Scholar Publishing Group
International Journal of Health and Pharmaceutical Medicine
https://doi.org/10.38007/IJHPM.2020.010304
ISSN 2789-8393 Vol. 1, Issue 3: 23-35

Dynamic Changes of Serum Ferritin Concentration in Mice during Exercise and Recovery

Yanping Li

Shanxi Medical University, Taiyuan, China

yanpingli@sxmu.edu.cn

Keywords: Exercise Anemia, Exercise and Recovery, Serum Ferritin Concentration, Dynamic Changes

Abstract: Iron is an indispensable important element in the human body. Serum ferritin is a reservoir of iron. Serum protein concentration is an important indicator of the health of the shadow body. Both high and low concentrations are not conducive to physical health. The purpose of this article is to study the specific situation of the dynamic change of serum ferritin concentration during exercise and recovery. This article takes the white rat as the experimental object and uses radioimmunoassay to dynamically determine and analyze the serum ferritin concentration during exercise and recovery of the white rat result. The results of the study show that, compared with the quiet time, exercise can reduce the serum ferritin concentration in the mice from the original 36.7ng/ml to 27.1ng/ml, the concentration is reduced by 32.8%, and the serum ferritin concentration will gradually increase during recovery. After 4.2h, it returned to the quiet level, indicating that exercise can sharply reduce the serum iron albumin concentration in a short period of time, causing exercise anemia. Therefore, exercise and recovery after exercise can cause changes in the serum protein concentration in the body, change the metabolism rate of serum ferritin in the human body, and have a certain regulating effect on the serum ferritin concentration.

1. Introduction

With the continuous rapid development of modern scientific information technology and the current strong market demand for competitive sports, it has greatly promoted the large-scale development of the emerging discipline of sports biochemistry. The research on the relationship between the metabolic balance of trace elements in the human body and the physiological level that affects human health, sports and health care and physical rehabilitation, athletes and comprehensive athletic ability is very active, and has become a hot research topic in the world today. Of course, there is no lack of research on the relationship between measuring the normal exercise of the human

body and measuring the concentration of ferritin in the internal organs and serum of the human body. High serum anemia ferritin concentration will directly affect the serious occurrence of iron deficiency anemia in football players. At present, most of the genetic research on iron deficiency anemia is limited to the genetic determination of anemia pigment, while others there are relatively few reports on the genetic identification of related medical diagnostic indicators of anemia, including the analysis of its inherent pigment conversion reaction mechanism. This article mainly attempts to analyze the intrinsic movement rules between dieting moderate exercise and anemia by trying to analyze the relevant indexes of the blood concentration of ferritin (SF) in the patient's serum.

Serum ferritin (SF) is usually one of the most sensitive and specific clinical indicators used to diagnose whether there is iron deficiency and excessive iron load in the body. In the early stage of typical iron deficiency anemia, high serum ferritin concentration. It may have very low clinical manifestations [1]. Intense sports arenas and sports not only aggravate the acceleration of ferritin metabolism in human serum, but also seriously affect the iron supply balance of the whole body. During the training of sports athletes, it is very easy for all athletes to have some sports long-term anemia, which directly affects all athletes' own competitiveness and sports ability, and in these sports long-term anemia due to anemia caused by iron deficiency. The rate of decline in the normal synthesis level of ferritin in human serum also accounts for a large percentage, and it is also one of the main causes of anemia affecting people's ability to compete in sports [2]. However, for the current main causes of sports anemia or early iron deficiency anemia in children, the lack of exercise leads to a serious decrease in the concentration of ferritin metabolism in patients' serum and other indicators that can reflect the normal status of serum ferritin metabolism, the mutual relationship still needs to be further studied [3].

In order to explore the specific manifestations of the dynamic changes of serum ferritin concentration during the movement and recovery of mice, this paper summarizes and analyzes a large number of medical achievements. Among them, Dwivedi gave a detailed introduction to the principle of dynamic changes in serum protein concentration caused by exercise, analyzed the problems and risks faced by exercise in regulating serum protein concentration, and elaborated related research methods and detection techniques [4]. Yesmin pointed out in his article that under the circumstances that today's medical technology has great limitations, there is no good method for the treatment of iron deficiency anemia, and most of them are based on food supplements [5]. Soheilykhah emphasized and stated that vigorous exercise can cause a sharp drop in the serum ferritin concentration in the body, causing exercise anemia, and even severe cases causing fainting and shock [6]. Huaqiao elaborated in the article that it will enter a recovery period after the exercise is stopped, and the serum ferritin concentration will return to the original level after a period of time, and pointed out the change rule of serum protein concentration during recovery [7]. Hamidieh pointed out that some anemia caused by exercise is mainly caused by the disturbance of ferritin metabolism, which makes it difficult for the continuous production of red blood cells, and analyzes the concurrent principle of anemia, which has important guiding significance for the treatment of anemia [8].

This article studies the dynamic changes of serum ferritin concentration during exercise and recovery of mice based on the summary of previous research results and experience. What is different from the previous ones is that there are some innovations in the research content and detection methods. The specific innovations are following points: First, this article uses radioimmunoassay to detect the serum protein concentration of mice for the first time, which greatly improves the accuracy of the experimental data of the detection efficiency and makes the detection results more credible. Secondly, when performing serum sampling, this article boldly uses

the bone marrow aspiration method and takes the serum ferritin in the bone marrow as the research object. This method is simple to operate and is more conducive to calculation and comparison than traditional sampling methods. Third, for the first time, this article explores the changes and characteristics of serum ferritin and transferrin in rats with exercise anemia through long-term incremental load treadmill exercise to explore various indicators that can reflect the body's iron deficiency.

2. Exercise and Serum Ferritin Metabolism

2.1. The Biological Value of Ferritin

The iron and zinc elements play a vital protective role for the healthy growth of iron. Iron and zinc elements are usually the main components of human ferritin. The iron element in the human body can only play a variety of iron's biological role after being combined with various iron and protein. The main physiological role is that the human body is responsible for controlling the physical transport of oxygen required by the body and participating in providing the body's required substances. Energy and many metabolic mechanism processes related to metabolic processes [9]. The other classification is to store calcium and iron at the same time. Calcium accounts for about 20% of the total body's calcium absorption of iron. The main components are calcium ferritin and iron-rich hemosiderin. Its main structure is distributed in the human liver. In the bone marrow of the spleen and kidney, the main nutritional role is to store calcium and iron at the same time. The biological content of this part of the iron reserve changes long-term in the body. Its main nutritional role is that some organisms that will be digested and absorbed from the normal diet are temporarily not normally needed iron reserves are combined in the form of non-toxic drugs in a timely manner. When the functional iron in these bodies cannot be normally metabolized and consumed, it can directly use this part of iron reserves to provide nutritional supplements in time.

Ferritin is the main carrier of human hematopoiesis. Loss of ferritin can cause anemia. Ferritin loss is a long-term, gradual process, divided into two stages: erythropoiesis and iron deficiency and iron deficiency anemia stage [10]. Although the first two stages of ferritin deficiency are iron deficiency, their levels are still within the normal range and are often referred to as latent iron deficiency or subclinical iron deficiency. During the period of potential iron deficiency, the human body is in a semi-healthy state due to fatigue, decreased work ability and intellectual behavior, but its symptoms are hidden and difficult to find, and the incidence is more than twice the original. Therefore, it is especially important to detect people with iron deficiency early. When the accumulation of iron and functional iron in the body decreases, it can be tested and intervened to prevent the iron balance from continuing to develop into iron-deficiency anemia. It can effectively prevent and control iron deficiency and reduce the prevalence of iron deficiency in the population. In other words, from the perspective of work and research in the field of public health, ensuring sufficient iron reserves in the body is the most basic way to prevent iron deficiency. Therefore, the assessment of iron reserves in high-risk populations with iron deficiency is the focus and core of the assessment of human iron nutritional status.

There are many ways in which proteins play a role in human biological physiology and in applications. Ferritin is often directly affected by many micro-factors unrelated to the body's iron storage process, such as necrosis of human tissue membranes, inflammation, malignant tumors, and the iron conversion rate of human red blood cells and it is less acceptable to directly accept the above-mentioned related factors [11]. Therefore, it is more likely to accurately reflect the amount of iron stored in the body. The content of iron protease depends on the saturation of iron transferase and the biosynthesis rate of human hemoglobin. When the body's cells have insufficient intake of

ferritin or the body's ferritin metabolism is accelerated, resulting in an increase in the rate of ferritin loss in the body, the body's cells will use the body's reserve energy iron to transfer and allocate it normally through the movement of transferrin in the body. In order to make up for the normal lack of functional reserve iron in the body cells that need to store iron in the body, although the content of transferrin iron in the body is very small, it not only reflects the energy reserve iron required in the body and the functionally active iron in the body. The normal distribution of transport also directly reflects the normal changes in the distribution of reserve ferritin in the body. Transferrin is an essential trace element that maintains the normal life of the body in the body. The main biological mechanism of ferritin in the body is as follows: through transferrin, it participates in the normal composition of hemoglobin in the body, determines the normal transport of oxygen in the body and improve the ability to store iron. Iron is an important nutrient that constitutes the body's respiratory chain and participates in the metabolism of energy iron needed by the body; ferritin is the main synthetic cofactor of polyphosphates in the body. The biological application is very extensive and has high research value.

2.2. Principle of Exercise on Serum Ferritin Metabolism

Exercise will cause increased destruction of serum ferritin cells, resulting in a decrease in the number of athletes' serum ferritin in the concentration of red blood cells, and a decrease in the total number of serum and ferritin concentrations. When the number concentration of hemoglobin, the number concentration of serum and hemoglobin in white blood cells decreases and reaches a certain level, it is the occurrence of sports iron deficiency anemia [12]. A large number of clinical research analysis results have confirmed that the training of some athletes may directly lead to the natural phenomenon that the symptoms of early sports anemia in humans rise sharply, and the training of some athletes may also directly cause the iron metabolic function of the human body. Disturbance has occurred, which has caused some athletes to develop iron-deficiency early anemia, which may account for a large proportion of human early sports anemia. Iron has always played an extremely important role in physical and biological oxidation in the human body. Oxygen oxidative transport capacity, the body's physiological energy metabolism, and immune system function are all closely related to edible iron elements. The normal maintenance of exercise response ability also plays a very important role in promoting. The direct impact of sports comprehensive training on human iron metabolism is a problem that people in the world are still very concerned about. Sports science workers have direct impact on comprehensive iron training on human iron metabolism and lack of iron adaptability to human sports. Direct effects and iron supplementation have promoted in-depth research on many aspects of the human body's ability to adapt to sports, and some research progress has been made.

Serum ferritin exists in all cells of the human body, and it plays an extremely important role in molecular biology research. For sports such as e-sports, athletes in aerobic training must continually endure a large amount of oxygen stimulation, which inevitably requires an athlete to be equipped with high, medium and low levels of oxygen energy production. The metabolic reaction rate and the training needs that can meet a large number of overloads and high-intensity aerobic exercise, and the high-level metabolic reaction rate of oxygen energy and oxidase activity, the metabolic rate of the oxygen supply of the respiratory chain and the human body. The metabolic capacity of oxygen energy supply is closely related, and ferritin in human serum has exactly such biological functions in human body. Therefore, serum ferritin has an extremely important inhibitory effect on the reduction of the oxygen carrying capacity of mobilization exercise. When the mobilization of the body occurs a disturbance of ferritin metabolism in the serum-lack of serum ferritin, it will directly lead to a reduction in daily energy synthesis of serum proteins and hemoglobin. The daily exercise

capacity of carrying iron and oxygen is significantly reduced and the body's energy metabolism is imbalanced, which affects all athletes' energy metabolism balance level, which makes the daily work of mobilizing the body significantly reduce the oxygen carrying capacity, resulting in a significant decrease in the daily sports oxygen carrying capacity of all athletes. Exercise may cause metabolic disorders of football serum calcium and ferritin deficiency-serum ferritin deficiency is usually one of the important causes of football sports iron deficiency anemia, and the increase in the incidence of sports iron deficiency anemia in daily sports football training. The rate is also the main influencing factor that may lead to a serious decline in the comprehensive athletic ability of football players, especially for some aerobic and endurance football players.

Exercise leads to disorder of serum ferritin metabolism and reduces the body's hematopoietic capacity. Because ferritin in serum blood has a very important regulatory effect on the body's ability to respond to exercise, and the lack of excessive load of ferritin in serum blood in the body may have huge physiological side effects on human health, so how to apply it correctly and easily. The detection index method can accurately reflect the normal status of normal serum ferritin metabolism in the body. How to scientifically and rationally choose supplemental serum ferritin preparations to prevent the lack of serum ferritin excess in the body and reduce the adverse and side effects of iron overload on the healthy body are very important. The metabolic function of serum ferritin is determined by the rapid supply of iron in the medicinal diet, the rapid absorption of iron, the rapid transport and utilization of iron, the iron athletes stored in the iron, and the massive consumption and rate of iron in the body. Of course, exercise aerobic training directly affects the metabolic system of iron-containing protease in human serum through the direct impact of the above-mentioned factors, which directly leads to severe iron deficiency and a small amount of anemia, which seriously affects the normal exercise oxygen supply capacity of the human body. The results of the researchers show that when football players have ferritin deficiency and iron-deficiency iron anemia, most of the iron ferritin supplements given to football serum can also significantly improve football players' aerobic fitness.

3. Experimental Design and Detailed Process

3.1. Experiment Design and Experiment Grouping

In order to explore the specific situation of the dynamic changes of serum ferritin concentration during the movement and recovery of mice, an experiment was designed in this paper. In the experiment, 30 male mice were selected. They were of similar age, weighing between 20g and 30g, with good health and normal ability to transport. The white mice are housed in cages, the feeding temperature is 25±2, the laboratory temperature and humidity are 45% -50%, the daytime cycle is 7: 00-18: 00, the feed standard is rodent feed, to ensure the cleanliness of the feed, and equip a veterinarian to deal with unexpected situations during the experiment. The mice are randomly divided into two groups, one group is the sports group, one group is the non-sports group, and the sports group is divided into three groups, each group of five mice, so that the sports group of mice participate in swimming training exercises. The experimenters track and record the experiment data throughout.

The long-term swimming model of the rat was established with reference to the exercise science laboratory of the university of ford dales in the united states. In the experiment, all rats in the exercise group were allowed to swim for 20 minutes without weight-bearing, three times a day. The swimming group was randomly divided into 3 groups, and the non-exercise group was used as the control group. The rats in the exercise group were swimming with a 5% body weight load for 5 hours, and 4 rats were eliminated because they could not adhere to swimming for a long time. After

swimming, the water on the rats was quickly removed with a dry towel and a hair dryer, and they were killed immediately after swimming (E50, n=8) and 19h (E5D, n=8) after swimming. The temperature of the water is kept at 35 while swimming, and the water depth is 35cm. During swimming, most rats can keep their noses above the water continuously, a few occasionally sink to the bottom of the bucket, and then quickly lift their heads out of the water. After swimming, the rats were very tired and nearly exhausted. The experimental period is ten days, and the rats are fed on time every day to ensure that the rats have sufficient physical strength. On the sixth day of the experiment, the tail load of the rats in the swimming group (20±3g), let the rats swim in the morning, middle and evening three times a day, each time for 20min, when the postural reflex disorder of the rat was picked up in time to correct. As much as possible to ensure the same amount of exercise in the exercise group, and record data.

3.2. Preparation of Experimental Materials

The main instruments used in the experiment are as follows: INTEGRM110 ultrapure water system (DE Gong MILLFIG company), 85-2 type constant temperature magnetic stirring bar (Shandong Yuan Hua Analytical Instrument Co, Ltd.), 260-1AB type electric heating constant temperature drying oven (background Hexing Scientific Instrument Co, Ltd). Serum ferritin ultrasonic analyzer, red blood cell color detector (Henan Xiyu Scientific Instrument Co., Ltd.), BIO-652 plate washer produced by the company, 64RCentigfig low temperature high speed centrifuge produced for germane company. P-4 type electrophoresis cell is produced by Beijing Kaiyuan Xinhua Instrument Co, Ltd. DYCP-110 type carbon plate transfer current cell is produced by Beijing Linyi instrument factory, paraffin slicer, fully automatic gambling embedding machine. For the germane life company, the electronic balance for the stayer company. BIO-RAS protein vertical electrophoresis tank, FERS stabilized flow electrophoresis instrument.

500ml of absolute ethanol, 100ml of citrate buffer, 200ml of 1% strength hydrochloric acid alcohol (prepared by the laboratory), 52ml of sealing tablets, 600ml of cleaning agent, 500ml of formalin, ready-to-use immunohistochemistry kit 3 pcs, 5 cotton swabs. DAP reagent, disinfectant 1000ml, bovine serum protein (purchased from Jiangsu We yuan Chemical Co, Ltd), glycine (laboratory stock), organic ethanol 100ml. TDD solution (purchased from Zhejiang Xiyu Chemical Co., Ltd.), 200ml of ammonium persulfate, SDS solvent, NC membrane (purchased from Comfort Zhongyang Energy Co), pre-stained protein 20mg (purchased from NET company), ferritin inhibitor (laboratory stock). EDTA-free, ferritin phosphatase inhibitor 80ml, sliced paraffin (purchased from Sino pharm Group Chemical Reagent Co., Ltd.), paraformaldehyde 20ml, ammonium bicarbonate 40ml. PMSG (purchased from Yunnan Anuran Chemical Co, Ltd). RIPA lysate 70ml, eosin PH staining 6 kits.

3.3. Experimental Content and Data Collection

After the exercise, the internal tissue of the white mouse was sliced. After performing a thoracoabdominal aortic operation on the heart of the small white mouse to draw the heart blood, then quickly open the chest cavity of the white mouse with a knife, remove a large amount of heart blood and place it on an ice tray. Cut the entire heart along the direction of the interventricular sulcus, take two pieces of myocardium longitudinally from the anterior wall of the left ventricle, and the entire myocardial tissue contains the endocardial to epicardial structure. The soft tissue of the internal organs of the small white rat is sliced and trimmed to form a suitable round square. The upper and lower edges should be kept parallel and tightly fixed on the small white mouse. The thickness after slicing is generally 3-5um. When slicing, the angle between the left and right tilting

of the knife is generally controlled to about 20-28, the bevel angle when slicing should be uniform, and it is appropriate to rotate 4-5 blades per minute. In order to maintain the hardness of the visceral tissue, the visceral tissue of the white mouse can be placed in the freezer to be refrigerated before being taken out during slicing. The visceral tissue of the white mouse with more blood content components should be paid attention to ensure the integrity of the slice. The viscera of the white rat are woven too hard, which may be related to the inappropriate dehydration time. The abdominal viscera and soft tissue of the small white rat can be rinsed and infiltrated with a small amount of wet water. Use clean pure powder and water (the amount of easily dissolved tablets plus glycerin powder and protein) to make a patch, put it at 40-50 and heat it to dry the tablet, flatten it, put it in a 50 drying oven and dry it, the baked slices are quickly placed in 98% xylene and soaked and dewaxed twice, each time for 18 minutes. The sliced tissue of the mouse was taken out and tested with a ferritin concentration detector. The results and dynamic changes of serum ferritin content in mice are shown in Table 1.

Table 1. Results and dynamic changes of serum ferritin concentration in mice

Group	Frequency	The first group content(ng/ml)	The second group content(ng/ml)	The third group content(ng/ml)
When quiet	9	153±0.62	79±1.14	112±1.15
In motion	8	198±0.94	84±3.56	126±3.74
After failure	11	366±0.65	93±2.38	210±2.35
One hour after failure	14	187±0.78	85±1.57	137±3.77

After verification of the research data in this experiment, a metrology database is established, and the data of the metrology data database is expressed by the angle x±s. The diking form test was used to verify the normality of multiple sets of data results. The analysis of variance was not used for the comparison of the mean between multiple groups. The comparison between patients with no mean among multiple groups was tested using the p and q forms. The high concentration of ferritin in the serum of the patients and the data of lowering blood sugar, blood lipids, blood pressure and other data. From the experimental results, we can see that the ferritin concentration in the serum of the mice during exercise to failure was significantly lower than that at rest ($p<0.05$). And it was still at a lower concentration level at the beginning of the recovery again, that is, when it recovered again after 0.8h, it has rebounded significantly, especially when it recovered again after 2.5h, it has dropped to the lowest point in the near future, and then gradually recovered. It was close to the quiet level at 4.2 h. It shows that acute exhaustion exercise will cause the serum ferritin to decrease obviously, and its concentration will gradually rise as the recovery time prolongs. It is suggested that serum ferritin, an indicator of iron metabolism and iron deficiency anemia, has obvious dynamic changes during acute exhaustion and recovery.

4. Relationship between Exercise and Serum Ferritin Concentration during Recovery

4.1. Analysis of the Dynamic Changes of Serum Ferritin Concentration in Mice during Exercise and Recovery

It can be seen from the experimental data that exercise anemia is often accompanied by a low serum ferritin concentration and a tendency to iron deficiency. This article aims to reflect the relationship between exercise and anemia, especially iron deficiency anemia, through the indicator of serum ferritin. In the swimming exercise test of the white mice, the serum ferritin of the two groups of mice decreased from the previous (168.2±5.3) mmHg and (95.8±7.2) mmHg to (139.6±6.5) mph and (86.05.5) mph ($P<0.05$), which proves that during exercise, it can effectively reduce the concentration of ferritin in the capillary serum of mice, and the blood alt. But it proves

that the improvement of blood tissue on the various indexes of hematopoietic control ability of mice after exercise is more obvious. Before and after the experiment, the key indicators of glucose function, urine serum glucose, and blood lipids in mice and white mice changed significantly after exercise. After exercise experiments, the key indicators of hemopoietic function in serum blood ferritin and glucose metabolism in mice in the exercise test group were significantly higher. Before the two groups of experiments ($p<0.05$, $p<0.01$), the control group only detected alt, alp hematopoietic levels were significantly different from the two groups before the experiment ($p<0.01$). After the experiment, there were significant differences between the clinical exercise group and the clinical control group ($p<0.05$, $p<0.01$). The data of changes in blood glucose, blood lipids, and blood pressure during movement and recovery of the mice are shown in Table 2.

Table 2. Data of blood glucose and blood lipid changes in mice during exercise and recovery disease after exercise

Project name	Blood sugar	Lipids	Blood pressure(MPa)
Before exercise	57±3.284	138±0.482	12.7
After exercise	66±1.417	146±0.185	11.6
Quiet group	83±1.325	140±0.221	10.9
During recovery	73±2.118	109±0.337	14.8

The lowest concentration of ferritin (sf) in serum blood is too high. It is the most sensitive and specific blood organism in the current clinical research results that shows that the mouse protein in the mouse is overloaded with iron deficiency in the blood and other ferritins discharged from the blood. According to scientific testing indicators, it has appeared in the early stage of severe iron deficiency anemia in mice for the first time. It can be said that its performance is due to abnormal blood excretion or reduced blood pressure: at this time, the highest concentration of ferritin in the serum of mice is in the general anemia situation. It is impossible to be accurately reflected as a reserve of iron in the blood, and there is usually a parallel arrangement between the two. The erythrocyte serum basic ferritin (EF) and erythrocyte serum protein (sf) in the iron deficiency anemia control group and the recessive erythrocyte iron deficiency group are significantly lower than the normal anemia control group, and some iron deficiency anemia is important. One of the causes is the disorder of iron metabolism leading to erythropoiesis. The determination of serum ferritin is very meaningful for early iron deficiency, but in certain pathological conditions, the serum ferritin content sometimes cannot accurately reflect the storage status of iron in the body. The combination of the measurement of erythrocyte ferritin (RBC-F) and the measurement of serum ferritin can better understand the iron status of various anemia patients. The former is a carrier for transporting iron in megaloblasts, and the latter is the excess iron after storage of synthetic hemoglobin, which can reflect the state of iron storage in the body. The correlation between serum ferritin concentration and iron outside the red blood cells is high. The dynamic changes of serum ferritin concentration in mice during exercise and recovery are shown in Figure 1.

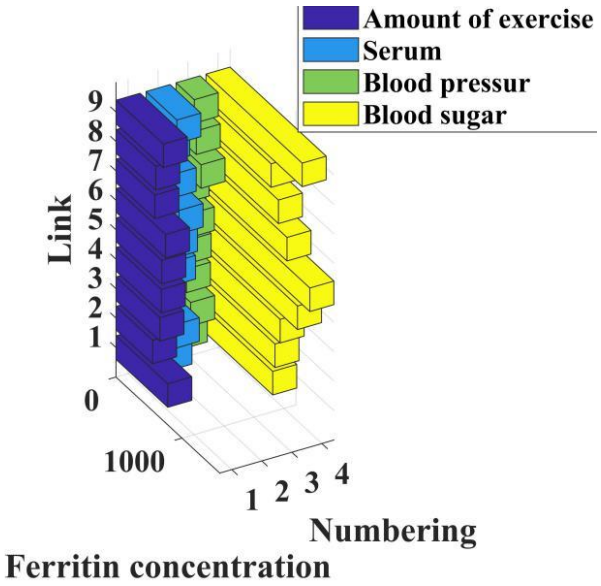

Figure 1. Dynamic changes of serum ferritin concentration

From the data in Figure 1, it can be seen that exercise can reduce the serum ferritin concentration in the mice from the original 36.7ng/ml to 27.1ng/ml, and the concentration is reduced by 32.8% compared with when it is quiet. The concentration will gradually increase and return to the quiet level after 4.2h.

4.2. Analysis of Exercise Anemia Caused by Changes in Ferritin Concentration and Treatment Methods

In this paper, through the research results, it was found that intense exercise intensity can directly lead to the serious occurrence and development of iron deficiency anemia caused by the disorder of serum ferritin metabolism in the body, which directly affects the level of serum ferritin in the body. The decrease of serum ferritin concentration is one of the main factors causing exercise anemia. According to the results of a large number of animal and other human physiology studies, iron negative balance has the following explanations. The occurrence of sports iron deficiency anemia may be mainly caused by a series of factors, that is, it may be considered as various. The result of factors integrated with each other. The possibility that the iron content of the body is in negative balance during iron negative balance exercise training is also one of the main causes of sports iron deficiency anemia caused by anemia. The formation and occurrence of iron negative balance anemia is mainly due to the lack of exercise training. Due to the acceleration of the normal growth rate of the body's bones and tissue metabolism, the body's iron requirement increases, the rate of iron loss increases, the iron intake is insufficient. The depletion of iron storage was caused by both. The amount of iron intake is closely related to the iron content in the diet, the availability of dietary iron, dietary habits and the absorption capacity of the small intestine. The analysis of iron-containing food intake can improve the concentration of serum ferritin in the body and is an effective method for the treatment of anemia. The specific effect is shown in Figure 2.

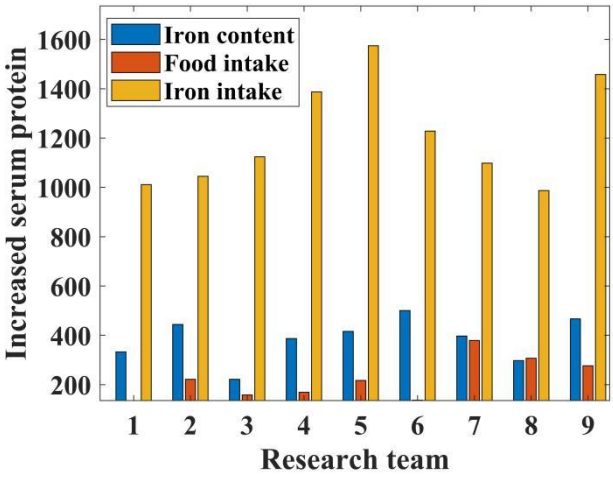

Figure 2. Iron-containing food intake can improve the concentration of serum ferritin in the body

From the data in Figure 2, it can be seen that the intake of iron-containing food can improve the concentration of serum ferritin in the body, and can increase the concentration of serum ferritin in the body by 27%.

The results of this study show that exercise leads to a significant increase in the concentration of free radicals in the blood, a change in antioxidant enzyme activity, a decrease in serum ferritin concentration and an increase in red blood cell regeneration capacity. The iron and hemoglobin needed to be released after hemolysis and death of erythrocytes are destroyed. The ferritin released can be effectively combined with bilirubin and ferritin in the serum. Only when the combined release capacity of bilirubin and serum ferritin can iron be excreted from erythrocyte urine and increase rapidly. The increase in the release concentration of hemoglobin due to aerobic exercise training and the decrease in the release concentration of ferritin in the serum of bilirubin and the decrease in the release concentration of ferritin binding ability after red blood cell transport are due to the activity of bilirubin and platelets in the blood. The increase increases the red blood cell regeneration ability. Therefore, exercise can increase the synthesis rate of red blood cells, thereby improving the hematopoietic ability. The specific effect is shown in Figure 3.

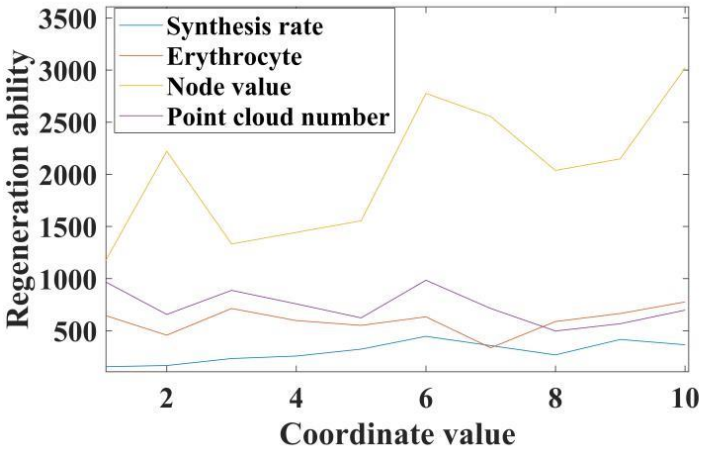

Figure 3. Exercise can improve the body's immune ability in elderly patients with non-alcoholic fatty liver disease and hypertension

From the data in Figure 3, it can be seen that exercise can increase the synthesis rate of red blood cells, thereby improving the hematopoietic capacity and increasing the body's hematopoietic capacity by 19%.

The level of serum ferritin is usually an important physiological index that directly reflects whether the status of iron in the blood of the athlete's body changes. When the athlete's body reserves of iron decrease, the concentration of the athlete's serum ferritin will also decrease accordingly. It is highly closely related. Long-term endurance training can make athletes' body serum ferritin and serum transferrin content significantly lower than those of infrequent athletes when they lack iron in endurance event groups, and they are engaged in endurance sports training projects with athletes. The relationship is not significant. This situation shows that the intensity of endurance training can directly lead to a decrease in the concentration of serum ferritin reserves in athletes. When the loss of iron in the body's blood caused by endurance training increases the body's iron deficiency, the athlete's serum ferritin reserve concentration, serum transferrin concentration, and serum transferrin saturation are all reduced, but some are not related to the iron reserve concentration. Factors can also directly cause changes in the serum ferritin concentration of athletes. At present, some researchers have found that the ferritin in the athlete's body serum may increase temporarily after iron deficiency after a high-intensity endurance exercise. The reason for the high level is roughly believed to be the possible reason is the body's increased iron storage hemochromatosis, secondary iron overload, such as excessive blood transfusion, inappropriate treatment of iron dosage, hemolytic anemia, etc. Vigorous exercise will change the concentration of serum ferritin in the body and increase the serum ferritin metabolic rate, thereby increasing the probability of occurrence of sports anemia, as shown in Figure 4.

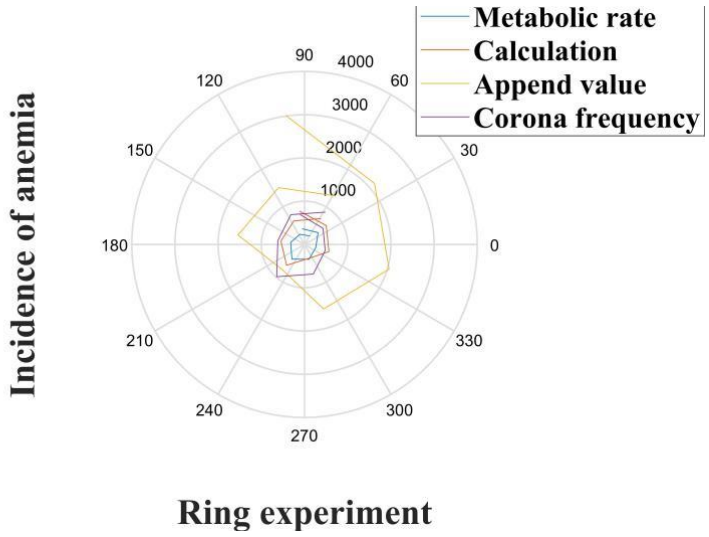

Figure 4. Vigorous exercise will change the concentration of serum ferritin in the body and increase the rate of serum ferritin metabolism

It can be seen from Figure 4 that strenuous exercise will change the concentration of serum ferritin in the body and increase the serum ferritin metabolic rate, thereby increasing the probability of the occurrence of sports anemia, in which the serum ferritin metabolic rate is increased by 25%, and the probability of dynamic anemia An increase of 34%.

5. Conclusion

(1) Serum protein concentration is an important indicator of human health. Too high and too low

ferritin are considered to be detrimental to the health and development of athletes. If too low, it will directly cause severe anemia. If too high, it may directly cause skin inflammation or even tumors. Long-term exercise can significantly reduce the ferritin in the human serum, and the athletes still have a low level of ferritin in the early recovery period, which fully shows that long-term exercise may directly lead to temporary metabolic disorder and temporary iron deficiency.

(2) The results of the study show that, compared with the quiet time, exercise can reduce the serum ferritin concentration in the mice from the original 36.7ng / ml to 27.1ng / ml, the concentration is reduced by 32.8%, and the serum ferritin concentration will gradually increase during recovery. After 4.2h, it returned to the quiet level, indicating that exercise can sharply reduce the serum iron albumin concentration in a short period of time, causing exercise anemia.

(3) The research in this article shows that the intake of iron-containing food can improve the concentration of serum ferritin in the body, and can increase the concentration of serum ferritin in the body by 27%. Exercise can increase the synthesis rate of red blood cells, thereby improving the hematopoietic ability, and the human body's hematopoietic ability is increased by 19%. Vigorous exercise will change the concentration of serum ferritin in the body and increase the serum ferritin metabolic rate, thereby increasing the probability of the occurrence of sports anemia, in which the serum ferritin metabolic rate is increased by 25% and the probability of the occurrence of dynamic anemia is increased by 34%.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Chu A, Petocz P, Samman S. (2017). "Plasma/Serum Zinc Status During Aerobic Exercise Recovery: A Systematic Review and Meta-Analysis", Sports Medicine,47(1), pp.127-134.

[2] Claesson-Welsh L. (2015). "Vascular Permeability - The Essentials", Upsala Journal of Medical Ences, 120(3), pp.135-143. DOI: 10.3109/03009734.2015.1064501

[3] Zhi-Jun Zang, Su-Yun Ji, Shi-Zong Huang. (2016). "Impact of Cellphone Radiation on Sexual Behavior and Serum Concentration of Testosterone and LH in Male Mice", Occupational Diseases and Environmental Medicine, 4(3), pp.56-62.

[4] Dwivedi A D, Dubey S P, Sillanpaa M. (2015). "Fate of Engineered Nanoparticles: Implications in the Environment", Coordination Chemistry Reviews, 287(6), pp.64-78. DOI: 10.1016/j.ccr.2014.12.014

[5] Yesmin F, Islam M S, Ferdoushi S. (2016). "Evaluation of Serum Ferritin Concentration in Mild and Severe Pre-Eclamptic Women", Mymensingh Medical Journal, 25(1), pp.119-125.

[6] Soheilykhah S, Mojibian M, Moghadam M J. (2017). "Serum Ferritin Concentration in Early Pregnancy and Risk of Subsequent Development of Gestational Diabetes: A prospective Study",

Int J Reprod Biomed, 15(3), pp.155-160. DOI: 10.29252/ijrm.15.3.155

[7] Huaqiao T, Nana L, Lin L. (2018). "Effect of MRSA on CYP450: Dynamic Changes of Cytokines, Oxidative Sress, and Drug-Metabolizing Enzymes in Mice Infected with MRSA", Infection & Drug Resistance, 11(5), pp.229-238. DOI: 10.2147/IDR.S153871

[8] Hamidieh A A, Moeininia F, Tayebi S. (2015). "Efficacy of Hepatic T2 MRI Values and Serum Ferritin Concentration in Predicting Thalassemia Major Classification for Hematopoietic Stem Cell Transplantation", Pediatric Transplantation, 19(3), pp.301-306.*

[9] Dimitrijevic Z M, Salinger-Martinovic S S, Jankovic R J. (2019). "Serum Ferritin and Renal Recovery in Acute Kidney Injury 63", The Tohoku Journal of Experimental Medicine, 248(2), pp.63-71.

[10] Marta Kopańska, Patrycja Zagata, Marta Gogowska. (2015). "The Changes in Albumin Concentration after Acrylamide Exposure in Mice Brain Structures", Journal of Microbiology, Biotechnology and Food Ences, 4(2), pp.54-56.

[11] Satou T, Ogawa Y, Koike K. (2015). "Relationship between Emotional Behavior in Mice and the Concentration of (+)-α-Santalol in the Brain", Phytotherapy Research, 29(8), pp.1246-1250.

[12] Assenza A, Congiu F, Giannetto C. (2017). "Serum Iron, Ferritin, Transferrin and Haptoglobin Concentration Variations during Repeated Show Jumping Competition in Horse", Acta Veterinaria Brno, 85(4), pp.343-347.