the maximum residual variance of ARMA time-series model was only 0.21, which was significantly lower than the other three models (MRM:3.40, SRM:3.18, CAR:3.60); the lung capacity of the experimental group was increased from 3008.59 to 3524.51, the BMI index was decreased from 22.95 to 18.89, and all the physical fitness indicators showed significant improvement in the experimental group, and the significant improvement on all of them (P<0.05). The conclusion of the study indicated that the analysis of rehabilitation data based on the time series model has high precision, and the rehabilitation path combining the perfect guarantee system, scientific fitness guidance and complex talent training can effectively improve the physical quality of the disabled and provide scientific basis and practical guidance for the rehabilitation of disabled people's sports.

Index Terms Rehabilitation of disabled people, time series model, ARMA model, sports, rehabilitation data analysis, body-medicine integration

I. Introduction

Health is an inevitable requirement for the comprehensive development of human beings and a basic condition for economic and social development [1]. In order to promote the construction of a healthy China, the government has clearly pointed out the need to increase the “integration of physical medicine” and non-medical health interventions, and emphasized the importance of solving the health problems of key special populations such as people with disabilities [2], [3]. This is the “integration of sports and medicine” in the practice level after years of exploration, and finally in the policy aspect can be presented [4]. With the rise of national health as a national strategy, physical fitness and health of China are inseparable and imperative, and the disabled as a special group, their physical fitness situation deserves the attention and concern of society [5].

Disabled people are individuals who have lost the ability to perform certain activities in a normal way due to the loss or abnormality of some aspects of their mental, physical or part of the human body structure, in which all or part of them are lost [6]. The five main categories include visual disability, hearing and speech disability, intellectual disability, physical disability and mental disability [7]. Disability not only brings great physical and psychological pain to disabled people, but also brings serious disturbance to their daily learning and life [8]-[10]. In addition, disability also affects the life, work and study of other members of the family, creating thousands of family misfortunes, and ultimately becoming a great resistance to social development [11]. Rehabilitation sports for people with disabilities is a discipline that combines rehabilitation medicine and sports, and uses various sports programs and equipments to help this special group of people to treat their physical diseases and correct their mental health, so as to achieve the purpose of promoting the healthy development of the disabled group [12]-[14].

The application of healthcare big data as a necessary condition to promote the construction of a healthy China and improve public well-being, is an important support to promote changes in the medical model and improve the health governance model, and is an important way to cultivate the development of new business models and economic growth points [15], [16]. However, the traditional construction of rehabilitation information technology, most of the software and hardware “bundled” model, when the need to meet certain business needs, the first is to purchase a certain amount of hardware resources, with the development and deployment of the specified software. Each business objective occupies a certain amount of hardware resources, resulting in an unbalanced distribution of resources, and at the same time bringing a certain amount of maintenance costs [17]. In recent years, with the rise of portable medical devices, on the one hand, it promotes the change of rehabilitation medical construction for disabled people, and on the other hand, it launches a challenge to the traditional rehabilitation medical construction model [18], [19]. New medical devices can obtain a large amount of information about users with the help of biosensors and mobile APP, and collect user information in real time [20]. The traditional model of informatization construction in rehabilitation medicine can no longer undertake the storage and analysis of high-dimensional data [21]. Therefore, there is an urgent need to adopt new informatization technology to promote the transformation of rehabilitation medicine informatization and the digital development of sports rehabilitation for the disabled.

Health is an inevitable requirement for the promotion of comprehensive human development and a basic condition for economic and social development. With the implementation of the national health strategy, the physical fitness of disabled people as a special group deserves more attention. Rehabilitation sports for the disabled is a discipline that combines rehabilitation medicine and sports, helping the disabled to treat physical diseases and correct mental health through various sports programs and equipment. However, the traditional rehabilitation information construction mostly adopts the “bundled” model of hardware and software, which leads to unbalanced resource allocation and increased maintenance costs. With the rise of portable medical devices and the development of biosensor technology, a large amount of high-dimensional rehabilitation data is generated in real time, and the traditional model of rehabilitation medicine informatization can no longer meet the demand for data analysis. This study intends to construct a data analysis framework applicable to sports rehabilitation of disabled people from the perspective of time series model and explore the optimization of rehabilitation path. The study first combs through the theoretical basis of the time series analysis method, including the basic principles and mathematical expressions of AR model, MA model and ARMA model; then takes the rehabilitation data of disabled person A as an example and compares the prediction accuracy of ARMA time series model with that of multivariate regression model, stepwise regression model, and CAR model; and then proposes a rehabilitation pathway that includes the three dimensions of institutional guarantee, scientific fitness guidance and talent cultivation from the actual perspective of disabled person's sports rehabilitation. Finally, the practical effects of the proposed rehabilitation strategies are verified through experiments on 40 disabled people with structural or functional impairments of the locomotor system. This study combines quantitative analysis with qualitative research, focusing on both the prediction accuracy of data modeling and the innovation of pathways in the actual rehabilitation process. Through the high-dimensional rehabilitation data analysis based on the time series model, combined with the optimized rehabilitation strategy, it is expected to improve the rehabilitation effect of disabled people, provide theoretical basis and practical guidance for the scientific development of disabled people's sports under the background of the integration of body and medicine, and help improve the health level of disabled people's groups, promote the construction of Healthy China and the comprehensive development of disabled people.

II. Analysis of data on sports rehabilitation for persons with disabilities based on time-series modeling

II. A. Timing analysis method

II. A. 1) Timing analysis

The method of analysis by time series, called temporal analysis [22], [23], can be arranged in time, space or other physical quantities sequentially arranged into an ordered array using statistics to deal with the analysis is, is an effective mathematical method. The ordered data in the paper are the analyzed data of the sampled fluids of this test, arranged by sampling time.

The time-ordered analysis method originates from practical forecasting applications, especially in economic forecasting applications. G.U. Rule in 1927 for the first time proposed the autoregressive parametric model of time series (AR model), and then in the practical application, based on the AR model gradually developed a sliding average parametric model (MA model) and autoregressive sliding average parametric model (ARMA model) several types of time series analysis model. The application is very wide.

II. A. 2) Timing models and their modeling methods

The $AR(n)$ model, i.e., the n-order autoregressive model, as a classical model for time series analysis, the algorithm of this model is simple, practical and reliable, so the $AR(n)$ model is widely used in many fields, especially for time series prediction.

Let the full sequence of physical quantities waiting to be analyzed (in this paper, sports rehabilitation data for the disabled) arranged in order of sampling time be:

$$X' = \{x_1', x_2', x_3', \dots, x_t', \dots, x_N'\} \tag{1}$$

where the subscript t represents the sequence of sampling time and the total number of samples is N.

According to the modeling and application requirements of $AR(\mathrm{n})$ model, the raw detection data are first preprocessed:

(1) Test the smoothness of the original detection data sequence X'. From X', the mean $\mu_{X'}$ and its k-order covariance $\hat{C}_{xx,k}$ can be calculated as follows:

$$\mu_{X'} = \sum_{t=1}^{N} x_t' \Big/ N \tag{2}$$

$$\hat{C}_{xx,k} = \left[\sum_{t=k+1}^{N} (x_t' - \mu_{X'})(x_{t-k}' - \mu_{X'})\right] \Big/ (N-k) \tag{3}$$

If the 1st and 2nd order covariances are approximately equal to zero, X' passes the test of smoothness and X' is a wide smooth stochastic process.

(2) Test the normality of the raw monitoring data series X'. Test the third-order moments and fourth-order moments of X', if X' is normally distributed, its third-order moments and fourth-order moments need to satisfy the following equation:

$$E\left[\frac{x_t' - \mu_{X'}}{\sigma_{X'}}\right]^3 = 0 \tag{4}$$

$$E\left[\frac{x_t' - \mu_{X'}}{\sigma_{X'}}\right]^4 = 3 \tag{5}$$

According to the literature, the raw sequences in real fault prediction applications are normally distributed, and the default X' satisfies the normal distribution.

(3) Zeroization of the original detection data sequence X'. After X' passes the smoothness and normality tests, X' is zeroed into $X = \{x_t\}(t = 1, 2, \dots, N)$ as follows:

$$x_t = x_t' - \mu_{X'} \ (t = 1, 2, \dots, N) \tag{6}$$

For the zeroed sequence $X = \{x_t\}(t = 1, 2, \dots, N)$, model $AR(n)$:

$$x_t = \varphi_1 x_{t-1} + \varphi_2 x_{t-2} + \cdots + \varphi_n x_{t-n} + a_t \tag{7}$$

$$a_t \sim NID(0, \sigma_a^2) \tag{8}$$

The order n of the model is determined during the modeling process. The model has $\varphi_1, \varphi_2, \cdots, \varphi_n$, and σ_a^2 for a total of $n+1$ unknowns, which are determined during modeling. (7) Eq. $\{a_t\}$ is the sequence of model residuals, which by definition has:

$$a_t = x_t - \varphi_1 x_{t-1} - \varphi_2 x_{t-2} - \cdots - \varphi_n x_{t-n} \tag{9}$$

$$\sigma_a^2 = E\left[a_t^2\right] = \sum_{t=n+1}^{N} (x_t - \varphi_1 x_{t-1} - \varphi_2 x_{t-2} - \cdots - \varphi_n x_{t-n}) / N \tag{10}$$

Based on the above model definition, the modeling steps for the specific $AR(n)$ model are as follows:

In the first step, the model takes the following form:

$$\overline{y} = \overline{x}\overline{\varphi} + \overline{a} \tag{11}$$

Among them:

$$\overline{y} = [x_{n+1}, x_{x+2}, \dots, x_N]^T \tag{12}$$

$$\overline{\varphi} = [\varphi_1, \varphi_2, \dots, \varphi_n]^T \tag{13}$$

$$\overline{a} = [a_{n+1}, a_{x+2}, \dots, a_N]^T \tag{14}$$

$$\overline{x} = \begin{bmatrix} x_n & x_{n-1} & \cdots & x_1 \\ x_{n+1} & x_n & \cdots & x_2 \\ \vdots & \vdots & \vdots & \vdots \\ x_{N-1} & x_{N-2} & \cdots & x_{N-n} \end{bmatrix} \tag{15}$$

In the second step, the model order is preset. Set the model order n in order from 1 to N', where N' is the highest order of the preset model and is any natural number in the interval $(1, N]$.

In the third step, the parameters $\bar{\varphi}$ of the model are estimated. For the already taken order n, the least squares estimate of the parameter matrix $\bar{\varphi}$ is:

$$\hat{\overline{\varphi}} = (\overline{x}^T \overline{x})^{-1} \overline{x}^T \overline{y} \tag{16}$$

In the fourth step, the variance σ_a^2 of the residual sequence $\{a_t\}$ is found. Substitute the estimated parameter matrix into $\bar{\varphi}$ equation (10) and calculate σ_a^2.

The fifth step is to test the modeling error. The method is as follows:

$$FPE = (N + n)\sigma_a^2 / (N - n) \tag{17}$$

Step 6, final modeling. Cyclic execution of the second step to the fifth step, different preset order, the error of the minimum corresponding to n for the final order, with this corresponding $\hat{\varphi}$ and $\hat{\sigma}_a^2$ that is, the parameters of the model, the final prediction model is as follows:

$$\hat{x}_{t+1} = \hat{\varphi}_1 x_t + \hat{\varphi}_2 x_{t-1} + \cdots + \hat{\varphi}_n x_{t-n+1} + \hat{a}_t \tag{18}$$

The model developed through the above steps implies the necessary connections between the data and also describes, to some extent, the nature of the physical system to which the data corresponds, and can therefore be used to make predictions and forecasts of the development of the future state of the system, i.e., of the future trends in the observed data series.

II. B.ARMA model properties

A sequence of observations identified as a smooth non-white noise sequence after a smoothness test and a pure randomness test enables a linear model to be built to fit the development of the sequence and to extract the relevant information embedded in the smooth sequence. The autoregressive moving average (ARMA) model is currently the most commonly used model for fitting smooth series to extract valid information from the series.

ARMA models can be subdivided into three main categories: autoregressive AR models, moving average MA models and autoregressive moving average ARMA models [24], [25].

II. B. 1) Autoregressive (AR) models

The p-order autoregressive model, i.e., the $AR(p)$ model, is structured as in equation (19):

$$\begin{cases} x_t = \varphi_0 + \varphi_1 x_{t-1} + \varphi_2 x_{t-2} + \cdots + \varphi_p x_{t-p} + \varepsilon_t \\ \varphi_p \neq 0 \\ E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma_\varepsilon^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \\ E(x_s \varepsilon_t) = 0, \forall s < t \end{cases} \tag{19}$$

$AR(p)$ model can be abbreviated under the constraints of the default upper equation:

$$x_t = \varphi_0 + \varphi_1 x_{t-1} + \varphi_2 x_{t-2} + \cdots + \varphi_p x_{t-p} + \varepsilon_t \tag{20}$$

As an example, the first-order autoregressive model, i.e., the $AR(1)$ model, has first-order dynamics, i.e., it has short-term memory. This dependence can be expressed as the value of the latter moment is mainly related to the value of the former moment, but not directly related to the value of the former moment before. The mathematical model can be expressed as, it is known that x_{t-1} and x_t is mainly related to x_{t-1}.

In performing the correlation analysis of the autoregressive model, the autoregressive $AR(p)$ model reduces to a centered $AR(p)$ model when $\varphi_0 = 0$ in equation (19). The analysis of its centered model is performed by simply shifting the uncentered series overall by one constant unit, which has no effect on the correlation of the observed series. In general, the uncentered autoregressive series can be transformed into a centered autoregressive series by equation (21). Let $\mu = \varphi_0 / 1 - \varphi_1 - \cdots - \varphi_p$, then

$$y_t = x_t - \mu \tag{21}$$

Call $\{y_t\}$ a centralized sequence of $\{x_t\}$. The model can be simplified by introducing a delay operator, and the expression for the centered $AR(p)$ model is denoted:

$$\Phi(B)x_t = \varepsilon_t \tag{22}$$

where $\Phi(B)$ is an autoregressive coefficient polynomial of order p, $\Phi(B) = 1 - \varphi_1 B - \varphi_2 B^2 - \cdots - \varphi_p B^p$.

Unlike the general regression analysis forecasting methods which are subject to modeling difficulties caused by the choice of independent variables and multicollinearity, the application of autoregressive models has the advantage that relevant information about the forecasting target can be obtained from the historical observations of the time series itself.

Autoregressive models are more superior in terms of the constraint that the model variables are independent of each other. The autoregressive model generally uses the partial autocorrelation function to discriminate the order of the model, when the partial autocorrelation function image shows damped oscillations or unilateral decreasing, i.e., all the partial autocorrelation functions starting from the order of p are 0, it can be determined that the autoregressive model's order is p at this time.

II. B. 2) Moving Average (MA) Modeling

(1) Definition and statistical properties of the moving average model

The q-order moving average model, i.e., the $MA(q)$ model, is structured as in equation (23):

$$\begin{cases} x_t = \mu + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \cdots - \theta_q\varepsilon_{t-q} \\ \theta_q \neq 0 \\ E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma_\varepsilon^2, E(\varepsilon_t\varepsilon_s) = 0, s \neq t \end{cases} \tag{23}$$

$MA(q)$ model can be abbreviated under the constraints of the default upper equation:

$$x_t = \mu + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \cdots - \theta_q\varepsilon_{t-q} \tag{24}$$

Similar to the centering operation for autoregressive models, the uncentered moving average model is transformed into a centered moving average model by the overall shift $y_t = x_t - \mu$. Again, this centering operation does not affect the correlation of the observations, so the analysis of the correlation of the moving average model is often reduced to the analysis of its centered model. Similarly to the $AR(p)$ model, when $\mu = 0$, the model can be simplified by introducing a delay operator, and the centered $MA(q)$ model can be abbreviated as:

$$x_t = \Theta(B)\varepsilon_t \tag{25}$$

where $\Theta(B)$ is a moving average coefficient polynomial of order q and $\Theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \cdots \theta_q B^q$.

(2) Reversibility of Moving Average Models

If a moving average model satisfies the condition of reversibility, it can be expressed in an equivalent form, viz:

$$\Theta(B)I(B)x_t = x_t \tag{26}$$

For a reversible $MA(q)$ model, this can be equivalently written in the form of an $AR(\infty)$ model. Based on the reversibility of the moving average model, it can be seen that the reversible moving average model has a biased autocorrelation function trailing off. At the same time, since the autoregressive model partial autocorrelation function p order truncated tail, the reversible moving average model has a partial autocorrelation function ∞ truncated tail.

In general, a reversible $MA(q)$ model must correspond to an irreversible $MA(q)$ model with the same autocorrelation function and partial autocorrelation function as it, and this irreversible $MA(q)$ model is also similarly trailing in the partial autocorrelation function.

In summary, the $MA(q)$ model can compensate for the $AR(p)$ model when the assumptions cannot be met. Since the value of the parameter p in the $AR(p)$ model has a stronger effect on the time series compared to the value of the parameter 6 in the $MA(q)$ model, the smoothness of the $MA(q)$ model is conditional on the fact that smaller random variations are able to change the direction of the time series.

II. B. 3) Autoregressive moving average (ARMA) models

The autoregressive moving average model, i.e., the $ARMA(p,q)$ model, is structured as in equation (27):

$$\begin{cases} x_t = \varphi_0 + \varphi_1 x_{t-1} + \cdots + \varphi_p x_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \cdots \theta_q \varepsilon_{t-q} \\ \varphi_p \neq 0, \theta_q \neq 0 \\ E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma_\varepsilon^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \\ E(x_s \varepsilon_t) = 0, \forall s < t \end{cases} \tag{27}$$

As with the autoregressive model, when $\varphi_0 = 0$, the model at this point is said to be a centered $ARMA(p,q)$ model. Defaulting to the constraints of equation (27), the centered $ARMA(p,q)$ model can be abbreviated as:

$$x_t = \varphi_1 x_{t-1} + \cdots + \varphi_p x_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \cdots \theta_q \varepsilon_{t-q} \tag{28}$$

With the introduction of the delay operator, the $ARMA(p,q)$ model can be expressed as:

$$\Phi(B)x_t = \Theta(B)\varepsilon_t \tag{29}$$

It can be observed that the autoregressive model and the moving average model are degradations of the $ARMA(p,q)$ model from the $ARMA(p,q)$ model when p and q are zero, respectively. Therefore, both models are actually special cases of the $ARMA(p,q)$ model, and thus both are referred to as ARMA models.

The statistical properties of the $ARMA(p,q)$ model also synthesize the statistical properties of these two degenerate models. For an $ARMA(p,q)$ model, letting $Z_t = \Theta(B)\varepsilon_t$ yields $\{Z_t\}$ a zero-mean, variance of $(1+\theta_1^2+\cdots+\theta_q^2)\sigma_\varepsilon^2$ smooth series. Thus the $ARMA(p,q)$ model can be rewritten in the following form:

$$\Phi(B)x_t = Z_t \tag{30}$$

II. C. Comparison of time-series model forecast accuracy

In order to illustrate that the use of time series models to model the rehabilitation data on the use of sports by people with disabilities can obtain a high degree of accuracy with a small residual index. In this section, the traditional multiple regression model (MRM), stepwise regression model (SRM), CAR model are mainly used and compared with the time series model modeling. Disabled person A was randomly selected as the research object to monitor and analyze his physical rehabilitation data, and the modeling time period was from January 2020 to July 2024. The theory of selecting the optimal statistical model determined that the multiple regression model and stepwise regression model were used for model selection, and due to the maturity of the method, only the final modeling results and model comparison results are given in this section. The forecasts and residuals for each model are shown in Table 1.

From Table 1, the maximum residuals of the multiple regression model (MRM), stepwise regression model (SRM), CAR model, and ARMA time series model are 3.40, 3.18, 3.60, and 0.21, respectively. It can be seen that the ARMA time series model chosen in this paper has higher accuracy.

Table 1: Each model forest and residuals

Time	Real value	Forest value of each model				Residual of each model			
		MRM	SRM	CAR	ARMA	MRM	SRM	CAR	ARMA
2020/01	2.67	2.08	2.99	2.07	2.55	0.59	0.32	0.60	0.12
2020/02	3.71	1.17	2.46	0.11	3.72	2.54	1.25	3.60	0.01
2020/03	0.33	0.78	2.86	1.91	0.41	0.45	2.53	1.58	0.08
2020/04	2.93	3.85	1.11	2.81	2.86	0.92	1.82	0.12	0.07
2020/05	3.05	2.08	0.88	3.45	3.18	0.97	2.17	0.40	0.13
2020/06	2.21	3.93	0.18	1.04	2.36	1.72	2.03	1.17	0.15
2020/07	0.26	1.08	0.89	3.74	0.13	0.82	0.63	3.48	0.13
2020/08	1.41	0.95	2.85	0.55	1.61	0.46	1.44	0.86	0.20
2020/09	3.42	1.19	0.79	3.03	3.59	2.23	2.63	0.39	0.17
2020/10	0.82	3.87	0.64	2.94	0.74	3.05	0.18	2.12	0.08
2020/11	2.54	2.66	3.22	1.16	2.63	0.12	0.68	1.38	0.09
2020/12	0.56	0.42	3.74	1.73	0.63	0.14	3.18	1.17	0.07
2021/01	1.09	3.88	2.65	3.25	1.02	2.79	1.56	2.16	0.07
2021/02	1.21	2.43	0.82	3.44	1.19	1.22	0.39	2.23	0.02
2021/03	1.99	1.11	0.84	0.46	1.78	0.88	1.15	1.53	0.21
2021/04	0.66	0.57	1.96	0.77	0.63	0.09	1.30	0.11	0.03
2021/05	1.72	0.13	0.41	1.44	1.83	1.59	1.31	0.28	0.11
2021/06	0.76	1.98	2.31	0.14	0.91	1.22	1.55	0.62	0.15
2021/07	1.89	0.81	0.77	2.23	1.96	1.08	1.12	0.34	0.07
2021/08	1.15	1.04	2.28	3.18	1.33	0.11	1.13	2.03	0.18
2021/09	3.27	3.12	3.89	1.19	3.14	0.15	0.62	2.08	0.13
2021/10	3.31	1.59	2.26	2.17	3.38	1.72	1.05	1.14	0.07
2021/11	2.13	2.22	2.45	2.98	2.21	0.09	0.32	0.85	0.08
2021/12	1.04	2.36	2.67	2.23	0.97	1.32	1.63	1.19	0.07
2022/01	2.06	1.49	0.12	1.78	2.15	0.57	1.94	0.28	0.09
2022/02	0.82	1.73	0.57	2.44	0.93	0.91	0.25	1.62	0.11
2022/03	2.26	2.63	1.63	2.92	2.37	0.37	0.63	0.66	0.11
2022/04	0.14	0.93	0.61	3.33	0.19	0.79	0.47	3.19	0.05
2022/05	1.22	3.68	3.91	0.08	1.43	2.46	2.69	1.14	0.21
2022/06	1.89	1.46	0.99	2.59	1.76	0.43	0.90	0.70	0.13
2022/07	0.32	1.93	1.55	2.63	0.37	1.61	1.23	2.31	0.05
2022/08	1.58	2.23	2.05	2.75	1.39	0.65	0.47	1.17	0.19
2022/09	1.51	3.45	0.67	0.36	1.46	1.94	0.84	1.15	0.05
2022/10	2.59	0.84	3.68	1.15	2.66	1.75	1.09	1.44	0.07
2022/11	1.59	0.45	3.27	1.83	1.48	1.14	1.68	0.24	0.11
2022/12	1.02	1.41	3.28	1.81	1.09	0.39	2.26	0.79	0.07
2023/01	0.39	2.33	0.08	0.03	0.46	1.94	0.31	0.36	0.07
2023/02	1.61	1.41	2.83	3.11	1.68	0.20	1.22	1.50	0.07
2023/03	2.76	1.86	1.53	3.65	2.83	0.90	1.23	0.89	0.07
2023/04	3.73	0.33	2.46	3.31	3.66	3.40	1.27	0.42	0.07
2023/05	3.73	2.44	3.56	2.09	3.79	1.29	0.17	1.64	0.06
2023/06	3.21	3.02	3.97	0.93	3.26	0.19	0.76	2.28	0.05
2023/07	2.99	1.22	2.33	0.59	3.02	1.77	0.66	2.40	0.03
2023/08	0.86	2.85	1.58	2.32	0.78	1.99	0.72	1.46	0.08
2023/09	3.57	1.36	2.69	0.31	3.65	2.21	0.88	3.26	0.08
2023/10	2.78	2.98	1.62	2.54	2.81	0.20	0.16	0.24	0.03
2023/11	2.02	1.35	0.24	0.23	2.08	0.67	1.78	1.79	0.06
2023/12	1.34	2.42	1.79	0.54	1.41	1.08	0.45	0.80	0.07
2024/01	1.05	2.76	2.18	2.35	1.11	1.71	1.13	1.30	0.06
2024/02	2.25	0.81	0.48	3.15	2.29	1.44	1.77	0.9	0.04
2024/03	3.63	3.57	3.23	2.82	3.72	0.06	0.40	0.81	0.09

2024/04	0.68	3.01	3.33	2.03	0.59	2.33	2.65	1.35	0.09
2024/05	1.46	2.69	3.09	0.75	1.55	1.23	1.63	0.71	0.09
2024/06	1.32	1.17	3.29	2.99	1.37	0.15	1.97	1.67	0.05
2024/07	3.19	0.44	3.02	0.43	3.25	2.75	0.17	2.76	0.06

III. Exploration of sports rehabilitation strategies for persons with disabilities

III. A. Pathways to sports rehabilitation for persons with disabilities

(1) Constructing a sound supporting security system

Many people with disabilities have limited financial income due to personal physical defects, so it is difficult for them to have extra money to participate in fitness training after paying for medical expenses. At the same time, people with disabilities and normal people have different needs in fitness venues, equipment, etc., so the venues for people with disabilities to exercise need to be specially constructed, and the source of funding is also a major problem. At present, there are very few places for disabled people to exercise, so in order to solve the problem of venues and equipment fundamentally, the government or society should provide financial and other support to ensure that every disabled person can participate in rehabilitation sports. As persons with disabilities are a vulnerable group, the government should take the lead, lead social organizations and more people to participate in teams that provide assistance to persons with disabilities, build a more comprehensive protection system, rationally allocate social resources, and provide persons with disabilities with free support in terms of equipment, venues, and funding, so that they can enjoy the benefits of public sports resources. In addition, local governments can also invite and encourage social forces to join in the investment and construction of sports venues and facilities for people with disabilities through a variety of ways, so that more people with disabilities can join in physical exercise, looking for equipment that meets their own needs for sports, without worries.

(2) Utilizing new media to popularize science and enhance the awareness of scientific fitness for the disabled.

In order to make people with disabilities can effectively improve the level of exercise, to ensure the scientific nature of fitness, all kinds of rehabilitation centers and colleges and universities should regularly carry out publicity lectures, invite sports experts to popularize professional knowledge, so that people with disabilities can continue to enhance the awareness of scientific fitness and maximize the positive effect of physical exercise. At the same time, the current network media development is very rapid, especially the new media, both social and news functions, doctors and fitness instructors can carry out scientific popularization work after identity authentication in the new media. New media can not only provide the public with credible content and up-to-date knowledge, but also help generate broader social value. The use of new media to increase health education and publicity will enable more people with disabilities to fully understand the importance of physical activity for rehabilitation, so that they can more actively accept scientific arrangements for physical activity.

At the same time, due to the low educational level of many disabled people, some of them cannot clearly understand the content of the text description, and some of them are even reluctant to participate in sports activities due to their low self-esteem and fear of displaying their own physical defects, and some of them even exclude sports activities in public places. For these special groups, self-rehabilitation can be realized at home by combining with the self media, especially during the epidemic, health promotion and rehabilitation guidance work can be carried out more smoothly. In addition, we can also promote the program of rehabilitation and sports into the family in each small area, arranging professionals to visit the families of people with disabilities in each small area, popularizing professional knowledge and providing professional guidance, so that people with disabilities and their family members can change their views on physical exercise, and then actively participate in daily physical exercise and related activities run by the community or society.

(3) Cultivation of Comprehensive Talents

On the basis of the rich resources of higher education, medical schools and sports colleges are encouraged to jointly create specialties in the integration of sports and medicine, including the creation of a dual-degree training system. Talent cultivation must utilize the important position of colleges and universities. Medical schools with rehabilitation majors, whether Western medicine or Chinese medicine, and various sports colleges with sports rehabilitation majors, combine the demand for talent cultivation under the background of body-medicine fusion, integrate medical knowledge and sports knowledge with each other, cultivate composite talents, prepare a perfect teaching plan program, innovate the relevant education work mechanism and mode through the integration between theoretical education and practical operation education, and constantly Improve the quality of education and achieve the expected goal of talent cultivation. At the same time, to improve the teaching concept of teachers, in order to cultivate the body-medicine integration of complex talents, first of all, teachers need to set up the correct conceptual awareness, through the teaching and research department teaching seminars, fully recognize the importance of the cultivation of complex talents.

III. B. Analysis of rehabilitation effects

In order to investigate the effect of the sports rehabilitation pathway for disabled people proposed in this paper, 40 disabled people with structural or functional injuries of the motor system were selected as experimental subjects, and they were randomly and equally divided into experimental group and control group. The experimental group adopts the sports rehabilitation strategy of this paper, while the control group is not required. The physical fitness of the two groups before and after the experiment was measured to examine the rehabilitation effect.

Before the beginning of the experiment, the physical fitness test scores of 40 disabled people in the experimental and control groups were counted and recorded as shown in Table 2. The following data were obtained by using the independent samples T-test, and it can be seen from the data shown in Table 2 that there is no significant difference between the two groups of physical test data in BMI, lung capacity, seated forward bending, deep squatting, motor response, and one-legged standing (P>0.05), which is statistically significant.

Table 2: Inter-group comparison results before the experiment

Item	Control group	Experimental group	T	P
BMI index	21.56±2.13	22.95±3.17	-2.065	0.359
Lung capacity	2989.85±487.69	3008.59±448.54	-1.779	0.542
Preflexion	7.53±2.59	8.06±2.93	-0.574	0.496
Deep squat	18.74±9.45	19.93±10.56	-0.593	0.612
Sport reaction	19.42±10.05	18.64±9.45	0.674	0.478
Stand with one foot	16.54±3.74	17.61±2.84	-0.428	0.356

At the end of the experiment, the six physical qualities of the experimental and control groups were tested again, and the results are shown in Table 3. As seen in Table 3, after the exercise rehabilitation experiment, the experimental and control groups produced significant differences. The two groups, which had no significant differences before the experiment, showed significant differences in BMI, lung capacity, sitting forward bending, deep squatting, motor response, and one-legged standing after the experiment (P<0.05). The results of these six indexes in the experimental group were 18.89, 3524.51, 10.63, 22.26, 21.66, and 20.15, while the results of the indexes in the control group were 21.86, 3004.52, 7.25, 18.04, 18.59, and 16.85, which made the experimental group significantly better than the control group performance.

Table 3: Inter-group comparison results after the experiment

Item	Control group	Experimental group	T	P
BMI index	21.86±2.85	18.89±2.04	1.562	0.004
Lung capacity	3004.52±496.54	3524.51±513.88	-7.865	0.001
Preflexion	7.25±2.46	10.63±3.16	-1.584	0.004
Deep squat	18.04±8.79	22.26±10.69	-2.635	0.001
Sport reaction	18.59±9.48	21.66±10.45	-3.045	0.002
Stand with one foot	16.85±3.84	20.15±4.96	-2.685	0.003

The pre- and post-experiment test data of the control group were compared, and the results are shown in Table 4. From the results of Table 4, it can be found that the control group did not see any significant differences in the six physical fitness indicators of BMI, lung capacity, sitting forward bending, deep squatting, motor response, and one-legged standing before and after the experiment (P>0.05), and basically remained at the same level.

Table 4: Inner-group comparison results of control group before the experiment

Item	Before	After	T	P
BMI index	21.56±2.13	21.86±2.85	-0.682	0.326
Lung capacity	2989.85±487.69	3004.52±496.54	-2.886	0.254
Preflexion	7.53±2.59	7.25±2.46	0.374	0.715
Deep squat	18.74±9.45	18.04±8.79	0.869	0.624
Sport reaction	19.42±10.05	18.59±9.48	1.655	0.542
Stand with one foot	16.54±3.74	16.85±3.84	-0.279	0.409

Similarly, the data of the experimental group in the group before and after the experiment were compared and the results are shown in Table 5. Observation of Table 5 shows that the experimental group produced a significant improvement in physical fitness after the experiment. The BMI index of the disabled in the experimental group decreased by 4.06, and the lung capacity, seated forward bending, deep squatting, motor response, and one-legged standing increased by 515.92, 2.57, 2.33, and 3.02 respectively, and the significance test of the six physical quality indexes was less than 0.05, which indicates that the experimental group had a significant improvement in physical quality after the physical rehabilitation strategy for the disabled in this paper, and it is enough to show that the method has a better rehabilitation effect.

Table 5: Inner-group comparison results of experimental group before the experiment

Item	Before	After	T	P
BMI index	22.95±3.17	18.89±2.04	3.265	0.001
Lung capacity	3008.59±448.54	3524.51±513.88	-4.623	0.001
Preflexion	8.06±2.93	10.63±3.16	-2.548	0.003
Deep squat	19.93±10.56	22.26±10.69	-3.182	0.002
Sport reaction	18.64±9.45	21.66±10.45	-2.896	0.003
Stand with one foot	17.61±2.84	20.15±4.96	-4.108	0.003

IV. Conclusion

This study analyzes the sports rehabilitation data of the disabled based on the time series model, explores the optimization of sports rehabilitation strategies for the disabled, and draws the following conclusions:

First, in the analysis of rehabilitation data, ARMA time series model shows higher prediction accuracy, and its maximum residual is only 0.21, while the maximum residuals of multiple regression model, stepwise regression model and CAR model are 3.40, 3.18 and 3.60, respectively, which proves that ARMA time series model is more suitable for analyzing and predicting the rehabilitation data of the disabled. Secondly, the sports rehabilitation pathway for the disabled constructed in this study achieved significant results in practice, and the experimental group improved the ability to stand on one foot from 17.61 to 20.15, the number of deep squats from 19.93 to 22.26, the motor response from 18.64 to 21.66, and the seated forward body flexion from 8.06 cm to 10.63 cm after the rehabilitation intervention, and all the indexes had a statistically significant differences ($P<0.05$).

The study suggests that a perfect supporting guarantee system, the use of new media for scientific fitness guidance, and the cultivation of composite talents are the key paths to sports rehabilitation for the disabled. These findings provide data support and practical guidance for sports rehabilitation of the disabled, and are of great significance in promoting the development of sports for the disabled in the context of physical and medical integration.

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