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Retraction

Retracted: Nanomaterials in Sports Training and Its Biological Safety

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] P. Li, "Nanomaterials in Sports Training and Its Biological Safety," *Scientific Programming*, vol. 2022, Article ID 5769228, 9 pages, 2022.

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Research Article

Nanomaterials in Sports Training and Its Biological Safety

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Nanomaterials have many special functions. Sports field provides a platform for nanomaterials to show their excellent performance. At the same time, nanomaterials in the body may also have negative effects on cells, lung tissue, liver and kidney tissue, and brain tissue; there are certain biological safety risks. Based on the above background, this article studies the application and biological safety of nanomaterials in sports training. In this article, silver nanoparticles were prepared by improved liquid-phase chemical reduction method and photochemical reduction method. The antibacterial properties of silver nanoparticles with different concentrations and sizes were tested and characterized, and the possible antibacterial mechanism was speculated. Nanosilver refers to the metallic silver element with the particle size to the nanoscale. The acute toxicity test and hemolytic test were carried out on the safety of silver nanoparticles. In the acute toxicity test, when 100 μL nanosilver solution was added, the visceral weight, body weight, and tissue sections of mice were almost not affected; in terms of biochemical indexes, all biochemical indexes returned to normal when the injection volume was 0.1 μL. The results show that nanosilver still has certain influence on biochemical indexes at high dose. How to reduce the influence will be one of the key work in the future. In addition, hemolysis test showed that no hemolysis occurred when nanosilver solution was injected at 2.77 μL. This will lay a foundation for the use of nanosilver sportswear in direct contact with human blood in the future.

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1. Introduction

Nano New Material Formulation is a project to create new nanomaterials by direct ordering of atoms and molecules through natural alterations within 100 nanometers of space. Nanomaterials are new materials developed in the mid-1980s. The functional properties of nanomaterials are different from those of traditional materials, which determines the rapid development of related technologies and their wide range of applications. In addition to the characteristics of traditional materials, nanomaterials also have many new special properties that traditional materials do not have. In recent years, various forms of nanomaterials compete to penetrate competitive sports, which greatly promotes the improvement of sports level and the development of scientific sports and humanistic sports. At present, nanomaterials have been widely used in sports engineering fields, such as stadiums, sports equipment, and sports clothing. However, due to the size effect, surface effect, quantum size effect, and macro effect of quantum tunnel of nanomaterials, specific biological effects may be caused, which will have negative effects on the environment and biology and threaten human health. This article analyzes and discusses nanomaterials and their biosafety in sports training, aiming to make certain contributions to nanomaterials.

Due to the importance of nanomaterials research, many research teams began to study nanomaterials, and achieved good results. Protein nanoparticles (NP) interface is the interdisciplinary frontier field, full of challenges and opportunities. Fernandez Rosas discussed the guidelines for improving the biological application performance of NMS and reducing potential biosafety hazards by designing protein nanoparticle interactions, as well as the future development direction and challenges of this exciting field [1]. Nalwa reviewed its unique physical and chemical properties, potential applications in the medical field, and human biological safety in clinical trials. Finally, Nalwa tried to put forward some suggestions for future research work on nanomedicine [2]. Nurul reviewed the quantitative techniques of SP2 carbon nanomaterials and compared their advantages and disadvantages. The pharmacokinetics, biodistribution, and ecological absorption of SP2 carbon nanomaterials were studied by quantitative analysis. The effects of surface modification, size, shape, and exposure route on the biological behavior of SP2 nanocarbon materials were discussed. Valentina reviewed various methods for the preparation of large pore size (3–50 nm) mesoporous silicate nanoparticles (MSN). This work also includes the construction of magnetic analogs of macroporous mesoporous silica nanoparticles (lpmmsn) and their biomedical applications [4]. This kind of structural material has broad application prospects in drug loading and drug delivery of macromolecular drugs and biological macromolecules.

In the diagnosis of genetic diseases and other diseases, the gene detection system based on nanomaterials has significant advantages over the traditional diagnostic system in terms of simplicity, sensitivity, specificity, and portability. Garner reviewed the application of nanomaterials in the detection of disease-related genes, including colorimetry, fluorescence, electrochemistry, microarray, surface-enhanced Raman spectroscopy, quartz crystal microbalance, and dynamic light scattering (DLS). Gold and silver are the most commonly used semiconductor nanomaterials [5]. Singla introduced various gene detection methods based on nanomaterials, discussed their advantages, and illustrated the properties of these nanomaterials and their emerging applications in the detection of specific nucleic acid sequences. Singla introduced the theory of nanotechnology and its historical development, including the methods for researchers to evaluate the structure and morphology of nanoparticle-modified adhesives. The influence of different types of nanoparticles on asphalt binder and mixture, suitable dosage, modification method, existing problems, and benefits are described. It is expected that the implementation of nanotechnology in the future will have a significant impact on the improvement of pavement performance [6]. Moniruddin reviewed dental nanomaterials, their pathways into the central nervous system and the related neurotoxic effects. Finally, the limitations of current methods for testing toxicological effects of nanomaterials were analyzed. The review of Moniruddin is helpful to better understand the central nervous system risk related to nanoscale and the further development of a safety assessment system [7].

The innovations of this article are as follows: (1) the composition of two kinds of nanosilver is analyzed and discussed by the improved liquid-phase chemical reduction method and the improved photochemical reduction method. (2) The acute toxicity of two silver nanoparticles in mice was studied. (3) The biosafety evaluation of nanosilver was studied.

2. Nanomaterials and Their Application in Sports Training

2.1. Nanomaterials. Nanomaterials refer to materials that have at least one dimension in the three-dimensional space at the nanometer size (1–100 nm) or are composed of them as basic units, which is approximately equivalent to the scale of 10 to 1000 atoms tightly packed together [8]. From the materials point of view, nanomaterials can be metal or nonmetal. From the single arrangement point of view, it can be amorphous or crystalline, and can be single-phase or multiphase. Nanostructure is a new system constructed or constructed according to certain rules on the basis of nanoscale material units. It includes nanoarray system, mesoporous assembly system, and thin-film mosaic system. Because the particle size of nanomaterials is less than 100 nm, it has special properties, such as vision, chemistry, and magnetism, which are not common materials, mechanics, and thermodynamics [9, 10]. Nanomaterial particles will facilitate the delivery of drugs in the human body [11]. After entering the human body, smart drugs wrapped with several layers of nanoparticles can actively search for and attack cancer cells or repair damaged tissues. Among them, nanomaterials can be roughly divided into four categories: nanopowders, nanofibers, nanofilms, and nanoblocks [12].

(1) Surface and interface effects: the specific surface area of solid particles has a specific relationship with its particle size [13]. The surface of the particles increases with the decrease of particle size, resulting in more and more people being exposed to the outside. When the particle size changes from large to small, the percentage of surface atoms is significantly higher. The effect of this situation can not be ignored, we call it surface results. As the number of surface atoms increases, the symmetry of the surface decreases and the energy band is destroyed with the increase of the related surface and the surface active site [14]. There are many nonchemical equilibrium bonds between them. Therefore, nanoparticles are very active and can easily combine with other atoms to stabilize them [15, 16]. The smaller the size of nanoparticles, the more important the surface effect.

(2) Quantum size effect: when the size of nanoparticles decreases to a certain value, the properties of nanoparticles will change under certain conditions. The electron levels near the Fermi level change from almost continuous to discrete, or the energy gap increases. There are two levels of molecular orbital energy, one is the continuously higher occupied position and the other is the lowest vacancy [17]. Therefore, compared with macroscopic properties, there are great differences in light, catalysis, magnetism, heat, and conductivity. Generally, when the wavelength of the de Broglie wave on the Fermi surface is larger than the linear direction in the nanoparticle structure, the quantum size phenomenon is very important in this direction. When the size of nanomaterials becomes smaller, electrons will be confined in a relatively small nanospace, and their motion will be greatly reduced. However, the cohesive force and position of electrons will show the opposite trend [18, 19]. The number of atoms in the system can be gradually doubled. With the decrease in particle size, the specific surface area increases

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significantly, and the behavior of individuals and electrons on the surface and inside particles are very different. This makes the physical and chemical properties of light and heat, and the electrical and magnetic properties of nanosystems and macroscopic objects very different [20]. For example, when metal is subdivided into wavelengths smaller than light, it loses its luster and looks black. The smaller the size, the darker the color. As a result, the reflectivity of extremely thin metal particles in light is very low. Using this characteristic, it can be used as a high-performance conversion material, such as photothermal and photoelectric conversion, and can effectively convert solar energy into thermal energy and electric energy [21, 22]. In addition, it can also be used in sensitive infrared components and ultraviolet stealth technology. Another example is that the magnetic sensitivity and specific heat capacity of a particle can cause the frequency shift and change of the spectral line.

(3) Macroscopic quantum tunneling effect: when the total energy of a small particle is less than the height of the barrier, the particle can still pass through the barrier, so there is a tunneling phenomenon. It is found that the macroscopic physical quantities such as magnetism and magnetic flux also have tunneling effect, which is usually called macroscopic quantum tunneling effect [23].

(4) Volume effect: under normal circumstances, the total number of people contained in nanoparticles is also quite small, which is caused by the small size of nanoparticles. The surface properties of these nanoparticles are very different from those of traditional macromaterials [24]. These different properties are mainly manifested in physical and chemical properties such as adsorption and dispersion. Therefore, the description of the properties of these substances cannot be compared with the traditional macroscopic materials.

2.2. Preparation and Modification of Nanomaterials. In the field of biology and medicine, nanotechnology has application prospects in the fields of tissue repair and replacement materials, diagnosis and treatment, and genes and cells [25, 26]. There are many ways to prepare nanomaterials, such as hydrothermal method, gas phase method, and sol-gel method. Gas phase method refers to the method of directly converting material into gas, which reacts with gas state and then condenses into nanoparticles. For example, ceramics, metals, or alloys evaporate, which meet inert gases after evaporation, cool, and condense to form nanoparticles. Sol-gel method is using inorganic or metal alkoxides as precursors, mixed with the substrate in the solvent, hydrolyzing, concentrating, and drying to obtain nanocomposite [27, 28]. In the hydrothermal method, water is used as solvent and chemical reaction is carried out under high temperature and high pressure.

After modification, the adsorption and dispersion properties of nanomaterials will change. It can protect nanomaterials and improve their surface activity [29]. The surface state of modified nanoparticles has changed, so new properties can be obtained, which lays a foundation for the self-assembly of nanomaterials. The modification methods can be summarized as follows:

(1) Surface adsorption: through the cross-border force, other substances are adsorbed on the surface of nanomaterials to avoid the accumulation of nanoparticles. For example, the addition of surfactants forms a film between the nanoparticles, which prevents the particles from touching each other and avoids the formation of actual chemical bonds and hydrocarbon bridges.

(2) Surface deposition: a substance is coated or deposited on the surface, but there is no chemical reaction between them, as if covered with a layer of material to improve its performance.

(3) Esterification reaction: the esterification reagent reacts with the surface atoms to change its surface activity, so that the initial hydrophilic surface becomes hydrophobic surface.

(4) Coupling agent method: treatment of nanoparticles with coupling agents can improve their compatibility and increase their relationship with low surface energy materials such as SiO_2. After coupling factor treatment, it has good compatibility with organic compounds.

(5) Surface grafting modification: the polymer molecules react with the nanosurface or are trapped by free radicals to form chemical bonds. The dual advantages of polymer molecules and nanoparticles were realized, and the materials were optimized.

2.3. Biosafety of Nanomaterials

(1) Propagation of nanomaterials in the environment: the condition for any substance to be toxic to organism is that it can come into contact with organism in some way. It has different ways of action and different biological tissues. Understanding the mode of transmission of nanomaterials in the environment will help to better understand their biological effects. During the processing of nanomaterials, human skin may come into contact with this material. In addition, nanomaterials in the form of solid or aerosol can easily float in the air due to their small mass, so they can also enter the human body by breathing. For example, workers in coal mines and silicon industries are prone to inhale quartz, dust particles, and asbestos fibers, which may lead to inflammation and fibrosis of lung organs.

(2) The relationship between the size and structure of nanomaterials and their biological effects: the nanomaterial multifunctional plastic made of nanomaterials has the functions of antibacterial,

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deodorant, anticorrosion, anti-aging, anti-ultraviolet, etc. It can be used as antibacterial and deodorant plastic in electric ice cream and air conditioner shell. The size of biological cells usually ranges from a few small cells to dozens of small cells. On the contrary, nanomaterials are much smaller than cells and are easy to enter and interact with organisms. The smaller the particle size, the greater the unit surface activity and the greater the biological effect. Another main reason is that the smaller the size of nanomaterials, the easier it is to penetrate the human skin and enter the human body to interact with physical cells. The biological effect of nanomaterials is not only related to the size of nanomaterials, but also to the structure of nanomaterials.

(3) Study on biosafety evaluation system of nanomaterials: scientists believe that nanomaterials can affect internal metabolic processes or signaling pathways, resulting in a slight confusion of cell biochemical effects, and short-term toxicity analysis results may not be obvious. Therefore, in short-term or subchronic exposure tests, typical in vivo or in vitro environmental flow path must be calibrated. At the same time, the detection method of nanomaterial distribution in biological system is also an important part of evaluation system.

2.4. Specific Application of Nanomaterials in Sports Training

(1) Sports equipment: first is the racket. Nanotechnology is widely used in table tennis rackets, badminton rackets, tennis rackets, and other rackets. It can not only increase the feel, strength, and flexibility of the racket, but also reduce its weight. Second, the pole. Pole is the main equipment of pole vault. It has experienced the development process of wood pole, bamboo pole, metal pole, glass pole, and carbon fiber. Third, boats. The application of retroreflective coating on the watercraft can reduce the resistance of liquid to the movement of the watercraft without affecting the weight, color, and quality of the watercraft. The nanoparticles were treated and modified by a special process to make the dispersion of nanoparticles in the matrix wax relatively uniform, and then they were applied to watercraft by mechanical or manual scrubbing. A very thin film is formed at the bottom, which does not increase the weight of the surface of the boat, but it can also modify materials such as water resistance, adhesion, hydrophobicity, detergent resistance, and polishing.

(2) Track and field track: for the nano runway, nano polyurethane is produced by adding appropriate amount of nano dust into the traditional plastic track material, and then the nano runway with better performance than the ordinary plastic sheet is produced. It can be said that nano runway not only has the advantages of ordinary plastic runway, such as aging resistance, high-temperature resistance, suitable hardness, good durability, good wear resistance, and good elasticity, but also has its unique advantages, such as high elongation and high resistance when broken. It can prolong the service life and improve the athletic performance of athletes.

(3) Exercise tonic: most of the sports supplements are taken orally, but in the oral process, sports supplements will be affected by the first transformation of biological metabolism beneficial to the host, and cannot play the application effect, such as protein and peptide. However, the application of nanomaterials can avoid the influence of first pass advantage and make use of targeted drug delivery to play the role of sports supplement. For example, Q10 is a biological antioxidant. Taking Q10 after exercise can remove free peroxide in time, reduce the content of MDA in serum, promote the activity of SOD in serum, and eliminate or delay the fatigue after exercise. As a drug delivery system, nanoliposomes can increase the accumulation of Q10 in the liver and increase the passive targeting of the liver. Therefore, sports drinks containing Q10 syndrome nanoliposomes can improve the blood condition in vivo. The results showed that lactic acid content decreased, protein decomposition was suspended, and liver glucose level was maintained to achieve a good antifatigue effect.

3. Nanomaterials Biosafety Experiment Design

3.1. Research Object. Nanomaterials have their own characteristics, especially the large specific surface area, so they will not affect the tactile and air permeability of textiles, and can adsorb nanoparticles on the surface of textiles. For example, the main material of nano waterproof cloth is polyester fiber. In order to prevent rainwater from contacting polyester fiber and invading the cloth, needle-like silicon wire with a diameter of 40 nm is coated. Compared with the ordinary sportswear, the texture of nano sportswear is the same. In summer, it has mildew proof and antibacterial properties. In winter, it is warm, waterproof, washable, and breathable. It helps to avoid viral myocarditis and Mercury's cold and other symptoms. Among the new nanosilver fiber sportswear, the new sportswear has an excellent antibacterial function, and the bactericidal effect of nanosilver is related to the concentration and particle size of nanosilver. Exploring the optimal particle size and concentration of nanosilver, and testing and evaluating the safety of nanosilver are the basic prerequisites for using nanosilver as sterilization material in the future.

This article is mainly to study the acute toxicity test and hemolysis test used to detect the toxicity of nanosilver. Acute toxicity test refers to one exposure in the experiment or multiple exposures within a day. The injection method is to inject silver nanoparticles into mice by tail vein method, and carefully observe whether the mice have abnormal or normal diet and life. In order to obtain nontoxic nanosilver, many experiments have been tried to achieve the effect of

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Table 1: Various concentrations of nanosilver.

Sample serial number	Nanosilver solution concentration
1	4.04×10^{-5} mol/L
2	4.04×10^{-6} mol/L
3	4.04×10^{-7} mol/L
4	4.04×10^{-8} mol/L
5	4.04×10^{-9} mol/L
6	4.04×10^{-10} mol/L
7	4.04×10^{-11} mol/L

sterilization. The so-called hemolysis test refers to the detection of red blood cells after the they are ruptured and dissolved to see whether the nanosilver dissolves in the blood.

3.2. Experimental Materials. The concentration of nanosilver solution is 4.04×10^{-5} mol/L, the particle size is 10 to 15 nm; 0.09% saline solution, sterilized at 120°C for 20 minutes, and placed at room temperature for later use; 4% sodium citrate solution.

Mice (ICR grade), half male and half female, weighing 25 to 26 g, were purchased from Qinglongshan farm. Culture conditions: temperature 22 ± 2°C, relative humidity 55 ± 5%. Free to drink sterilized high-temperature deionized water and enjoy normal food.

Small white rabbit (ICR grade) was purchased from Qinglongshan farm.

3.3. Experimental Methods. The concentration of nanosilver in the above main reagents is 4.04×10^{-5} mol/L, which is used as the initial concentration and continuously diluted 10 times under a series of concentrations. Overall, six different sample designs are shown in Table 1.

A total of 80 ICR mice, half male and half female were used in the experiment. Samples 1 to 7 were treated with ultrasonic vibration for 5 minutes before each use to obtain stable and uniform conditions. The control group and the experimental group were injected with a sterile 1 mL syringe through the tail vein, the injection dose was 100 μL.

(1) Body weight difference and organ weight: after 30 days of feeding, the animals were weighed and killed after anesthesia. The rats were dissected and the heart, liver, spleen, lung, and kidney were removed. The mice were washed with normal saline, dried with paper, and weighed with an electronic analytical balance.

(2) Serum biochemical indexes: after 15 days of feeding, blood was taken from the eyes and whole blood was taken with a sterile syringe. After centrifugation, serum biochemical indexes were detected with supernatant.

(3) Histopathological examination: , the lungs, kidneys, and livers were taken and immediately stabilized to 10% formalin for 24 hours. HE staining was used to observe the changes in tissue sections and taken photos.

3.4. Hemolysis Test in Rabbits

(1) Concentration selection of hemolysis test: 4.04×10^{-5} mol/L nanosilver in the main reagent is the original solution in the following tests, and the following four samples are prepared according to the original solution.

Sample a: 2.77 μL 4.04×10^{-5} mol/L
Sample B: 2.77 μL 4.04×10^{-6} mol/L
Sample C: 2.77 μL 4.04×10^{-7} mol/L
Sample D: 2.77 μL 4.04×10^{-8} mol/L

(2) Preparation of anticoagulant rabbit blood: about3 mL of ICR grade rabbit ear vein blood was obtained by dripping fresh anticoagulant rabbit blood with sodium citrate solution (mass concentration 4%, proportion 4:1). Then 2 mL of rabbit blood was diluted with 2.5 mL sodium chloride injection (0.09%).

(3) Methods of hemagglutination test: nanosilver was added into 10 mL sodium chloride injection. About 10 mL distilled water was added to the positive control group. Sodium chloride injection with the same volume as the negative control was added, and each group was tested three times in parallel. All the tubes were placed in a water bath (37°C) after 30 minutes, 0.2 mL diluted rabbit blood was added to each tube, slowly stirred, and placed in the channel for another hour. Centrifuged at 800 g for 5 minutes, and then the liquid was poured into the test tube. The supernatant was transferred into the cuvette and the absorbance was measured at 545 nm with a spectrometer.

Calculation results: the average values of three groups were taken for all samples. The calculation formula is as follows:

$$\text{Hemolysis rate} = \frac{X-Y}{Z-Y}. \quad (1)$$

Among them: X, experimental group; Y, negative control; and Z, positive control.

4. Biosafety Analysis of Nanomaterials

People will come into contact with nanosilver materials in many aspects. Due to the special properties of nanosilver particles, the defense mechanism of human body contacting with the outside world will be broken through. Therefore, the nanosilver materials used in our daily life have great security risks. It has been reported that silver poisoning is related to long-term exposure to silver-related environments. Silver selenide and irreversible sulfide precipitation appear in the skin and eyes, and the color of the skin and eyes

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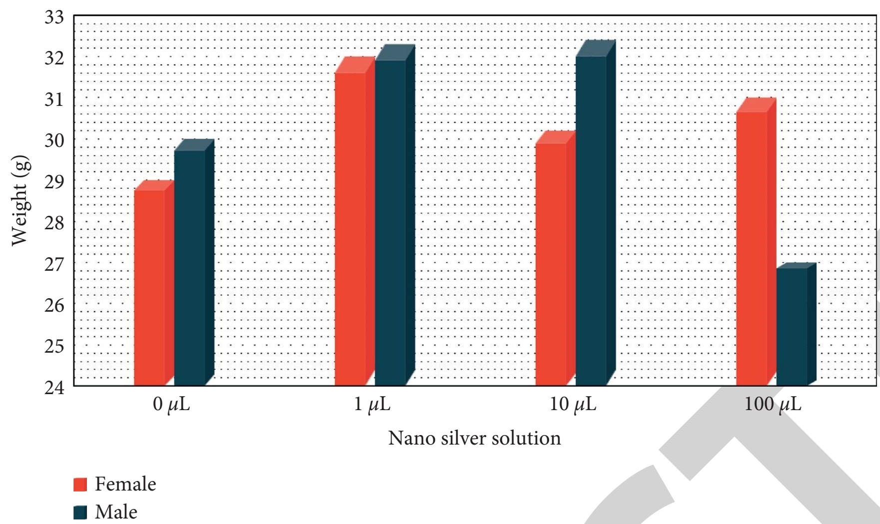

Figure 1: Mouse body weight detection.

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will change. Silver-containing textiles can be in direct contact with a large surface area of the body for a long time, which may have adverse effects on health. People wearing silver-containing products may be more susceptible to infection, and children and adults may suffer from skin diseases. Clothing containing silver causes skin damage, and the degree of damage may depend on the amount of silver penetrating the skin.

A large number of research data show that nanosilver has certain toxic side effects, but some studies also show that the impact of nanosilver on the body is very limited and is quite low. The content of nanosilver exposed to human life is not enough to cause harm to the human body. Although the damage of nanosilver materials to the human body has not been clearly understood, we should use the products containing nanosilver reasonably.

4.1. Acute Toxicity Test in Mice. In the acute toxicity test, the male and female were separated first, and then the weight of mice was analyzed, and the significance of the same sex was compared. The four groups were the control group and the test groups. Control group (0 μL), sample 3 (1 μL), sample 2 (10 μL), and sample 1 (100 μL). The test data are as follows: body weight analysis showed that there was no significant difference in body weight among the four groups ($P > 0.05$), and there was no significant difference between female and male mice. It can be seen that even if 100 μL nanosilver solution is added, the weight of mice will not change as shown in Figure 1.

The toxicity of silver nanoparticles on viscera (heart, lung, spleen, kidney, and liver) of mice was studied, and the changes in visceral weight were analyzed. As shown in Figure 2: when 100 μL nanosilver solution was added, the weight of heart, spleen, liver, lung, and kidney of mice did not change ($P > 0.05$). There was no significant difference between female and male mice. It can be seen that even if 100 μL nanosilver solution is added, the weight of visceral organs of mice will not change.

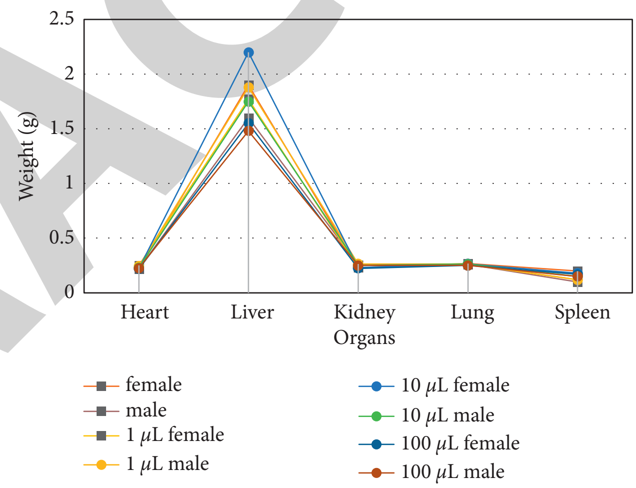

Figure 2: Weighing of mouse organs.

It can be seen from Figure 2 that these two nanosilver materials can destroy mouse embryonic hepatocytes, change their shape, and produce shrinkage, thus significantly reducing the mitochondrial function of cells and significantly increasing the concentration of lactate dehydrogenase (LDH) in the culture medium, indicating that nanosilver can destroy the cell membrane. Silver nanoparticles can induce oxidative stress, accompanied by cytotoxicity. Some studies have shown that nanosilver particles can pass through and destroy the K562 cell membrane of patients with chronic myeloid leukemia and affect the release of ROS, which leads to oxidative stress and eventually leads to cell death. It is proved that nanosilver particles have a good inhibitory effect on the deterioration and development of chronic myeloid leukemia. Exposure of mouse lung fibroblast tumor cells (L-929) to nanosilver significantly increased the level of ROS-related metallobinding protein family genes, activated NF-KB pathway, and JAK-STAT signaling pathway. The mechanism of the change may be that the cells will produce genotoxicity after being treated with nanosilver.

Table 2: Mouse biochemical index test.

Test group	Biochemical index test					
	Lactate dehydrogenase	Total cholesterol	Urea nitrogen	Creatinine	Alanine aminotransferase	Aspartate aminotransferase
Contrast	4274	0.23	4.06	27.82	7.71	12.33
Sample1	8491	0.19	6.42	41.31	11.06	16.776
Sample2	10559	0.14	5.80	36.47	13.49	39.12
Sample3	5985	0.17	8.11	29.35	8.55	10.12
Sample4	5161	0.25	4.74	28.19	13.49	11.54
Sample5	4871	0.23	4.56	23.61	13.70	12.64
Sample6	4678	0.28	4.73	28.77	11.26	15.01
Sample7	4381	0.32	4.12	30.10	10.35	13.29

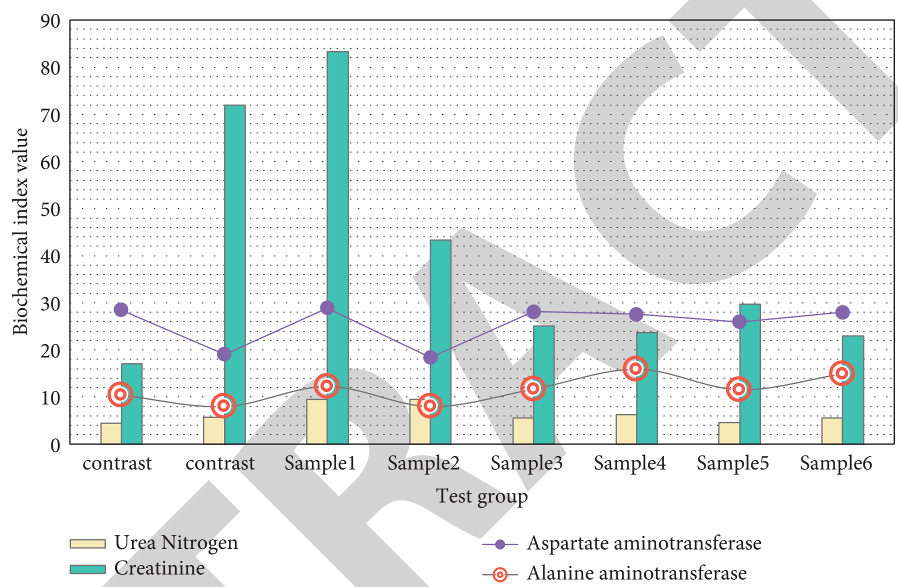

Figure 3: Test value graph of mouse biochemical indicators.

The above experimental results show that the weight of mice and the weight of heart, spleen, liver, kidney, and lung have not changed significantly. The serum of mice can be sent to detect for further experiment, that is to detect biochemical indexes. The experimental results are shown in Table 2 and Figure 3:

Analysis of biochemical data shows that when a high concentration of nanosilver is added, the biochemical indexes are obviously higher. However, if the injection volume of nanosilver is 1 μL, the biochemical indexes will be similar to the normal value. Obviously, the creatinine and lactate dehydrogenase are still too large. If the injection amount is 1/10 μL, all the indexes will be the same as the normal value.

Therefore, it is concluded that the nanosilver solution with a particle size of 10~15 nm and a concentration of 4.04×10^{-5} mol/L is safe when the injection volume is less than 1/10 μL.

4.2. Hemolysis Test Analysis. Hemolysis test is another experiment to detect the toxicity of nanosilver, that is, to test the hemolysis of nanosilver with rabbit blood and determine the hemolytic value by spectrophotometer. The results are shown in Figure 4.

The above results showed that the absorbance value did not increase after adding nanosilver, which was almost the same as that of the negative control group, indicating that there was no hemolysis of blood cells after adding nanosilver.

So far, the preparation, particle size, morphology, size, dosage, and purity of nanosilver are different, and the exposure mode and target of nanosilver are also different, so it is difficult to compare the experimental results and form a conclusion. In addition, there may be cross and interaction in some mechanisms of nanosilver toxicity. Therefore, the systematic study on the toxicity mechanism of nanosilver at the molecular level and the toxicity relationship between nanosilver and silver ions will provide reference for the toxicology of nanosilver, and then find the corresponding control and detoxification methods, and provide comprehensive safety evaluation data for clinical application of nanosilver, and establish a comprehensive and feasible safety evaluation standard of nanosilver on this basis.

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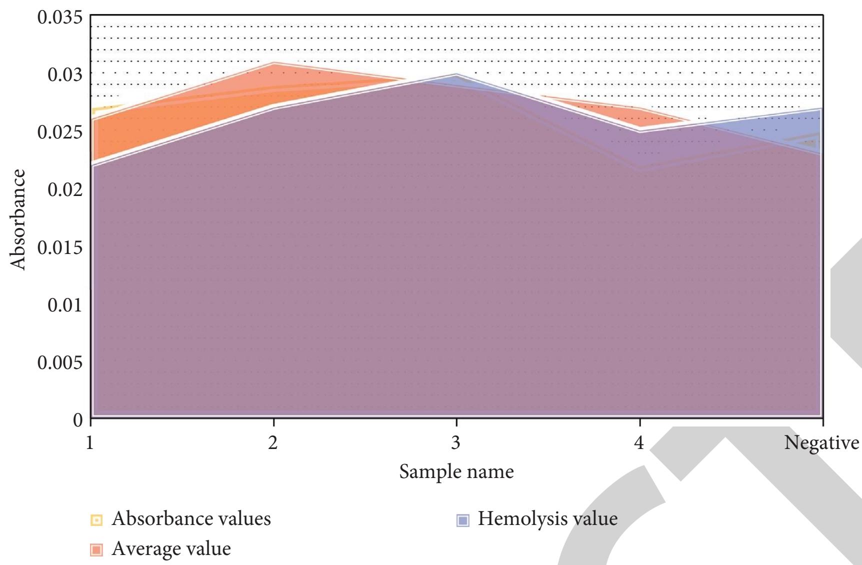

Figure 4: Area chart of absorbance value test.

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5. Conclusions

As a new material, nanomaterial is widely used in sports equipment, sports clothing, sports food, and other sports training to promote the improvement of the level of sports competition and provide a strong driving force for the long-term development of sports. However, due to the influence of subjective and objective factors, the influence of nanomaterials on biosafety cannot be ignored. This requires nanotechnology researchers and athletes to pay attention to the positive role of nanomaterials and strengthen their impact on biosafety and environment. In this study, the antibacterial ability and biological safety of nanosilver were discussed, and whether nanosilver was suitable for sportswear was studied.

In the acute toxicity experiment of this study, if 100 μL nanosilver solution was added, the body weight and tissue section of mice were almost not affected; for biochemical indicators, if the injection amount was 0.1 μL, all biochemical indexes returned to normal. The results show that nanosilver will still have a specific impact on biochemical indicators at high dose, and the method to reduce the impact will become one of the main topics in the future. In addition, in the hemolysis experiment, if the nanosilver solution was injected into 2.77 μL, hemolysis would not occur. This will lay the foundation for the future use of nanosilver products in direct contact with human blood.

However, due to the limitations of time and technology, this article does not conduct a more in-depth discussion of nanomaterials, and we will further carry out experimental analysis in the follow-up. Due to the limited means of characterization, it is impossible to characterize the nanomaterials synthesized under various conditions. The various characteristics of the synthesized materials under various conditions are observed and the effects of various conditions on the synthesis are compared. The minimum inhibitory concentration and minimum bactericidal concentration are not considered in the study of antibacterial and bactericidal properties of nanomaterials. This is a simple preliminary study on whether nanomaterials have bactericidal and antibacterial properties, and the impact of nanoparticles on soil, water, and the atmospheric environment. In the biological environment, diffusion, movement, and migration methods, the important problems that should be solved in the future biosafety research of nanomaterials are deposition, moving biological chain, accumulating into organisms, etc. [3].

Data Availability

This article does not cover data research. No data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Authors' Contributions

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