Establishment of sports health model for college students based big data

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Abstract. In recent years, China’s science and technology has developed rapidly. The coverage of communication networks is gradually expanding. This article understands the basic health status of college students through big data statistics. Excessive reliance on the Internet and electronic products make many college students unwilling to leave the dormitory and step into the playground to exercise. This article establishes a sports health model based on the health status of female college students, and provides design basis for later college student health model system according to the model. It takes weight as a measurement standard, and analyzes from the aspects of calorie absorption and consumption. Then it can get the required value through programming. Under the premise of not harming the body, the article makes a reasonable exercise plan for college students by controlling calories absorbed, exercise methods and exercise time per week. It aims to achieve the goal of reducing weight and maintaining physical health.

1. Introduction
With the continuous improvement of living standards, people have paid more and more attention to health issues. There are many factors that affect human health, including environmental factors, biological factors, lifestyle factors, health service factors and so on[1]. If the human body intakes excess energy every day, then this energy will be stored in the human body. The form of energy storage in the human body will make people gain more and more weight, resulting in obesity phenomenon[2].

Different exercise methods have different effects on the body weight changes. This study focuses on the impact of exercise methods on college student’s health status, and analyzes the changes in body. The weight can be used as a standard to measure whether the human body is in a healthy state, and to establish a mathematical model of the law of weight changes. Then the value of the required exercise time and exercise period under different exercise methods can be gotten, and a reasonable exercise plan can be formed.

2. Model assumption
The amount of calories absorbed by the body every day varies with diet, body mechanisms and other factors. And the conversion relationship between absorbed calories and weight is complicated. In order to ensure safety and health, and facilitate the quantitative analysis of calories absorption and consumption, this study idealizes some uncertainties and makes the following hypotheses.

H1. Assuming that the amount of weight gain is proportional to the amount of calories absorbed, that is, every eight million calories of calories absorbed will increase the weight by 1 kilogram.
H2. Assuming that the amount of weight loss caused by the body’s basic metabolism is proportional to the body weight every day.

H3. Assuming that the amount of weight loss caused by exercise is proportional to body weight, and is related to the form of exercise methods, exercise time, and exercise intensity.

H4. For safety and health, the weekly weight loss should not exceed one point five kilogram, and the weekly calories absorbed should not be less than ten thousand kilo calories.

H5. Assuming that the calories consumed by the human body in basic metabolism are the same as the calories consumed by digesting food.

3. Model Building

3.1. BMI analysis
Obesity is usually measured by body mass index. The body mass index is a ratio of body weight to height, which is considered to be a reasonable reflection of body fat in most people. It is calculated as the square of the weight over the upper body, as in

$$BMI = \frac{w(kg)}{I^2(m^2)}$$  \[
(1)
\]

The body mass index issued by the United Nations World Health Organization has the following regulations\(^4\).

I. When the BMI is between eighteen point five and twenty-four, it is normal weight.

II. When the BMI is between twenty-four and twenty-nine, it is overweight.

III. When the BMI is greater than twenty-nine, it is obese.

3.2. Human calorie consumption analysis
From a physical point of view, the essence of the human body is energy. The law of conservation of energy is one of the general basic laws in nature. The change in body weight can be considered to be caused by the destruction of energy conservation in the body. The calories consumption of the body mainly includes the calories consumed by the body’s basic metabolism, the calories consumed by physical activity and the calories consumed by digesting food.

3.2.1. Calories burned by the body’s basic metabolism
The calories consumed by the body’s basic metabolism vary with height, weight, age and other factors. The woman’s basal metabolism per week can be gotten by analyzing and calculating the relevant data, as in

$$Q = 126w$$  \[
(2)
\]

3.2.2. Calories burned by physical activity
Exercise method, exercise time and exercise period can affect the calorie consumption of the body. The \( \beta \) is calories burned per kilogram of body weight per hour. Therefore, the calories consumed by physical activity can be expressed, as in

$$Q = \beta tw$$  \[
(3)
\]

By referring to the information, several common exercise methods consume calories per kilogram of body weight in one hour \(^6\), as shown in Table 1.

| Exercise method | Calorie consumption (k cal) |
|-----------------|-----------------------------|
| Run             | 7.0                         |
| Dance           | 3.0                         |
3.2.3. Calories consumed by digesting food
It can be gotten by consulting and analyzing the relevant data that the basic metabolism and physical activity of the human body will affect the calorie consumption of food digestion to some extent. It can be expressed, as in

\[ Q_i = 10\% (Q_{i} + Q_{i}) \]  \hspace{1cm} (4)

3.3. Model establishment
The body’s basic metabolism, physical activity and digested food can reduce weight and the calories absorbed by the body through diet can increase body weight according to the above analysis. Assuming that the body absorbs a certain amount of calories per week without overeating. The \( \alpha \) is calorie conversion factor. The sports health model for college students can be expressed, as in

\[ w_{k+1} = w_k + \alpha C_k - \alpha (Q_i + Q_{i} + Q_{i}) \] \hspace{1cm} (5)

From the above equations, the weight of the female college student in the \( k+n \)th week can be expressed under the condition of insisting on exercise. The \( C_k \) is calories absorbed in week \( k \). The \( t \) is exercise time. Therefore, the sports health model of female college students can be calculated, as in

\[ w_{k+n} = (1 - 138\alpha - 1.11\alpha\beta)n \left( w_k - \frac{C_k}{138 + 1.11\beta} \right) + \frac{C_k}{138 + 1.11\beta} \] \hspace{1cm} (6)

4. Model checking
Suppose a female college student’s weight is seventy kilogram, the height is 160 centimeter in week \( k \), and absorbs ten thousand kilo calories per week. If the woman wants to reduce her weight to a healthy range, please make a reasonable exercise plan for the female college student.

4.1. Determination of health status
The body mass index can be calculated as 27.34 from known data. It can be judged that the female college student is overweight. It can get the value of \( \omega \) is between 47.36 and 61.44 by calculating. If the female college student wants to maintain normal health, her weight should be greater than 47.36 kilogram and less than 61.44 kilogram.

4.2. Determination of exercise mode and exercise time
According to the title, the value of original weight is 70, the value of weight after week n is 60, the calories burned per kilogram of body weight per hour are 7, the weekly calories absorbed are ten thousand, the value of calorie conversion factor is eight thousandths. Substituting the data into the (6). Then it can get the function relationship between the exercise time and exercise period, as in

\[ n = \frac{462r - 1720}{539r - 340} \] \hspace{1cm} (7)

Different exercise methods can make the value of exercise time and exercise period different in the case of a certain amount of weight loss and a certain amount of calories absorbed per week. If the female college student chooses to run, dance, play table tennis, play tennis, ride a bicycle or swimming, the functional relationship between the exercise time and exercise period can be obtained.

Swimming \hspace{1cm} 7.9

Play tennis \hspace{1cm} 4.5

Ride a bicycle \hspace{1cm} 2.5

Play table tennis \hspace{1cm} 4.4
through MATLAB programming[8]. It contains six sports modes, as shown in Figure 1. The program code can be found in (A.1).

![Figure 1. The function images under four exercise modes.](image)

4.3. Sports plan

If the female college student reduces the weight from seventy kilogram to sixty kilogram to ensure that the BMI is in the range of 18.5 to 24 and reach a healthy status from the above Figure 1. Then, exercise plan can be carried out according to the table 2.

| Exercise method         | Exercise time (hour) | Exercise period (week) |
|-------------------------|----------------------|------------------------|
| Running                 | 11                   | 18                     |
| Dancing                 | 15                   | 39                     |
| Playing table tennis    | 10                   | 40                     |
| Playing tennis          | 10                   | 39                     |
| Riding a bicycle        | 16                   | 47                     |
| Swimming                | 8                    | 24                     |

5. Model evaluation and promotion

The process of losing weight through exercise is much more complicated than that described in the model. In the sports health model of college students established in this paper, some uncertain factors that affect changes in body weight have been idealized. There is still a certain error between the exercise cycle gotten by the model and the actual exercise cycle. But the sports health model also has many advantages. The college student’s sports health model summarizes the relationship between exercise methods, exercise time, exercise period and body weight. It is not only beneficial for college students to adopt scientific and reasonable exercise methods to exercise, but also can help these students establish scientific health concepts to improve their physical fitness. It is known from the study that people can lose weight through reducing food intake and increasing calorie consumption. Then the sports health model is often used to tackle obesity. It not only can provide design basis for later the college student health model system, but also can give reasonable suggestions and plans for college student.
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Appendices
The program code of (A.1) is as follows:

\[
\begin{align*}
t1 &= 1:1:14; \\
t2 &= 1:1:14; \\
t3 &= 1:1:23; \\
t4 &= 1:1:11; \\
t5 &= 1:1:21; \\
t6 &= 1:1:16; \\
n1 &= \frac{\log((290.4*t1 - 1720)/(338.8*t1 - 340))}{\log((7862 - 4.84*t1)/8000)} \quad \text{% Playing table tennis} \\
n2 &= \frac{\log((297*t2 - 1720)/(346.5*t2 - 340))}{\log((7862 - 4.95*t2)/8000)} \quad \text{% Playing tennis} \\
n3 &= \frac{\log((165*t3 - 1720)/(192.5*t3 - 340))}{\log((7862 - 2.75*t3)/8000)} \quad \text{% Riding a bicycle} \\
n4 &= \frac{\log((521.4*t4 - 1720)/(608.3*t4 - 340))}{\log((7862 - 8.69*t4)/8000)} \quad \text{% Swimming} \\
n5 &= \frac{\log((198*t5 - 1720)/(231*t5 - 340))}{\log((7862 - 3.3*t5)/8000)} \quad \text{% Dancing} \\
n6 &= \frac{\log((462*t6 - 1720)/(539*t6 - 340))}{\log((7862 - 7.7*t6)/8000)} \quad \text{% Running}
\end{align*}
\]

plot(t1,n1,'r')
hold on  % Draw other graphics while keeping the first image
plot(t2,n2,'g')
hold on
plot(t3,n3,'b')
hold on
plot(t4,n4,'c')
hold on
plot(t5,n5,'y')
hold on
plot(t6,n6,'m')
hold on

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