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A Study on the Countermeasures to Improve the Physical and Mental Health of High-Altitude Migrant College Students by Integrating Artificial Intelligence and Martial Arts Morning Practice

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ABSTRACT

This paper comprehensively elaborates the differences in normal body and mind levels of high-altitude migrant college students between low-altitude and high-altitude regions, as well as the changes in normal body and mind levels of high-altitude migrant college students during their migration to high-altitude regions and the adaptation mechanism, so as to reveal the influence of altitude on the normal body and mind of high-altitude migrant college students and provide a comprehensive theoretical basis for the evaluation and standardization of normal body and mind levels of high-altitude migrant college students from different altitude regions. In view of the current situation of martial arts morning practice of college students and its problems, and the objective analysis of the reasons for the poor effect of martial arts morning practice, the article adopts the artificial neural network method and establishes a comprehensive evaluation model of normal body and mind of high-altitude migrant college students who perform martial arts morning practice based on the artificial neural network method, circumvents the empirical and arbitrary nature of the traditional threshold setting, takes the improvement of students' physical fitness as the guiding ideology, establishes The concept of a new model of cultivating the awareness of college students' martial arts morning practice, which includes relevant organizations and establishing a guarantee system, improving supervision, strengthening guidance, increasing the investment in hardware for students' physical exercise, and playing the role of associations. In the experimental validation, we find the data connection between each test sample and determine the threshold value of each index, and finally establish a scientific comprehensive evaluation model of normal body and mind of high-altitude migrant college students in martial arts morning practice, which makes up for the shortcomings of the original research method and evaluation model.

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Introduction

The main purpose of the research proposed in the context of martial arts morning practice to enhance college students' awareness of martial arts morning practice is to enable college students to exercise, improve their physical fitness and develop good habits of work and rest through martial arts morning practice. By changing their views and opinions on martial arts morning practice, they will consciously and actively join the ranks of martial arts morning practice (Ding, Qu, and Xi 2019; Gao, Li, and Wan 2020; Gao, Xue, and Wan 2020). With a healthy body and a sunny mind, they actively join the trend of social development, contribute their youth and vitality to the development of the country, and truly realize the unity of self-value and social value. Scientific martial arts morning practice can promote the health of the human body.

Science and research show that scientific martial arts morning practice can improve human health. It can improve brain function, expand coronary arteries, maximize the oxygen absorption capacity of human lungs, promote blood circulation throughout the body, improve the body's ability to adapt to nature through whole-body exercise, improve human immunity, and achieve the effect of disease prevention (Peacock et al. 2018). At the same time, martial arts morning practice can also cultivate self-confidence, help college students develop a healthy lifestyle, and help cultivate the concept of lifelong sports for college students. The growth of college students needs to be healthy through martial arts morning practice. The current physical fitness test results of Chinese college students show that the health condition of many college students is worrying. The physical fitness test results of Chinese college students have shown that the health condition of many students is worrying for several reasons.

Firstly, due to the increasing popularity of electronic devices, many college students lead sedentary lifestyles and have little physical activity. This lack of exercise can lead to decreased fitness levels and weight gain, which can contribute to health problems such as obesity, diabetes, and heart disease.

Secondly, the pressure of academic studies and the competitive job market have led to increased stress levels among college students. Stress can lead to poor sleep quality, lack of physical activity, and unhealthy eating habits, which can further contribute to health problems.

Thirdly, the availability and affordability of unhealthy food options on and off campus can also contribute to poor health among college students. A diet high in unhealthy foods can lead to weight gain and health problems such as high blood pressure and high cholesterol.

Finally, some students may engage in risky behaviors such as smoking, alcohol consumption, and drug use, which can lead to serious health consequences.

Overall, the physical fitness test results of Chinese college students show that many students are not taking care of their health properly, which can lead to various health problems. There is an urgent need to improve physical fitness through systematic and sustained physical exercise (Kozina et al. 2017).

In order for students to achieve the goal of "attaining the standard and striving for excellence, and strengthening physical fitness", the state has put forward the call for "martial arts morning practice" nationwide, which provides a good platform for college students to actively participate in martial arts morning practice and other physical exercises, and is more conducive to their personal growth and future development. The connotation and principles of cultivating students' awareness of martial arts morning practice under the background of martial arts morning practice. Students' normal body and mind, physical fitness, strong will and vitality are the embodiment of a nation's vigorous vitality, a sign of social civilization and progress, and an important aspect of national comprehensive strength (Allison et al. 2020). The main contents of college students' martial arts morning practice are shown in Figure 1.

The work of cultivating college students' awareness of martial arts morning practice is a systematic project in the context of martial arts morning practice, which is composed of elements such as cultivator, cultivated person, cultivation method and cultivation goal. At the same time, it is in a certain social environment and small school environment (Ding, Qu, and Xi 2020; Pei et al. 2022). The relationship between each element in the process of cultivating college students' awareness of martial arts morning practice, the internal structure as well as the environment in which it is located, and the effect of martial arts morning practice will all affect the overall function of the system.

The cultivation of college students' awareness of martial arts morning practice is a complex process that involves several elements. These elements include the internal structure of the system, the environment in which it is located, and the effect of martial arts morning practice. The relationship

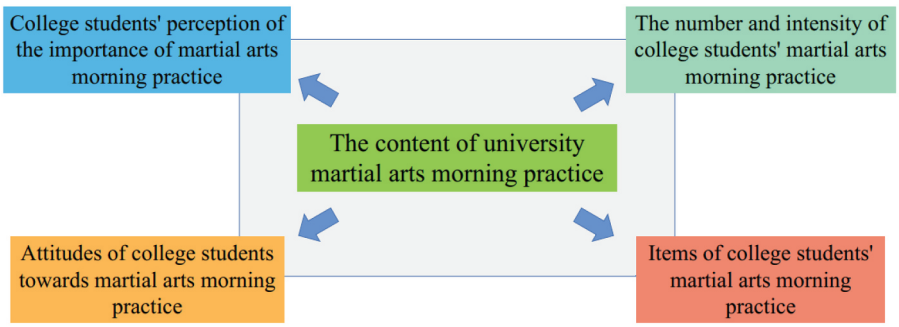

Figure 1. The main content of college students' martial arts morning practice.

between these elements is crucial in determining the overall function of the system.

The internal structure of the system refers to the components that make up the system, such as the curriculum, teaching methods, and evaluation methods. The curriculum should be designed to promote the benefits of martial arts morning practice, such as improved physical and mental health. The teaching methods should be effective in imparting the necessary skills and knowledge to students. The evaluation methods should be able to measure the progress and effectiveness of the program.

The environment in which the system is located also plays a significant role in the effectiveness of the program. Factors such as the availability of training facilities, the availability of qualified instructors, and the support of the university administration can all influence the success of the program. For example, if the training facilities are inadequate or the instructors are not qualified, the students may not be able to practice martial arts safely and effectively.

The effect of martial arts morning practice refers to the physical and mental benefits that students can derive from the practice. These benefits can include improved physical fitness, reduced stress levels, and improved mental focus. The effectiveness of the program in delivering these benefits is important in determining the overall success of the program.

Therefore, the relationship between each element in the process of cultivating college students' awareness of martial arts morning practice is essential to ensuring the overall success of the program. The internal structure of the system, the environment in which it is located, and the effect of martial arts morning practice are all interconnected and must be carefully considered to optimize the effectiveness of the program.

To explore the cultivation of college students' martial arts morning practice awareness in the context of martial arts morning practice, we must study in depth the system, mechanism, content and method of college students' martial arts morning practice awareness cultivation, the overall layout of college students' martial arts morning practice awareness cultivation, fully stimulate the initiative and enthusiasm of trainers and trainees, coordinate the concern of all aspects, rationalize the relationship between all elements, give full play to the advantages of each element, and realize the best effect of college students' martial arts morning practice awareness cultivation. The best effect of morning training awareness cultivation (Skowron-Markowska 2022).

In recent years, the development of science and technology makes more and more students can go to school in other places, and the number of students from low altitude areas who enter high altitude (subalpine and plateau) areas to study is increasing, and this group belongs to the typical group of people who live in low altitude and move to high altitude for a short time. The low air pressure and low oxygen partial pressure in high altitude areas will affect the

normal body and mind level of college students who migrate to high altitude areas for a short period of time, and there are differences between their normal body and mind level and that of college students who live in high altitude areas. The difference in normal body and mind levels between college students at low and high-altitude areas, due to the stimulation of the cardiovascular system by low oxygen partial pressure, people at high altitude areas often show higher hemoglobin content than those at low altitude areas, accompanied by a rise in erythrocyte pressure volume and other plateau adaptation phenomena.

The difference in normal body and mind levels between college students at low and high-altitude areas is due to the physiological adaptation that occurs when individuals are exposed to high altitudes. The stimulation of the cardiovascular system by low oxygen partial pressure at high altitudes triggers a series of adaptive responses in the body to cope with the reduced oxygen availability.

One of the most significant adaptations is an increase in the production of red blood cells. Red blood cells contain hemoglobin, a protein that binds to oxygen and carries it to the body's tissues. At high altitudes, the reduced oxygen partial pressure stimulates the production of erythropoietin, a hormone that stimulates the production of red blood cells. As a result, people at high-altitude areas often show higher hemoglobin content than those at low-altitude areas.

The increase in hemoglobin content is accompanied by other plateau adaptation phenomena, such as a rise in erythrocyte pressure volume. Erythrocyte pressure volume refers to the ability of red blood cells to swell and shrink in response to changes in altitude. At high altitudes, the reduced oxygen availability causes red blood cells to swell and expand, which helps to increase oxygen delivery to the body's tissues.

These physiological adaptations help individuals at high-altitude areas to cope with the reduced oxygen availability. However, these adaptations can also have negative effects, such as increased blood viscosity, which can increase the risk of thrombosis and other cardiovascular problems.

Overall, the difference in normal body and mind levels between college students at low and high-altitude areas is due to the physiological adaptations that occur in response to high altitude. The stimulation of the cardiovascular system by low oxygen partial pressure triggers the production of red blood cells and other adaptive responses to help individuals cope with the reduced oxygen availability.

The results of national student physical fitness and health research show that the normal body and mind of primary and secondary school students migrating to high altitude shows a steady trend of improvement, however, the normal body and mind of college students still shows a downward trend, and most of them are still on passing and failing grades, and the proportion of

students reaching good and excellent is small. In order to study the countermeasures to improve the normal body and mind of high-altitude migrant college students who practice martial arts martial arts in the morning, it is important to measure the physical fitness of college students through a certain number of physical test data. Numerous scholars have analyzed a large number of physical test data and proposed several health indicators for measuring physical fitness, but there is no unified standard model yet (Connor, Shelley, and Egan 2020; Zabjek 2016).

At present, there is a lack of a proven system, and if it can be warned and monitored in advance, students can realize that their physical condition is not good enough and may fail the physical test, and have enough time to improve, the declining trend presented should be changed. We focus closely on the normal body and mind normal body and mind of high-altitude migrant college students, and devote ourselves to the research of prediction model of normal body and mind fitness of high-altitude migrant college students with multi-dimensional data fusion, firstly collecting the data of high-altitude migrant physical test, secondly processing the data by combining the detailed process of data mining, and then using machine learning algorithm to build models to predict different test item levels, so as to give the needed students with alerts, and finally compare the prediction performance effects of different models on the data set to provide timely warnings and interventions for students with poor physical fitness (Connor, Shelley, and Egan 2020; Peacock et al. 2018).

Related Work

Normal Body and Mind of High-Altitude Migrant College Students

n medical science, the area with altitude above 2500 m is called plateau. Plateau area has special geographical environment and climatic conditions, such as low pressure, low oxygen, high cold, dryness, large temperature difference between day and night, strong solar radiation, etc. Among them, plateau low oxygen environment causes damage to human body function and cognitive function. For people migrating to the plateau, the low oxygen environment accompanied by long-term high-altitude exposure will damage their brain cognitive function and also cause many adverse effects on their physiology and psychology, such as headache, insomnia, chest tightness, shortness of breath and fatigue, etc. Among all the symptoms, sleep disorders are more common and prominent.

Foreign research shows that the incidence of sleep disorders in people who enter the plateau in a hurry is as high as 71% to 93%, while the domestic analysis of outpatient medical records in the plateau area shows that the incidence of sleep disorders in the plateau is as high as 42.20%. This shows

that the incidence of sleep disorders in the plateau is much greater than the global sleep disorder rate (27%) according to the World Health Organization, and the sleep survey results published by the China Sleep Research Association (the incidence of insomnia among Chinese adults reached 38.2%). In addition, the sleep status of migrant population is related to age and migration time, and the sleep quality of migrant population who are younger and have been migrating for more than 5 years is better; the sleep quality of plain migrant population who live in higher altitude areas was investigated, and it was found that the higher the altitude and the longer the migration time, the worse the sleep quality.

At present, there are few studies on the sleep quality of plateau, and the research objects about the sleep disorder of plateau in China are mainly for army officers and soldiers (Connor and Egan 2019). As a special group, the occurrence of sleep disorders and the factors affecting them may be different from those of the general population, as officers and soldiers stationed on the plateau not only have to face the harsh environment of hypoxia on the plateau, but also have to complete military tasks with high standards and quality. Questions such as whether plateau settlers have fewer sleep problems than transplants, whether the sleep quality of transplants changes with the increase of transplantation length, and what other factors affect the sleep quality of transplants. As the size of the highland migrant population gradually increases, it is particularly important to address the sleep disorders they face in the low oxygen environment of the plateau. However, few studies have been conducted on the general highland migrant population, and the sample size of the studies is small and the results are generalized (Kirk et al. 2021).

After students from low altitude areas move to high altitude areas, the change of atmospheric pressure and partial pressure of oxygen will have a series of effects on their body functions, which will be manifested in the initial stage as plateau habituation phenomena such as increased respiratory rate, increased blood pressure, etc. When individuals from low-altitude areas move to high-altitude areas, they experience a decrease in atmospheric pressure and a corresponding decrease in the partial pressure of oxygen. This decrease in oxygen availability triggers a series of physiological adaptations in the body to cope with the reduced oxygen supply. These adaptations are collectively known as the plateau habituation phenomena.

One of the initial effects of high altitude exposure is an increase in respiratory rate. The body attempts to compensate for the reduced oxygen availability by increasing the rate and depth of breathing, which allows for a greater intake of oxygen and removal of carbon dioxide. The increase in respiratory rate is often accompanied by other respiratory adaptations, such as an increase in lung volume and a decrease in arterial oxygen saturation.

Another initial effect of high altitude exposure is an increase in blood pressure. The body attempts to maintain adequate blood flow and oxygen

delivery to the body's tissues by increasing blood pressure. The increase in blood pressure is often accompanied by other cardiovascular adaptations, such as an increase in heart rate and cardiac output.

These initial effects of high altitude exposure are part of the body's adaptive response to the reduced oxygen availability. Over time, the body undergoes further adaptations to improve oxygen delivery and utilization, such as an increase in the production of red blood cells and an increase in capillary density in the muscles.

Overall, the change in atmospheric pressure and partial pressure of oxygen that occurs when students from low altitude areas move to high altitude areas has a series of effects on their body functions, which are manifested as the initial stage of plateau habituation phenomena such as increased respiratory rate, increased blood pressure, and other physiological adaptations.

If the altitude rise is too large and fast or if the body is weak, it may also induce acute altitude sickness, manifested as headache, nausea, chest tightness, poor breathing, and in serious cases, pulmonary/cerebral edema, which usually occurs within The students will gradually adapt to it within a week and the various stress reactions will be reduced or disappear (Hao Zeng 2019; Hwang and Kim 2018; Johnson 2018).

Therefore, the disadvantage of low altitude students' poor cardiorespiratory endurance is more obvious at high altitude. But fortunately, the normal body and mind of low-altitude students can be better improved after plateau acclimatization of all high-altitude migrant college students, and even still maintain the advantages of explosive strength and strength endurance. Through a follow-up survey of Han and hereditary Tibetan college students who entered Tibetan universities (average altitude 3658 m), it was found that the lung capacity and blood oxygen saturation of low-altitude Han students did not differ from those of hereditary Tibetan students, but the heart rate and blood pressure were significantly higher than those of hereditary Tibetan students, and they were still at a higher level by the second year of acclimatization.

The red blood cell (RBC), hemoglobin (Hb), red blood cell specific volume (HCT), platelet (PLT), and oxygen saturation (SpO2) of the plain college students who first entered the plateau were significantly lower than those of the native Tibetan students, but the physiological functions of the blood indexes of the plain college students had been better acquired after two years of adaptation to the plateau, suggesting that the adaptation of cardiovascular functions of the students who moved from low altitude to high altitude areas. This suggests that the adaptation of cardiovascular function of students from low altitude to high altitude plays an important role in the improvement of normal body and mind. When low altitude students move to high altitude, the partial pressure of arterial blood oxygen decreases, in order to transport more oxygen to all tissues and organs of the body, the compensatory contraction of

myocardium increases, the heart rate accelerates, and the ejection function of heart increases; at the same time, the low partial pressure of oxygen stimulates the secretion of erythropoietin (EPO), accelerates erythropoiesis and hemoglobin synthesis, increases the viscosity of blood, and increases the ejection resistance of heart, which eventually leads to The increase in heart rate and blood pressure will ultimately lead to a dual increase in heart rate and blood pressure (Committeri, Bondi, and Sestieri 2022; Li et al. 2022; Liu et al. 2020; Su, Zhang, and Huang 2022).

A longitudinal study of college students at the United States Air Force Academy (2210 m above sea level) showed that the aerobic and anaerobic endurance of the plain college students was lower than that of the subalpine college students during the two years they lived in the subalpine, although the blood indicators (red blood cell count and hemoglobin content) had reached the same level by the 17th month and the difference in aerobic capacity decreased, but the difference in anaerobic endurance was still large.

Martial Arts Morning Practice and Artificial Intelligence

Chinese martial arts have a long history in China and is a shining pearl of the Chinese civilization system. It has been transformed and developed continuously along with the civilization process of 5000 years (Kentiba et al. 2019). As a traditional culture, it contains a rich cultural connotation. It is not only theoretically based on Chinese traditional culture, but also integrates the comprehensive activities of Chinese traditional medicine and related disciplines for thousands of years. Through the continuous transformation of various dynasties, it has become the representative system of the times for traditional Chinese sports now.

The new age understanding of health has become more than just the promotion of physical health (Gao et al. 2022; Lv et al. 2022). The sports practiced in the traditional sense contain more roles, and martial arts sports as a traditional sport. As a traditional sport, martial arts plays an important role in the fitness and recreation of the public. In particular, the development of Taijiquan has thus established the status and function of martial arts practiced among urban residents. Based on the investigation and study of the development of martial arts in major cities across the country, problems and factors affecting the development can be found. The whole China has a more extended role for the implementation of the national fitness program and its popularization of martial arts. This paper investigates the development of martial arts in an urban area and identifies the problems and factors that affect it.

This paper can reflect more objectively the development of martial arts sports in urban areas in China and can have a high significance for the development of martial arts sports in the national fitness activities of urban

residents throughout China. Wushu morning practice is an extension and supplement of school sports, and students can enhance their physical fitness and enjoy their body and mind by participating in wushu morning practice. At the same time, martial arts morning practice can improve students' adaptability, promote them to develop good scientific habits and a healthy lifestyle, form a correct world view, treat people positively, cultivate a sunny character, and drive people around them to develop good fitness habits, laying the foundation for the formation of a lifelong view of sports.

The current situation of college students' participation in martial arts morning exercise is not optimistic, and the number of college students coming out of the dormitory and into the playground in the morning is low due to various reasons. In order to actively guide college students to participate in martial arts morning exercises, it is necessary to study the current situation and influencing factors of college students' participation in martial arts morning exercises (Wang et al. 2021).

Along with the booming development of network technology, the information on the Internet has grown rapidly. This huge amount of information has increased the possibility for users to obtain a large amount of knowledge in the Internet world, but then the shortcomings are also gradually exposed. The process of classifying college students' physical fitness is shown in Figure 2.

On the one hand, the amount of information is mixed and there is a lot of wrong and redundant information or even contradictory information, which makes it less and less efficient for users to get useful information from it (Pan and Zhuang 2021). On the other hand, there are many ways to carry this information, and for some slightly offbeat issues, it is difficult for users to obtain satisfactory results through the common search methods faster, so users are more and more demanding in obtaining

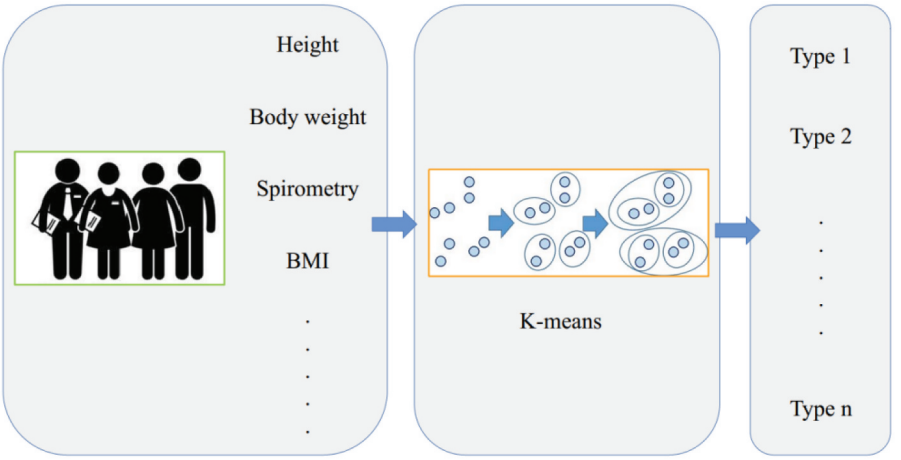

Figure 2. University students' physical classification process.

information accurately and quickly. Therefore, question and answer system is born to supplement the existing ways to obtain effective and uniform information, and the accuracy and usage rate has been greatly improved every year. They also use common natural language processing techniques to parse user input into a machine-understood form and return relevant answers, resulting in smaller, more accurate answers and less time spent by users searching for irrelevant information in traditional search engines.

Unlike traditional search engines or systems that return many documents, it can quickly understand the key points of a user's question and then give a comprehensive and reliable answer in a short time, and it is this feature that meets the growing needs of users, and the study of question-and-answer system algorithms has become an urgent issue for improvement in today's world. In recent years, the exponential growth of data and the enhancement of computer computing power have greatly boosted the rapid development of AI field, and many key problems in the field of image processing have been overcome by scientists one by one, but the development of natural language processing field is not as bright as the results of image processing field. In practical applications, there is a huge market potential and space for natural language processing, and more and more companies and research institutions are putting great efforts into it (Kious, Kondo, and G 2018; Li et al. 2021). With the rapid development of deep learning, natural language processing still has many bottlenecks, but at the same time there are also many remarkable achievements. In the past, Q & A systems generally used traditional templates to capture key pieces of user questions and integrate them with information from the answer database using different matching techniques to give users a comprehensive answer. Thanks to the rapid development of Q&A algorithms and related fields, Q&A systems are gradually transitioning from making answers based on shallow semantics to mining deeper semantic understanding. It is believed that in the near future, the breakthrough development of Q&A systems will definitely lead the peak of an era. Artificial intelligence technology is now deeply penetrating into all walks of life, combining with traditional industries to produce different "chemical reactions" and bursting out new economic vitality, and the medical field is no exception.

The evaluation of college students' physical fitness and giving targeted exercise guidance is part of college sports work. Since there is a complex nonlinear relationship between the exercise ability of human body and various influencing factors, it is difficult to evaluate students' normal body and mind artificially, and the evaluation by using artificial neural network can reduce the influence of human factors and can better ensure the objectivity and accuracy of evaluation results.

Methods

Model Architecture

This study uses BP neural network to classify the normal body and mind of high-altitude migrant college students and to accurately identify the type of physical fitness. (1) To construct an index system for evaluating the normal body and mind of high-altitude migrant college students, which will be used as variables for K-means clustering analysis and as input layer neurons for constructing an artificial neural network. (2) Clustering is used to divide the data into K classes, and the physical fitness test data and physical fitness type of each student become $\{x_1, x_2, \ldots, x_i\} \rightarrow y_j$ mapping. (3) Set the parameters of the neural network and input the training data set into the artificial neural network for training, so that it forms a mature x (physical fitness test index) to y (physical fitness type) mapping mechanism. Finally, the model is evaluated, saved, and implemented for prediction. The process of data processing is shown in Figure 3.

Data Pre-Processing

The raw data are cleaned and standardized to make the data format conform to the model settings. First, duplicate, abnormal and vacant data are found and removed. Secondly, the "shoulder turn," "1000 m run," "800 m run," "50 m run" were converted to high merit indexes using the countdown method" converted to high performance indicators. Finally, the data were standardized

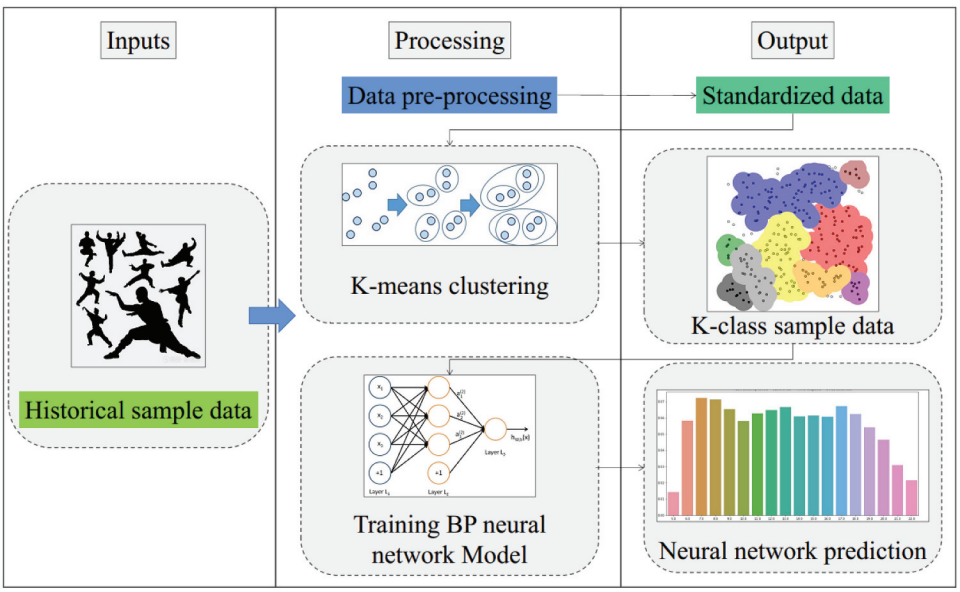

Figure 3. Model Structure.

Table 1. Pre-processed data format.

	Endurance quality	Speed	Functional ability	Agility	Physical size	Strength	Flexibility
Student1	0.52981	1.28151	−0.2567	−0.6751	−.5013	0.83177	−0.64061
Student2	0.52981	.04856	1.52788	0.2448	−.0598	−0.4962	−0.3899
Student3	−1.50137	−.2644	0.64431	−0.4036	.7638	−0.3625	0.64668

by Z-Score to make the data dimensionless. The total scores of strength quality and flexibility quality were calculated based on the weights. The format of the pre-processed data is shown in Table 1.

Data Classification Process

The steps of K-means clustering algorithm are as follows. (1) There are sample sets $X = \{x_i \mid i = 1, 2, \ldots, N\}$, K categories for $C_j (j = 1, 2, \ldots, K)$, and K clustering centers as $A_j = (j = 1, 2, \ldots, K)$. From the sample X, k objects are randomly selected as the initial clustering centers.

(2) Based on the formula:

$$d(x_i, x_j) = \sqrt{(x_i - x_j)^T (x_i - x_j)} \tag{1}$$

The Euclidean distance between each sample and each clustering center is calculated, and each object is classified into the category closest to the clustering center.

(3) Using Eq:

$$A_j = \frac{1}{N_j} \sum_{x \in C_j} x \tag{2}$$

The mean value of all sample points in each class cluster is used as the new clustering center.

(4) Repeat steps (2)(3) until the clustering centers no longer change or the number of iterations reaches the preset maximum number of iterations.

The value of K in the K-means algorithm can be determined using the elbow method. The core idea is that as the number of clusters K increases, the sample division will become finer, the degree of aggregation of each cluster will gradually increase, and the error squared, and SSE will gradually become smaller. The formula for calculating the error squared and SSE is as follows.

$$SSE = \sum_{i=1}^{k} \sum_{p \in C_i} |p - m_i|^2 \tag{3}$$

C_i is the i-th cluster, p is the sample points in C_i, mi is the center of mass of C_i (the mean of all samples in C_i), and SSE is the clustering error of all samples, which represents the good or bad clustering effect.

The influence of the weights of a NN can be measured using a technique called sensitivity analysis. Sensitivity analysis involves systematically varying

the weights of the NN and observing the resulting changes in the network's output. By doing so, it is possible to determine which weights have the greatest influence on the network's output, and which weights have little or no influence.

One way to perform sensitivity analysis is to use a technique called backpropagation. Backpropagation is the process by which a NN adjusts its weights during training in order to minimize its prediction error. During backpropagation, the network computes the derivative of its output with respect to each weight, which indicates how much the output would change if the weight were to be adjusted. By computing these derivatives for each weight, it is possible to determine the sensitivity of the output to each weight.

Another approach to sensitivity analysis is to use a technique called perturbation analysis. Perturbation analysis involves perturbing the weights of the NN by a small amount and observing the resulting changes in the output. By perturbing each weight in turn and observing the resulting changes in the output, it is possible to determine the sensitivity of the output to each weight.

Once the sensitivities of the weights have been determined, it is possible to use this information to optimize the weights of the NN. For example, weights with high sensitivities may be adjusted more aggressively during training in order to improve the network's performance. Alternatively, weights with low sensitivities may be pruned or removed from the network in order to simplify its architecture and reduce its computational cost.

Body Mass Evaluation Model Training and Prediction

The neural network structure diagram is shown in Figure 4. BP neural network is a supervised learning network in which the input signal acts on the output nodes through the hidden layer and undergoes a nonlinear transformation to produce the output signal.

In the forward propagation process, the calculation formula of each neural node in the hidden layer is as follows.

$$H_j = f\left(\sum_{i=1}^{n} v_{ij} X_i + b_j\right) \tag{4}$$

The calculation formula of each node in the output layer is the same as that of the hidden layer. After one forward propagation, the total error between the desired output and the actual output is calculated with the following formula.

$$E = \frac{1}{2}\sum_{k=1}^{l} (T_k - O_k)^2 \tag{5}$$

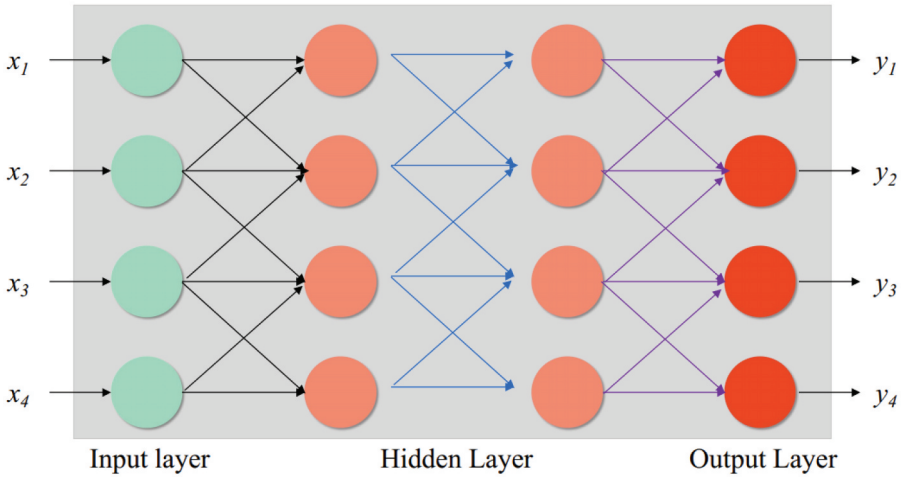

Figure 4. Neural network structure diagram.

To calculate the influence of the weight w_{jk} between the hidden layer and the output layer on the overall error, the total error can be used to find the bias derivative of w_{jk}, which can be expressed using the chain method as follows.

$$\frac{\partial E}{\partial w_{jk}} = \frac{\partial E}{\partial O_k} \cdot \frac{\partial O_k}{\partial H_j} \cdot \frac{\partial H_j}{\partial w_{jk}} \tag{6}$$

After deriving the derivative, we get

$$\frac{\partial E}{\partial w_{jk}} = (Tk - Ok) \cdot Ok \cdot (1 - Ok) \cdot H_j \tag{7}$$

The final new w_{jk} is adjusted as

$$w_{jk(new)} = w_{jk} - \eta \cdot \frac{\partial E}{\partial w_{jk}} = w_{jk} - \eta \cdot (T_k - O_k) \cdot O_k \cdot (1 - O_k) \cdot H_j \tag{8}$$

In the formula, η is the learning rate, which affects the network learning rate. A trained neural network, i.e., able to respond to similar samples of input information. Let $y_k(n)$ be the actual network output of neuron k at moment n for input x(n), and $d_k(n)$ denote the output that the corresponding sample should have, the error can be written as:

$$e_k(n) = d_k(n) - y_k(n) \tag{9}$$

Error correction learning is the process of minimizing the objective function based on $e_k(n)$ so that the actual output of each output neuron in the neural network is closest in statistical significance to the output that the sample should have. The most used objective function is the criterion of mean squared deviation, defined as

$$J = E\left(\frac{1}{2}\sum\nolimits_k e_k^2(n)\right) \tag{10}$$

where E is the expectation operator. Because it is necessary to count the properties of the whole process when using J as the objective function directly, to solve this difficulty we generally use the instantaneous value of J at moment n (n) instead of J, i.e.

$$\varepsilon(n) = \frac{1}{2}\sum\nolimits_k e_k^2(n) \tag{11}$$

Using the most rapid gradient descent method we get:

$$\Delta w_{kj}(n) = \eta(n) e_k(n) x_j(n) \tag{12}$$

where $\eta(n)$ >0 is the learning step. This learning rule is successfully applied to a wide range of neural network models, such as the simplest perceptron learning algorithm, which is the most primitive application of neural networks; and the most classical application is the back propagation learning algorithm, also known as BP algorithm. When the activation of neurons at both ends of a given synapse (connection) are synchronized (same activation or same inhibition), the strength of that connection should be enhanced and vice versa weakened. It is expressed in a mathematical model as:

$$\Delta w_{kj}(n) = F\big(y_k(n), x_j(n)\big) \tag{13}$$

where $y_k(n)$, $x_j(n)$ are $\Delta w_{kj}(n)$ the states of the neurons at both ends, most often used as:

$$\Delta w_{kj}(n) = \eta y_k(n) x_j(n) \tag{14}$$

Since $\Delta w_{kj}(n)$ is correlated with the $y_k(n)$, $x_j(n)$, it is also called the correlation learning rule. In the competitive learning of the network each output unit competes, and finally only the strongest one can be activated. When the learning system is in a smooth environment (statistical features do not change over time), it is theoretically possible to learn the statistical features of the environment through supervised learning, and these statistical features can be remembered by the neural network as experience; if the environment is non-smooth, the usual supervised learning does not have the ability to track such changes, and some adaptive capability of the network is required to solve this problem.

The term “smooth environment” refers to a situation where the statistical features of the input data remain constant over time. In such an environment, it is possible to learn the statistical features of the data using supervised learning, where the neural network learns to map inputs to outputs based on a labeled training set. Once the statistical features of the environment have

been learned, they can be remembered by the network as experience and used to make accurate predictions in the future.

However, in a non-smooth environment, the statistical features of the input data may change over time. For example, the distribution of the input data may shift, or the relationships between inputs and outputs may change. In such cases, traditional supervised learning methods may not be effective, as they assume that the statistical features of the data remain constant. To solve this problem, the neural network needs to have some adaptive capability, which allows it to track changes in the environment and adjust its parameters accordingly.

One way to achieve this adaptive capability is to use techniques such as online learning or incremental learning, which allow the network to learn from new data as it becomes available. These methods typically involve updating the weights of the network based on new input-output pairs, rather than retraining the entire network from scratch. By gradually updating the network's parameters in response to changes in the environment, the network can adapt to non-smooth environments and make accurate predictions over time.

It must be noted that during error correction learning, the network is presented with a set of input-output pairs and attempts to learn a mapping between them by adjusting its weights iteratively. The process of error correction learning begins with the network making an initial prediction for each input in the training set. The error between the predicted output and the desired output is then calculated using a cost function, such as mean squared error or cross-entropy. The network then adjusts its weights in order to minimize this error using an optimization algorithm, such as stochastic gradient descent. During each iteration of the training process, the network updates its weights to reduce the error between its predicted output and the desired output. This process continues until the error is minimized to a satisfactory level, or until a predetermined number of iterations have been completed. By adjusting its weights based on the error between its predicted output and the desired output, the network is able to learn a function that maps inputs to outputs with high accuracy.

Experiments and Results

Experimental Data

Combined with the actual needs of college students' martial arts morning exercise activities, the index system was formulated in accordance with the principles of safety, simplicity, reliability and practicality. The physical and mental test indexes include: height and weight in the physical form category, lung capacity in the physical function category, and 50 m running, sitting forward bending, standing long jump, 1000 m running (male), 800 m running (female), pull-ups (male), sit-ups (female) in the normal body and mind

category of high-altitude migrant college students. The flexibility quality of human body is mainly reflected in shoulder, trunk and hip flexibility, and the flexibility quality indexes are proposed to be shoulder rotation, prone back extension and seated forward bend. The questionnaire was designed and distributed to experts for further screening. After the questionnaire was returned, the indicators and test methods with the highest frequency were retained and tested on 493 male and 513 female students.

Cluster Analysis of Normal Body and Mind of High-Altitude Migrant College Students

With the help of Sklearn plug-in package of Python computer language, the pre-processed normal body and mind test data of high-altitude migrant college students were subjected to K-means clustering analysis, and the relationship graphs of 1 to 16 classes were calculated and the inflection points were observed respectively. The results of their calculation are shown in Figures 5 and 6.

As can be seen from the figure, in the clustering results of physical fitness types of male and female students, when K takes a value around 8, the curve starts to level off gradually, so it can be divided into 8 classes more appropriately. z-Score standard score reflects how many standard deviations the obtained data have from the mean, and the farther the z-score standard score is from the value of 0, the larger the data are from the mean, indicating that the quality is more excellent or worse.

As can be seen from Table 2 and Figure 7, the first category of boys deviated from 1.251 standard deviations in body size, speed and endurance values were more than one standard deviation below the mean, and other indicators were lower than the mean; this type of boys belonged to the fat type, and obesity limited his mobility.

The overall indicators of the second category of boys were below the average performance, with a thin body type, poorer endurance, and weaker cardiorespiratory function. The third category of boys was 0.752 standard deviations below the mean for size and 0.261 standard deviations below the mean for strength and function. The boys in this category were thin in size, more flexible and faster in short distances but lacked strength and had weak cardiorespiratory function.

The fourth category of boys has above average function, strength and size, while speed, agility and endurance indicators are below the average, especially endurance indicators are 1.561 standard deviations below the average, this type of boys are stronger, strong and powerful muscles, but poor endurance, poor movement speed, and belong to the endurance lacking type. The fifth category of boys has better speed quality and agility quality, while functional, endurance and body size indicators are below the average, this type of boys are

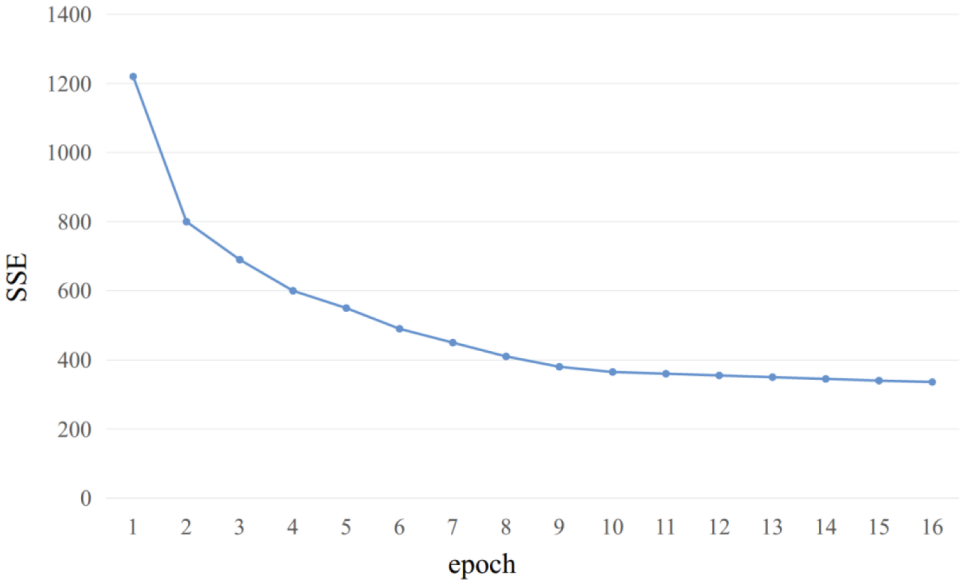

Figure 5. Relationship between K and SSE in male students.

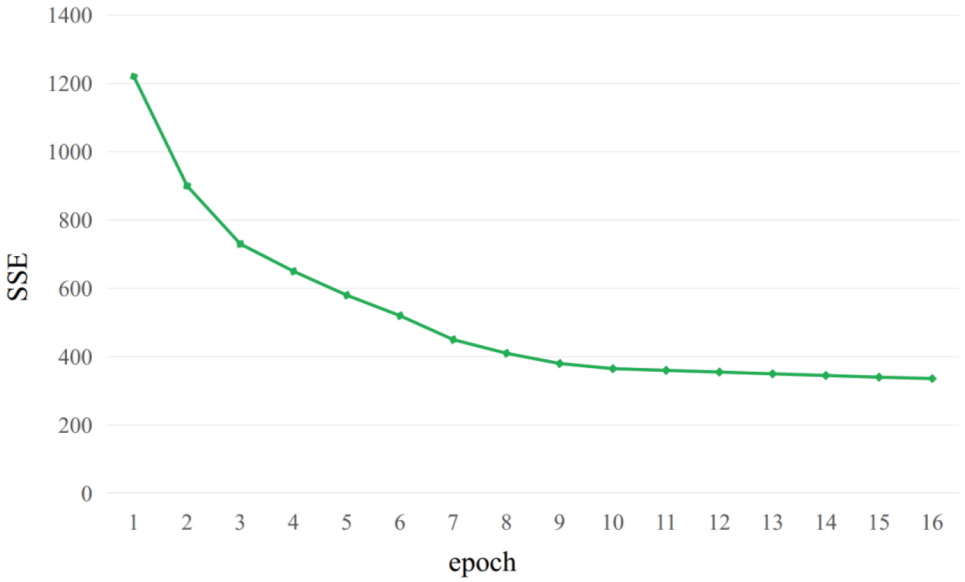

Figure 6. Relationship between K value and SSE for female students.

lean, lower body fat rate, belong to the athletic type, higher explosive power, but slightly worse endurance. Most of the data for boys in the sixth category were above average, especially stronger in speed, endurance, agility, lower body fat percentage and better endurance. Category 7 boys were above average in speed, strength, flexibility, and size, and slightly worse in endurance, function, and agility, and were explosive. Category 8 boys had a more

Table 2. Mean Z-Score standard scores of each physique type for male students after K-means clustering.

Body Type	Endurance quality	Speed	Functional ability	Agility	Physical size	Strength	Flexibility
1 Class	−0.237	−1.439	−1.582	−0.035	−.128	−0.463	1.251
2 Class	−0.424	−.168	−0.592	−0.067	−.033	−0.015	−0.524
3 Class	−0.261	.242	0.103	−0.213	.086	0.453	−0.752
4 Class	0.745	−.864	−1.561	0.853	−.054	−0.465	0.928
5 Class	−0.263	.635	−0.652	0.168	.152	0.928	−0.435
6Class	0.462	.837	0.806	0.216	.122	0.713	−0.461
7Class	−0.151	.622	−0.531	0.413	.092	−0.073	0.491
8Class	0.251	.248	0.322	0.224	−.018	−0.084	0.015

Figure 7. Mean Z-Score standard scores of each physique type for male students after K-means clustering.

mediocre physical condition, with no particularly poor aspects, but no particularly outstanding aspects either.

As can be seen from Table 3 and Figure 8, the first category of girls has stronger endurance quality, 0.603 standard deviations above the average, better function, speed, and sensitivity, leaner physique, and lighter physique makes her good at running, so she has better endurance quality, but relatively weak strength development.

The second category of girls has poor strength quality and relatively good endurance quality. The third category of girls has all indicators below the average, especially the endurance quality is 1.270 standard deviations below the average, belongs to the lean type, the overall quality is low, and the normal body and mind level of high-altitude migrant college students is poor. The fourth category of female students has a body size value higher than the average value of 0.538 standard deviations, endurance quality

Table 3. Mean Z-Score standard scores of each physique type for female students after K-means clustering.

Body Type	Endurance quality	Speed	Functional ability	Agility	Physical size	Strength	Flexibility
1 Class	0.430	.331	0.603	0.045	−.049	0.402	−0.315
2 Class	0.005	.083	0.153	−0.237	−.029	0.002	−0.065
3 Class	−0.377	−.476	−1.270	−0.091	−.065	−0.009	−0.481
4 Class	0.895	−.393	−0.903	−0.143	−.042	0.117	1.819
5 Class	0.263	−1.649	−1.614	0.495	−.109	−0.247	0.522
6Class	0.131	.855	0.219	0.494	.056	0.618	−0.018
7Class	0.221	−.480	0.257	0.261	.048	−0.348	0.391
8Class	0.064	−.016	0.145	0.035	.092	−0.065	0.030

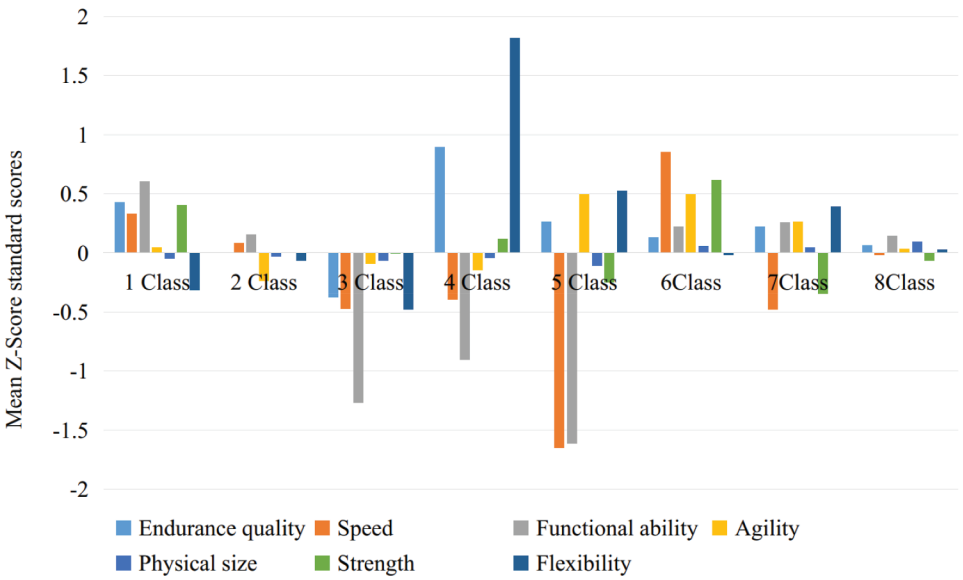

Figure 8. Mean Z-Score standard scores of each physique type for female students after K-means clustering.

value lower than the average value of 0.903 standard deviations, and function higher than the average level of 0.895 standard deviations, this type of female students has a fat body size, large lung capacity and certain strength, but the level of endurance is low. The fifth category of female body type is higher than the average level of 1.736 standard deviations, endurance quality and speed quality is very poor, this type of girls belong to the obese type. The sixth category of female body high altitude migrant college students have better normal body and mind, most of the indicators are higher than the average, and belong to the explosive type. The seventh category of female students have higher than average indicators of function, endurance, and strength, but poor speed and sensitivity. The data of each index of the eighth category of female students are not far from the average level, and the standard deviation of most of the indexes does not exceed 0.1.

Neural Network Analysis of Normal Body and Mind of High-Altitude Migrant College Students

This study used the Python language and the Keras artificial neural network framework to design, debug, evaluate, and apply the learning model. First, the Keras framework was used to construct a feedforward neural network and establish a fully connected network layer (Dense layer). Second, the pre-processed data of male and female students are used as input and the results of K-means clustering analysis are used as output to train the network and obtain the mathematical model. Finally, a test sample data set is used as input to the network model, and the type obtained from the model prediction is compared with the actual type to verify the accuracy and error of the model. If the accuracy of the obtained model prediction is poor, the network can be trained again by adjusting the model parameters or increasing the sample size, and the network model can be made ideal through continuous adjustment and optimization. From the results of network training (see Table 4), the prediction accuracy of male students' data reached 94.3% on the test data set after 20 iterations, and the prediction accuracy of female students' data reached 93.7% on the test data set after 20 iterations.

This indicates that the model has a high accuracy in discriminating students' physical fitness types. The trained Keras neural network model was saved as a single HDF5 file. When the model was used to determine the physical type of a student, the model was loaded using the filepath method and judged using the model predict method.

The above statement implies that a pre-trained neural network model was used to predict the physical type of a student. The "filepath method" refers to a way to load a pre-trained model in Python, where the path to the saved model file is specified as an argument to the load_model function. This function is typically provided by deep learning libraries such as TensorFlow or Keras. Once the pre-trained model has been loaded, the "model predict method" is used to make predictions on new data. This method takes input data as an argument and returns the model's predicted output for that data. In the case of determining the physical type of a student, the input data may consist of measurements such as height, weight, body mass index (BMI), and other physical characteristics, while the output may be a categorical label indicating the student's physical type (e.g. "ectomorph," "mesomorph," or "endomorph").

Table 4. BP neural network training and testing results.

	Number of training samples	Accuracy	Loss	Number of test samples	Precision	Loss
Male students	394	0.9358	0.2345	99	.9435	0.2289
Female students	410	0.9312	0.2380	103	.9372	0.2339

In summary, the process of using a pre-trained model to determine the physical type of a student involves loading the model from a saved file using the filepath method and then using the model predict method to make predictions on new data.

Conclusion

In this paper, we proposed an analysis of the countermeasures to improve the normal body and mind of high-altitude migrant college students based on K-means and neural network for martial arts morning practice. The experimental results show that the cardiorespiratory endurance of college students in low altitude areas is generally lower than that of college students in high altitude areas, but the strength quality (explosive strength and muscular endurance) shows more obvious advantages; and when students in low altitude areas move to high altitude areas for a short period of time, all the normal body and mind of college students who move to high altitude areas will have a short time habitual decline, and after the body gradually adapts, all the normal body and mind of college students who move to high altitude areas will begin to recover.

After the body gradually adapts, all the normal body and mind of high-altitude college students will begin to recover, among which the strength quality even appears to recover in excess, but the cardiorespiratory endurance is still at a low level. The results of cluster analysis show that the physical fitness of male and female college students can be divided into eight categories, and different types have different physical fitness characteristics. BP neural network was trained using the cluster analysis data to establish the physical fitness evaluation model, and the accuracy reached more than 94%.

It can be seen that the physical fitness evaluation model based on K-means clustering and BP neural network can more accurately determine the normal body and mind types of high-altitude migrant college students and can be used as a basic algorithm for automated and accurate evaluation of the physical fitness types of college students. This paper also shows that the influence of martial arts morning practice on normal body and mind level should be considered when implementing national student normal body and mind standards in high-altitude areas, and that martial arts morning practice can indeed improve the normal body and mind of high-altitude migrant college students.

Meanwhile, as more and more low-altitude students enter high-altitude universities, the normal body and mind level of college students in high-altitude areas may imagine a false decrease under the same standard.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Data availability statement

The data used in this study are available from the author upon request.

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