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Multi index evaluation method of pathological weight loss effect of aerobic exercise based on telemedicine monitoring

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Abstract

INTRODUCTION: Pathological obesity seriously endangers human health.
OBJECTIVES: A multi index evaluation method of pathological weight loss effect of aerobic exercise based on telemedicine monitoring is proposed to evaluate the pathological weight loss effect of aerobic exercise by using telemedicine monitoring system.
METHODS: According to the indexes of aerobic exercise affecting weight loss effect, a multi index evaluation system of pathological weight loss effect of aerobic exercise was established. The medical sensor of the telemedicine monitoring system is used to collect the index data in the multi index evaluation system of pathological obese personnel. The medical sensor uses the wireless node to transmit the collected data to the remote monitoring center. The evaluation module of the remote monitoring center uses the collected data and selects the fuzzy comprehensive evaluation method to evaluate the pathological weight loss effect of aerobic exercise.
RESULTS: The experimental results show that this method can effectively use the telemedicine monitoring system to collect the physiological parameters of pathological obese people, and use the parameter collection results to evaluate the effect of aerobic exercise on pathological weight loss.
CONCLUSION: The proposed methods can provide basis for human aerobic exercise pathological weight loss.

Keywords: Telemedicine monitoring, Aerobic exercise, Pathological, Weight loss effect, Multi index evaluation, Fuzzy comprehensive evaluation.

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1. Introduction

With the increasing innovation of science and technology, information technology not only brings more convenience to our daily life, but also brings a new revolution to medical equipment. The combination of information technology and medical equipment [1] can not only reduce the burden of medical personnel, but also improve the accuracy of medical equipment inspection results and increase patients' trust in the hospital. The on-line monitoring of medical equipment based on wireless communication makes full use of the increasingly mature information technology, which can improve the efficiency of staff, reduce the work intensity and the waiting time of patients and improve the efficiency of work. For hospitals, it can also reduce the cost of equipment maintenance. At present, all countries in the world are facing the problems of shortage of medical resources, uneven distribution and increasing medical costs [2]. Countries are trying to

alleviate the shortage of medical and health resources in various ways, so as to improve the overall service level. Based on the development of network information platform, telemedicine applies advanced information technology to the field of medical and health, breaks the barrier of time and space, and carries out relevant health service activities such as medical consultation, diagnosis, treatment, monitoring, consultation and education [3], which can realize the sharing and utilization of medical resources among different regions and alleviate the problems of lack of medical resources and uneven regional distribution. China pays more attention to and continues to promote the construction of telemedicine system, from the experimental exploration stage in the late 1980s, the platform construction and preliminary application in the mid-1990s, to the popularization of telemedicine by using information technology in the 21st century. However, the implementation of telemedicine in China started late compared with foreign developed countries. At this stage, the development of telemedicine in China is still in the preliminary stage, and a unified and perfect evaluation index system has not been formed. This makes telemedicine bring benefits to patients, medical workers and medical service institutions. At the same time, there are still relevant problems in technical level, talent preparation, fund investment and supervision. The lack of standardized evaluation standards [4] will hinder the sharing and interconnection of information and resources within the telemedicine system. Obesity is a nutritional metabolic disorder that endangers human health. It is mainly fat metabolism imbalance, which is the result of the comprehensive action of many factors [5]. Excessive accumulation of fat around the skin and organs is harmful to people's health. It is mainly shown that obese people are prone to coronary heart disease, hypertension, diabetes and so on. According to statistics, the proportion of obese people suffering from heart disease in China is 2.5 times that of ordinary people; The number of people suffering from hypertension is three times that of ordinary people; On average, 3 out of every 4 patients with diabetes or arteriosclerosis are obese [6]. Obesity has been listed as one of the five major diseases seriously endangering human health by the World Health Organization. As for pathological obesity, some people think that obesity itself is pathological, but we don't think it is completely certain. Pathological obesity covers a wide range, but it mainly refers to obesity caused by certain diseases, such as Cushing's syndrome, hypothyroid obesity, post hepatitis obesity, etc. Simple obesity has more serious complications, which also means that obesity has become pathological.

At present, there are many studies on aerobic exercise. Steinberg et al. studied the impact of aerobic exercise on executive function and perceived fatigue [7]. The research results show that aerobic exercise can improve human executive function and reduce human perceived sensitivity to fatigue; DAHER et al. studied the therapeutic effect of aerobic exercise training on patients with neck pain [8]. The results show that appropriate aerobic exercise can alleviate patients' neck pain; Barbuto et al. studied the potential benefits of aerobic exercise on degenerative cerebellar diseases [9], and the results verified that aerobic exercise also has certain benefits on degenerative cerebellar diseases. Zhou et al. [10] conducted a meta-analysis of the effects of aerobic exercise on glucose and lipid metabolism in obese children and adolescents. Purpose of the study is to evaluate aerobic exercise for obese children and adolescents blood sugar/lipid metabolism index, the influence of chapter for FeiPanEr, youth aerobic exercise to lose weight, which provides the basis for preventing chronic diseases, in order to "exercise", "sports intervention", "childhood obesity," "" "adolescent obesity "and" sugar "" insulin" and "blood" as the combination of keywords retrieval China hownet (CNKI), Google Academic, Web of Science, Wiley Online Library and other databases from 2000 to 2019, and using manual retrieval methods, it is concluded that aerobic exercise has a significant effect on weight loss in obese children and adolescents. Ji et al. [11] to study the aerobic exercise with HIIT time ratio of female college students to reduce fat effect, BMI greater than 25 in Beijing sports university recruitment of female college students, will be selected 18 subjects were randomly divided into 2 groups, the total duration of the same movement, a group of anaerobic and aerobic exercise plus four groups another group to add 6 groups of anaerobic aerobic exercise. The subjects' body weight, body fat percentage and maximal oxygen uptake were measured before and after the experiment. Results: There were no significant differences in body weight and body fat percentage between the two groups before and after the experiment ($P<0.05$), significant differences in heart rate before and after the experiment ($P<0.05$), significant differences in basal metabolic rate before and after the experiment ($P<0.05$), significant differences in exhaustion time between the two groups ($P<0.05$), and significant differences within the group The ($P<0.01$). It is concluded that there is no significant difference in fat reduction effect between the two exercise intervention methods of combining aerobic and HIIT for 6 weeks in this experiment, and the optimal time ratio of combining aerobic and HIIT remains to be studied. However, the combination of aerobic exercise and HIIT can effectively improve cardiopulmonary endurance, and the longer the HIIT time, the more effective the improvement of cardiopulmonary endurance. The above methods all have certain limitations, some methods are poor in the rationality of evaluation, and some methods are poor in the collection of physiological parameters of personnel.

Today, there is little research on the application of aerobic exercise to pathological weight loss. Thus, this paper studies the multi index evaluation method of pathological weight loss effect of aerobic exercise based on telemedicine monitoring, uses the telemedicine monitoring system to collect various physiological parameters of pathological obese personnel, and uses the collected physiological parameters to formulate a multi index evaluation system of pathological weight loss effect

of aerobic exercise, to obtain the multi index evaluation results of pathological weight loss effect of aerobic exercise.

2. Design of remote medical monitoring system

2.1. Overall system architecture design

The telemedicine monitoring system is required to be able to collect, monitor and store the monitoring data of multiple wireless nodes in real time at the same time, so it is necessary to equip the telemedicine monitoring system with a data acquisition module to send the collected medical data to the host computer at high speed. Due to the slow speed of serial communication, the monitoring system adopts network communication to realize high-speed data transmission. Telemedicine monitoring system does not only require to monitor multiple medical systems on one PC, but also require multiple medical staff to monitor and view the physiological information of each patient's pathological weight loss of aerobic exercise at the same time on multiple PCs. If the upper computer is responsible for both data collection and system viewing and display, data management will be disordered when multiple people view at the same time, and the wireless node needs to send each data to multiple upper computers repeatedly. To solve these problems, the upper computer design of the system adopts the C / S structure, that is, one site in the network is set as the server, and the other nodes are the clients. The server is responsible for receiving and storing the data of the wireless nodes [12], processing the client requests, and then returning the results to the client. In this way, multiple clients can jointly monitor and view the information of multiple patients. Based on the above requirements analysis, the overall structure of the system design is shown in the figure below.

The overall structure of the telemedicine monitoring system used in the multi index evaluation method for pathological weight loss effect of aerobic exercise based on telemedicine monitoring is shown in Figure 1.

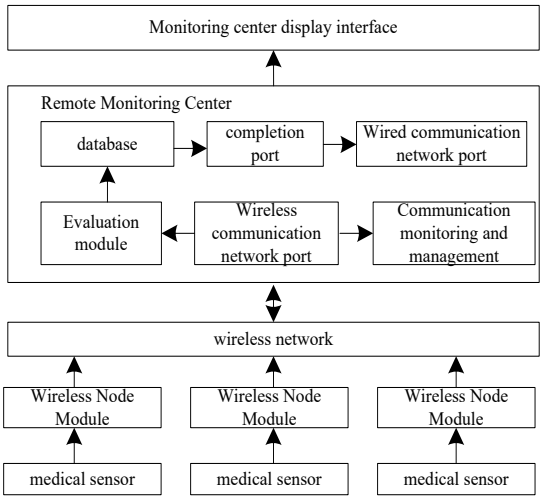


Figure 1. Telemedicine monitoring system

The medical sensor is used to collect the physiological parameters of pathologically obese personnel. Each data acquisition node is equipped with a wireless node. Wireless nodes continuously send instructions through serial ports and collect physiological data from medical sensors of pathologically obese people. The wireless node classifies, calculates and processes the received data and packs it, then, the data is sent to the server in the same local area network at high speed through the wireless network. The medical sensor uses the wireless node to transmit the collected data to the remote monitoring center, the server writes the received data into the database, and saves and monitors the switching state of each wireless node [13]. The client establishes communication with the server through wired communication, and then sends commands to the server to read the medical data stored in the database. The service evaluation module uses the collected human body data to evaluate the pathological weight loss effect of aerobic exercise through the multi index evaluation method based on fuzzy comprehensive evaluation. Finally, the evaluation results of pathological weight loss effect of aerobic exercise are displayed to the monitoring personnel in the software terminal to realize the purpose of remote real-time monitoring.

Since the client terminal software is installed on the PC of medical staff, the software client is required to support the general Windows platform, and the software interface should be friendly, easy to operate, beautiful and adaptive to the screen size and size [14]. Functional requirements are perfect, stable, high reliability and good real-time performance. It can view the physiological data of current online pathological obesity personnel and select different comprehensive display interfaces according to the situation. When the pathologically obese personnel carry out aerobic exercise, the display value of physiological parameters exceeds the limit value, which can automatically flash and alarm. While

comprehensively monitoring multiple pathological obesity personnel, it can realize the key monitoring of a pathological obesity personnel. In the functional interface, it can choose to view the historical clinical medical data of pathological obesity personnel, select parameters to draw a trend chart, and select waveform to review the historical waveform. In addition, some condition notes and parameter values that cannot be measured by other medical systems can be added, which can be sent to the server and saved in the database for the analysis of pathological weight loss effect of aerobic exercise in the later stage to provide clinical data.

2.2. System optimization design

Wireless node module is the main component of telemedicine monitoring system, and its functions mainly include three aspects. The first is the serial port data acquisition of telemedicine monitoring system, including continuous circular command sending, serial port data receiving and data processing; The second is to send the collected physiological data of pathologically obese people to the server through wireless network, including data packaging and communication protocol formulation; The third is the monitoring of communication status and the handling of network exceptions. According to the main functional requirements of the above wireless node module, the structure diagram of wireless node module is optimized, as shown in Figure 2.

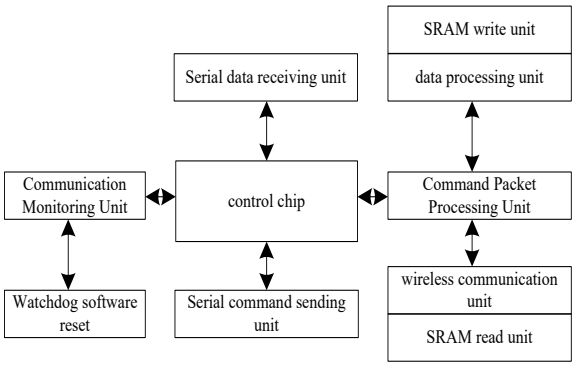


Figure 2. Wireless node module structure diagram

The function diagram of each module in the wireless node is as follows:

(1) Serial port data receiving unit

Through serial port interruption, it can receive the physiological data of pathologically obese personnel from the serial port of telemedicine monitoring system, and cache the received data;

(2) Data processing unit

The data of telemedicine monitoring system received through the serial port are analyzed, such as the distinction between real-time waveform and slow data (parameters with data update cycle greater than or equal to one second), then the real-time waveform data are converted into ASCII code, and then it is brought into the formula to calculate the floating point number, analyze the format of "slow" data, and convert the ASCII code into real number;

(3) SRAM write unit

It is used to save the physiological data of pathologically obese personnel after data processing, which is divided into two parts: real-time waveform data and "slow" data, and the classified cache is written into SRAM;

(4) Check in unit

After the wireless node is powered on, the network is initialized successfully and connected to the specified WiFi. It needs to send a check-in command to the specified check-in port of the server to notify the server that the node has been online, and the server will open a new thread and network port to communicate with the node;

(5) Wireless communication unit

It communicates with the server every second, reads out the latest second of data buffered in SRAM, packages the data and sends it to the server;

(6) Serial port command sending

It sends the data request command of various parameters through the serial port in a circular manner. The next data request command can be sent only after the last serial port command is received;

(7) Communication monitoring unit

After successful check-in, the wireless node starts to monitor the communication status with the server, and turns on the independent watchdog function. Each communication succeeds in feeding the dog. If the dog feeding timer overflows for more than five seconds, the communication is considered to have failed;

(8) Reset unit of watchdog software

By means of software reset, let the program restart to prevent network failure. After reset, it blocks the WiFi connection until the connection is successful and communication with the server is re-established.

Each module of the wireless node module cooperates with each other to complete the functions of data collection, data cache processing and data transmission related to the weight loss effect of pathological obese personnel, and uses a watchdog or timer to monitor the network communication status. It has countermeasures for the network emergency of the telemedicine monitoring system, and the system function is perfect.

2.3. Fat content data collection optimization

Fat content is an important detection index for patients with pathological obesity. In order to further detect the fat content in each part of the body of patients with pathological obesity, a system detection sensor is designed on the above optimized telemedicine monitoring system to collect fat content. The body fat detection

sensor of telemedicine monitoring system is composed of amplitude phase detector, operational amplifier circuit and a non inductive calibrated resistance R_s. The excitation current I_0 generated by the signal generator passes through the current excitation electrodes (H_C, L_C) and is successively injected into various parts of the body of the pathologically obese person and a calibrated resistance R_s located between the excitation electrode L_C and the ground. The voltage measurement electrodes (H_C, L_C) are used to obtain the measured voltage V_z of each part of the body of the pathologically obese person and the reference voltage V_s of the reference resistance R_s. Where R_s is a pure resistance without inductance, so that the phase of V_s and the phase of excitation current I_0 are equal. Voltages V_z and V_s are amplified by two high input impedance amplifiers IA_1 and IA_2 with the same amplification factor to obtain voltages V_{AS} and V_{AZ}.

The voltages V_{AS} and V_{AZ} are respectively sent to the input of the amplitude phase detector AD8302. The AD8302 outputs the DC voltages V_{MAG} and V_{PHS} proportional to the amplitude ratio and phase difference in the form of voltage. The expression is as follows:

$$V_{MAG} = K_1 \lg \frac{|V_{AZ}| + 650mV}{|V_{AS}|} \tag{1}$$

$$V_{PHS} = K_2 \left(|V_{AZ} - V_{AS}| - 90^\circ \right) + 880mV \tag{2}$$

Where K_1 and K_2 are proportional coefficients, m represents the output DC voltage coefficient of AD8302.

The voltage signals V_{MAG} and V_{PHS} output by the amplitude phase detector at each excitation frequency are sent to the microprocessor for A/D sampling and processing.

The complex impedance Z_X of various parts of the body of pathologically obese persons can be expressed as:

$$Z_X = R_s |K| \Delta V \tag{3}$$

The body fat detection sensor obtains the complex impedance of different parts of the body of pathologically obese people by collecting the signal amplitude and phase. There is a significant correlation between the impedance value of each part of the human body and the content of adipose tissue. Under the same size, the impedance value of fat meat is greater than that of streaky meat, and the impedance value of streaky meat is greater than that of lean meat. The water content and ion concentration in human body are closely related to the conductivity of human body. Almost all water and electrolyte are contained in muscle tissue, that is, lean body. The component contained in adipose tissue is triglyceride, which is insulated, so the conductivity of fat in tissue is smaller than that of non fat, that is, the impedance of adipose tissue is greater than that of lean body. The body fat detection sensor is used to detect the fat content in various parts of the body of pathologically obese people.

3. Realization of multi index evaluation of pathological weight loss effect of aerobic exercise

3.1. Multi index evaluation system of pathological weight loss effect of aerobic exercise

When establishing a multi index evaluation system for pathological weight loss effect of aerobic exercise, the evaluation module of telemedicine monitoring system considers the relevant indexes of aerobic exercise affecting weight loss effect as follows:

(1) Self evaluation

Pathological weight loss personnel score the Likert scale designed by the evaluation module. The score of each questionnaire of Likert scale is set to 0-10. The lower the score is, the lower the degree is [15], and vice versa. The questions of the scale include: the quality of sleep at night, the mental state in daily life during the day, the concentration of study and work, the degree of fatigue after exercise, the degree of relief of mental stress caused by exercise and the degree of subjective consciousness of exercise on life attitude.

(2) Body mass index (BMI)

Body mass index is the most important index to evaluate the state of overweight or obesity. The body data (weight and height) for calculating BMI is easy to measure, and the measurement method is not affected by race, age and gender. Therefore, it is regarded by relevant researchers at home and abroad as the most common and preferred index to evaluate obesity and overweight. This is an internationally recognized standard to measure whether the body is healthy or not [16]. The definition of BMI by the World Health Organization (WHO) is: the number of kilograms of body weight divided by the square of the number of meters of height.

The body mass index is calculated as follows:

$$BMI = w / a^2 \tag{4}$$

Where w is the weight and a is the age.

Basic metabolism is the energy required by the human body to maintain the minimum life activities. Specifically, the energy released by the body when it is awake and quiet is not affected by muscle contraction, nerve activity, food and ambient temperature, and only sustaining the energy consumed by heartbeat, breathing and some of the basic activities of life. The basic

metabolic rate is an important part of human energy consumption, and the basic metabolic rate BMR is a reference index for formulating the energy requirements of the appropriate population [17]. Estimating individual BMR is important for developing and implementing weight related interventions. For example, BMR can be used to determine the target energy intake in the weight loss plan; Establish a model that can dynamically predict weight gain and loss; Identify patients with potential metabolic abnormalities; Formulate public health measures to prevent obesity in different populations.

(3) Blood pressure (systolic and diastolic)

Aerobic exercise can reduce blood pressure. The pathological weight loss effect of aerobic exercise can be measured by blood pressure index.

(4) Body fat ratio

Body fat ratio refers to the proportion of body fat in the total body weight. The common calculation formula of body fat ratio is:

$$BF = 1.3BMI + 0.35a - 10.9s \quad (5)$$

In formula (5), BMI is the body mass index of the human body. s is gender. When the pathologically obese person is male, s = 1; When the pathologically obese person is male, s = 0.

(5) Heartbeat activity

The indexes of exercise physiological arousal and exercise recovery come from heartbeat activity. In addition to the common average heart rate and heart rate recovery value, multiple characteristics of measuring heart rate fluctuation can not only play a role in the comprehensive quantification of exercise physiological arousal [18], but also assist in the more comprehensive evaluation of exercise recovery effect. The non-invasive information acquisition of heartbeat activity usually relies on body surface ECG measurement and data analysis.

Through the above analysis, a multi index evaluation system for the pathological weight loss effect of aerobic exercise applied in the telemedicine monitoring system is established, as shown in Table 1.

Table 1. Multi-indicator system of pathological weight loss effect of aerobic exercise

Target layer	First-level indicator	Secondary indicators
Evaluation of the effect of aerobic exercise on pathological weight loss	Self-evaluation	Sleep quality
		Mental state
		Focus degree
		Degree of fatigue
		Mental stress relief
		Attitude to life
	Body mass index	Weight
		Height
		Basal metabolic rate
	Blood pressure	Systolic blood pressure
		Diastolic blood pressure
	Body fat percentage	Body mass index
		Gender
	Heartbeat activity	Heart rate mean
		Heart rate recovery value

3.2. Multi index evaluation method based on fuzzy comprehensive evaluation

Fuzzy analytic hierarchy process

U represents the index set of the multi index evaluation system for the pathological weight loss effect of aerobic exercise. According to the index set U_i and the evaluation standard set V_{imj} of the index layer, the membership matrix R_i of the index layer is obtained:

$$R_i = \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} \\ \vdots & \vdots & \ddots & \vdots \\ r_{im1} & r_{im2} & r_{im3} & r_{im4} \end{bmatrix} \quad (6)$$

Where: R_i is the membership matrix of the i-th criterion, and m means that the number of indicators contained in the i-th criterion is m.

Determination of the weight of each level

The judgment matrix A_i of the i-th criterion layer is established:

$$A_i = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mm} \end{bmatrix} \tag{7}$$

Where: A_i represents the relative weight matrix between indicators in the i-th criterion layer; a_{ij} is the weight value of the i-th index relative to the j-th index, using the 1-9 scale method proposed by Saaty.

The eigenvector W_i^* of the judgment matrix A_i is obtained and normalized to obtain the i-th criterion layer weight set W_i .

$$W_i = W_{it}^* / \left(\sum_{i=1}^{m} W_{it}^* \right) \tag{8}$$

The maximum characteristic root $\lambda_{\max}$ of the judgment matrix is calculated to conduct consistency test and judgment:

$$\lambda_{\max} = \frac{\sum_{j=1}^{m} \frac{A_i (W_i)_j}{(W_i)_j}}{m} \tag{9}$$

$$CR = CI / RI \tag{10}$$

Where: CI is the consistency judgment index; m is the order of the judgment matrix; RI is the average consistency index; CR is the calculation consistency ratio given by Saaty. When $CR \leq 0.1$, the judgment matrix has consistency.

Using the same method, the weight set $W_C = \{W_1, W_2, W_3, W_4\}$ of the index layer relative to the criterion layer and the weight set W_B of the criterion layer relative to the total target layer are obtained. According to the characteristics of multi index evaluation of pathological weight loss effect of aerobic exercise [19], the weight of multi index evaluation system of pathological weight loss effect of aerobic exercise is constructed according to the statistical analysis of experts' opinions.

Comprehensive evaluation of hierarchical fuzzy

The multi index evaluation system of pathological weight loss effect of aerobic exercise has three layers, which carries out two-level fuzzy comprehensive evaluation, that is, the evaluation of the first index layer to the target layer and the second index layer to the first index layer.

The fuzzy evaluation of the secondary index layer on the primary index layer is as follows:

$$D_i = W_C \circ R_i \tag{11}$$

The fuzzy evaluation of the first level index layer on the target layer is:

$$S = W_D \circ D_i \tag{12}$$

Where: D_i is the fuzzy evaluation of the i-th first level index layer; S is the membership matrix of the telemedicine monitoring system for the evaluation level of pathological weight loss effect of aerobic exercise; Operation "." is a fuzzy composition operator.

If the membership matrix does not meet $\sum_{j=1}^{4} S_j = 1$, normalize the evaluation results [20] to obtain a new judgment matrix P . According to the principle of maximum membership degree, the evaluation grade corresponding to $\max_{1 \leq j \leq 4} \{P_j\}$ is selected as the evaluation result, so as to accurately evaluate the pathological weight loss effect of aerobic exercise through the multi index evaluation system of pathological weight loss effect of aerobic exercise established by the telemedicine monitoring system.

4. Experimental analysis

In order to verify the effectiveness of multi index evaluation of pathological weight loss effect of aerobic exercise by using telemedicine monitoring system, 8 pathological obese people in the weight loss center are selected as the research object, including 4 males and 4 females. The monitoring personnel uses the telemedicine monitoring system to guide the effect of aerobic exercise on weight loss in patients with pathological obesity. Ten patients are given aerobic exercise of the same intensity to evaluate the weight loss effect obtained by eight patients with pathological obesity when they took aerobic exercise.

The method of this paper uses the evaluation module of telemedicine monitoring system, we evaluated the effect of aerobic exercise on weight loss in morbidly obese people. In the multi index evaluation system of pathological weight loss effect of aerobic exercise obtained by this method, the weight calculation results of each primary index and secondary index are shown in Table 2.

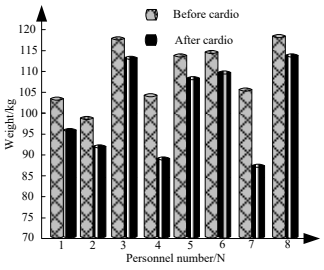
Table 2. Weights of indicators of pathological weight loss effect of aerobic exercise

first-level indicator	Weights	Secondary indicators	Weights
Self-evaluation	0.21	Sleep quality	0.18
		mental state	0.16
		focus degree	0.24
		degree of fatigue	0.18

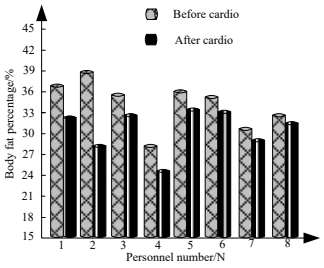
		mental stress relief	0.16
		attitude to life	0.08
Body mass index	0.28	weight	0.34
		height	0.33
		Basal metabolic rate	0.33
blood pressure	0.19	systolic blood pressure	0.5
		diastolic blood pressure	0.5
body fat percentage	0.17	Body mass index	0.5
		gender	0.5
heartbeat activity	0.15	heart rate mean	0.5
		Heart rate recovery value	0.5

It can be seen from the experimental results in Table 2 that the method in this paper can effectively determine the weight of many indexes in the established multi index evaluation system for the pathological weight loss effect of aerobic exercise. This paper uses the telemedicine monitoring system to collect various physiological indexes of pathologically obese personnel, and uses the determined weight to realize the effective evaluation of the pathological weight loss effect of aerobic exercise under different aerobic exercise intensity.

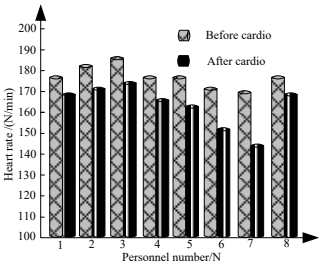
Eight patients with pathological obesity are subjected to aerobic exercise for 50 minutes a day for 15 days. Statistical methods in this paper, the remote medical monitoring system is used to collect the original physiological indexes of 8 pathologically obese people, the physiological indexes after 15 days of aerobic exercise, body weight, body fat rate and heart rate 15 minutes after exercise. The comparison results are shown in Figure 3.



(a) Weight



(b) Body fat percentage



(c) Heart rate +15 min

Figure 3. Collection results of physiological indicators of morbidly obese people

According to the experimental results in Figure 3, the method in this paper can effectively collect the evaluation indexes of weight loss effect of pathological obese people before and after aerobic exercise. Based on the results of weight loss evaluation indexes before and after aerobic exercise, we can evaluate the pathological weight loss effect of aerobic exercise with multiple indexes. It can be seen from the comparison results in Figure 3 that after 15 days of aerobic exercise, the body weight, body fat rate and heart rate 15 minutes after exercise of pathologically obese people have decreased significantly. The comparison results verify that pathologically obese people have obvious weight loss effect through aerobic exercise.

This paper uses the index data collected by the telemedicine monitoring system to evaluate, makes users answer the questionnaire in the self-evaluation index through the display interface of the system. Using the 10-point system as the scoring standard of the system, the evaluation results of the self-evaluation index of pathological obese personnel No. 7 in this method are shown in Figure 4.

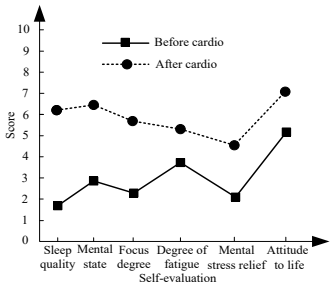


Figure 4. Self-evaluation index evaluation results

According to the experimental results in Figure 4, after 15 days of aerobic exercise, the score results of secondary indicators such as sleep quality, mental state and concentration of pathological obese personnel No. 7 have significantly improved, indicating that aerobic

exercise can effectively improve the sleep quality, mental state and other physical conditions of pathological obese personnel, and has an obvious weight loss effect on pathological obese personnel No. 7, it is verified that aerobic exercise can be a good treatment for pathological obesity, and further verified that the method has a high evaluation effect.

The method in this paper is used to evaluate the primary indicators of pathological obesity personnel No. 1, No. 2 and No. 3. The evaluation results are shown in Figure 5.

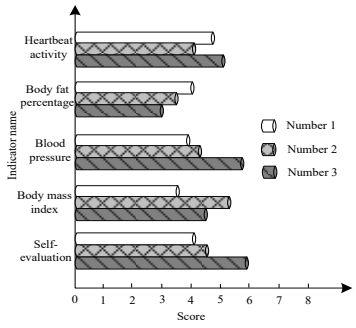


Figure 5. Evaluation results of the first-level indicators

According to the experimental results in Figure 5, the evaluation results of various primary indicators can be obtained by using the physiological parameters of human body collected by the telemedicine monitoring system and the evaluation scale formulated for the weight loss effect of pathological obesity. As can be seen from the experimental results in Fig. 5, the scores of various primary indicators of pathological obese persons No. 4 and No. 7 are significantly higher than those of other pathological obese persons, indicating that pathological obese persons No. 4 and No. 7 can obtain good therapeutic effect of pathological weight loss by using aerobic exercise. At the same time, it is verified that this method can effectively evaluate the therapeutic effect of aerobic exercise on pathological weight loss.

The accuracy of the data acquisition function of the telemedicine monitoring system used in the method in this paper determines the evaluation accuracy of the pathological weight loss effect of aerobic exercise. Pathological obese persons No. 4 and No. 7 are selected as the research object, to count the collection results and actual results of various human physiological parameters collected by this method. The collection accuracy results of different indicators are shown in Figure 6.

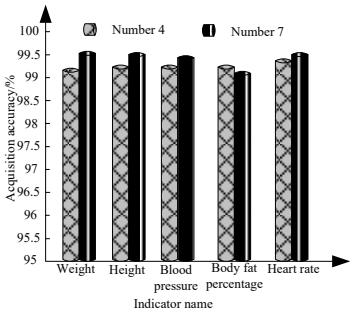


Figure 6. Data collection effect of telemedicine monitoring system

As can be seen from the experimental results in Fig. 6, the telemedicine monitoring system adopted in this method has a good effect on collecting human physiological parameters. The data collection results of various physiological parameters of No. 4 pathological obese person are very close to the actual physiological parameter results of No. 7 pathological obese person, which verifies that this method has high data collection effect. Accurate physiological parameters can be used to improve the evaluation results of pathological weight loss effect of aerobic exercise.

The operation performance of telemedicine monitoring system has an important impact on the evaluation effect of pathological aerobic exercise and pathological weight loss. The transmission speed of the telemedicine monitoring system when transmitting various human physiological indexes in different concurrent users is counted, and the statistical results are shown in Figure 7.

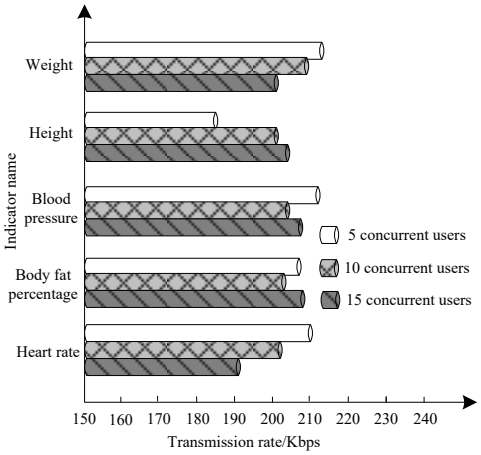


Figure 7. Data transmission speed of telemedicine monitoring system

According to the experimental results in Figure 7, the telemedicine monitoring system used in this method can ensure the data transmission speed higher than 180Kbps, which verifies that the telemedicine monitoring system adopted in this method has good data communication performance. This paper uses the telemedicine monitoring system to obtain the real-time physiological parameters of pathological obese people, so as to provide an effective communication basis for the accurate evaluation of the effect of aerobic exercise on pathological weight loss.

5. Discussion

Telemedicine monitoring system is used to realize multi index evaluation of pathological weight loss effect of aerobic exercise. At present, there are many researches on the methods and effects of weight loss, mainly including exercise, medicine, acupuncture and so on. Aerobic exercise intensity is an important factor of aerobic exercise because it is related to energy source, energy demand, oxygen consumption, sports injury and other factors. The exercise intensity is often expressed by heart rate, oxygen consumption and multiple of energy or oxygen consumption at rest. Because everyone's age, physical fitness and health are different, everyone's amount of aerobic exercise is also different. The American Sports Medical Association recommends that you continue to practice at medium intensity for 30 ~ 60 minutes every day, and the energy consumption of each activity is about 300 Kal, which has an obvious effect on weight loss and fitness. The current research shows that the proportion of fat energy supply increases with the extension of exercise time. For example, during 40 min, 90 min and 180 min continuous exercise, fatty acid energy supply accounts for 27%, 37% and 50% of the total energy consumption respectively. From the perspective of age, the exercise time of teenagers shall not be less than 1 hour each time, and that of middle-aged and elderly people shall be 30 ~ 40 minutes each time. According to the monitoring results of telemedicine system, the pathological weight loss management personnel can reasonably determine the time and intensity of aerobic exercise for weight loss personnel.

6. Conclusion

People gradually realize the importance of health, the understanding of obesity is more and more profound. Obesity itself is a disease, which can also lead to the onset of many chronic diseases, even life-threatening. The relevant research on weight loss is urgent. At present, the research on obesity in China is becoming more and more in-depth, and there has been a relatively mature system for the measurement and evaluation of obesity. There are also various methods and service systems for weight loss in China. This paper studies the multi index evaluation method for pathological weight loss effect of aerobic exercise based on telemedicine monitoring, and realizes the multi index evaluation of pathological weight loss effect of aerobic exercise through telemedicine monitoring system, so as to provide basis for human aerobic exercise pathological weight loss.

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