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Research Article

Health-Care Technology of Badminton Sports Based on Nanotechnology

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Nanotechnology has become an important technology that cannot be ignored in high and new technology, and the application of nanomaterials is to design all aspects of life. With the more popularization of badminton, the blending of the two is also increasing. The purpose of this paper is to discuss the combination of sports health care and nanotechnology in badminton. This paper starts with the application of nanotechnology in badminton racket materials, hoping to explore the impact of nanotechnology on badminton sports health care. In this paper, 130 testers of different ages from different schools were selected for 17 weeks of badminton training. By comparing the physical fitness indicators before and after, this paper finds the impact of badminton on physical health. The experimental results show that badminton exercise training has an impact on human health and has a significant impact on human height, weight, and lung capacity.

1. Introduction

Badminton is a traditional Chinese sport. In recent years, the excellent performance of the national badminton team in international competitions has gradually brought the fitness function of badminton into the public's field of vision. It integrates social, entertainment, fitness, stress relief, and other attributes into one and improves the body's physical health and physical self-esteem. It makes badminton the best choice for contemporary teenagers to carry out extracurricular sports training activities. In addition, the continuous increase of badminton extracurricular training activities, the gradual rise of badminton club training, and the expansion of badminton teachers and referees and other professionals have not only laid a foundation for the extracurricular badminton sports training for senior primary school students. It also provides a guarantee for their physical health and the development of physical self-esteem.

The global science and technology and economy are in a stage of rapid development, and information technology, biomedical technology, and nanotechnology have become three important technologies side by side. And nanotechnology is a key basic technology. It lays a solid foundation for the development of information technology and biotechnology. Nanotechnology has also increasingly become the focus of competition in the world's high-tech fields. Nanotechnology is more and more deeply affecting and changing people's production, life, and thinking. Its impact on economy, politics, and society is more reflected in the fierce competition between countries for nanotechnology research and application.

This paper mainly has the following two innovations: (1) This paper is based on the research of value proposition generation in the process of nanotechnology commercialization from a layered perspective. This paper mainly analyzes the generation of value propositions in the process of nanotechnology commercialization from the industry level, company level, and specific business level. (2) About the research on the connection of value proposition generation in the process of nanotechnology commercialization, this paper mainly analyzes the influencing factors, typical obstacles, and targeted strategies in the process of value proposition generation in nanotechnology commercialization.

2. Related Work

The emergence of nanomaterials has greatly changed people's lives, and nanotechnology has penetrated into all aspects of life, and there are many studies on it. Mihail C examined progress in nanotechnology development since 2000, achievements over the past decade, and opportunities for research, education, innovation, and social outcomes worldwide by 2020 [1]. Duhan J S believed that nanotechnology is an interdisciplinary field of study. He discussed the potential uses and benefits of nanotechnology in precision agriculture. Tools and techniques based on modern nanotechnology have the potential to solve various problems of traditional agriculture [2]. Lee CH conducted research on the science and engineering of water purification, especially oil-water separation. His research goals are to provide a comprehensive review on oil-water separation by nanotechnology and organic chemistry and to improve understanding of the environmental issues of water purification using nanotechnology [3]. Reis CP believed that nanotechnology has developed alternative routes of administration, namely, those based on nanotechnology. Nanoparticles made of synthetic or natural materials have been shown to successfully overcome the inherent barriers to insulin stability, degradation, and absorption across the gastrointestinal tract and other mucosal membranes [4]. Mirkin CA discussed emerging nanotechnology-based tools. These tools have the potential to dramatically impact cancer research, diagnosis, and treatment. His research explains how nanotechnology exploits the size, shape, and composition-dependent properties of nanomaterials. It provides new tools for precision cancer medicine [5]. Weng Y highlighted the latest progress in nanotechnology-based system development. The system can deliver ocular drugs and genes to the eye through corneal absorption, periocular injection, and intravitreal injection for the treatment and diagnosis of ocular diseases. Then, he discussed and prospected the applications and challenges of nanosystems in ophthalmology [6]. Falagan-Lotsch P saw it as a nanoactivation method currently on the market or in development, such as antimicrobial food contact surfaces/packaging, nanoactivated sensors for rapid detection of pathogens/contaminants, and nanodelivery biocidal methods. It showed great potential in the food industry [7]. Michal reviewed the research progress of nanoantibacterial drugs in the past two years and introduced their unique properties, mode of action, and activity against multidrug-resistant bacteria and biofilms [8]. Since the launch of the US National Nano Initiative (NNI) in 2000, nanotechnology research has become the focus of global attention. Various countries have formulated nanotechnology plans relative to their national conditions. It strives to seize the commanding heights of science and technology strategy in the twenty-first century and to seize the initiative of future economic development [9].

3. Nanotechnology Algorithms and Applications

3.1. Nanotechnology. Nanoscience and technology is one of the foundations of the new era of science and technology in this century. A nanometer is a unit of length and is one billionth of a meter. Studying the properties of materials and their applications in the range of 0.1 to 100 nm structure scale is what we call nanotechnology, and sometimes nanoscience and technology are also collectively referred to as nanotechnology. Nanotechnology is a technology to manufacture new materials, new devices, and research new processes based on nanoscience through new methods. The concept of nanoscience and technology is expressed differently in different literatures. But it will continue to improve as the discipline develops, and more detailed concepts will be drawn. Nanotechnology is based on advanced science and technology at the nanoscale and is the product of the combination of modern science and modern technology. Nanoscience and technology is the product of the interlaced and compatible theory and high technology, not just the expansion of a single discipline. Nanoscience and technology holds enticing prospects in terms of basic research. As a technology, nanotechnology will provide human beings with novel products and devices with specific functions. Nanoscience and technology are full of opportunities and challenges [10, 11].

Due to its unique properties, nanotechnology is widely used in military, medical, environmental energy, biological research, and other fields. It has brought great positive significance to national security and people's life, changed people's original production methods, improved production efficiency, and reduced energy consumption. And in the field of the environment, it is not far behind. The catalyst developed by it can effectively solve the problem of sewage and air quality [12, 13]. The huge positive significance of nanotechnology and some undiscovered potential values have made the world carry out crazy research on it, forming a "nanostorm" [14]. Among them, nanomaterials include four common forms of nanopowder, nanofiber, nanofilm, and nanoblock [15], as shown in Figure 1:

Nanotechnology contributes to the utilization of new energy sources. Hydrogen is abundant in nature. After burning, it will not pollute the environment, so it is regarded as a new type of energy in today's society. However, some previous technologies cannot achieve the best effect of hydrogen transportation and storage. The researchers discovered that carbon nanotubes are a material that can store hydrogen. The surface area of 1G carbon nanotubes can reach hundreds of square meters, and a large amount of absorbed hydrogen can be released by slight heating at room temperature. And this technology is expected to be included in the application stage in the future, when human beings can use hydrogen on a large scale to replace scarce fossil energy. Yet, the air we breathe will also change dramatically, as shown in Figure 2:

It is not difficult to see that the definitions of nanotechnology have different focuses on nanotechnology. The UNESCO definition highlights the convergence of nanoscale research at both theoretical and applied levels. The National Nanotechnology Innovation Organization's definition highlights the novel properties of materials and systems at the nanoscale. The NSF definition emphasizes convergent fusion at the nanoscale. The EU's seventh framework plan lists

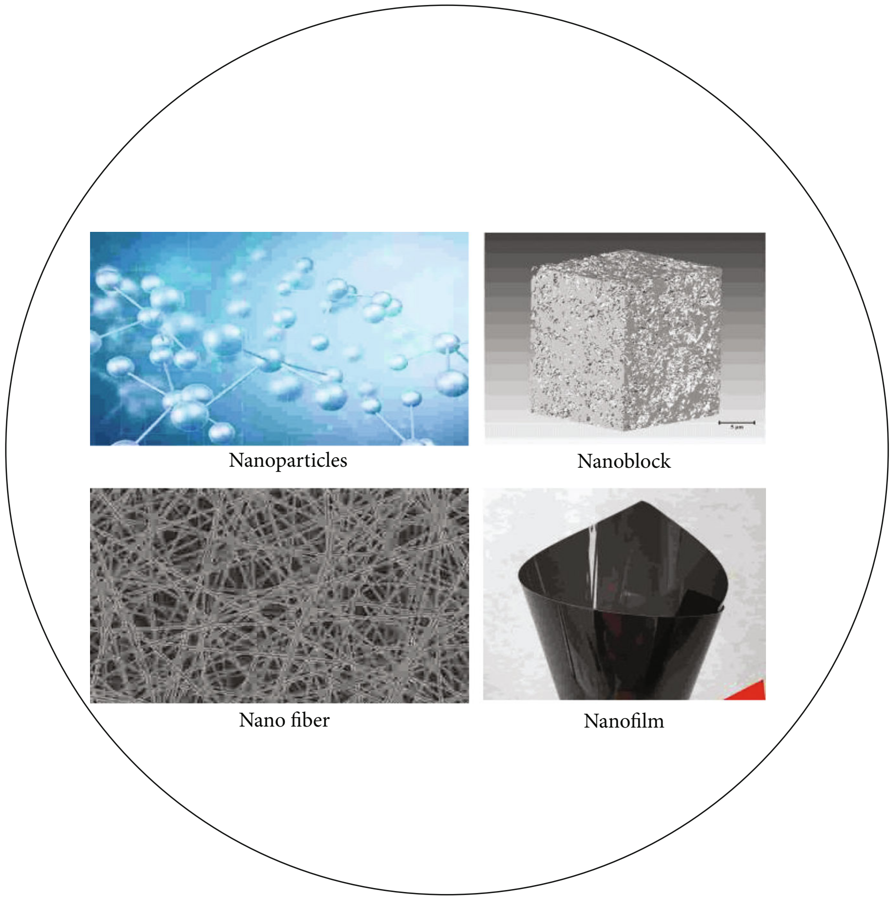

Figure 1: Four forms of nanomaterials.

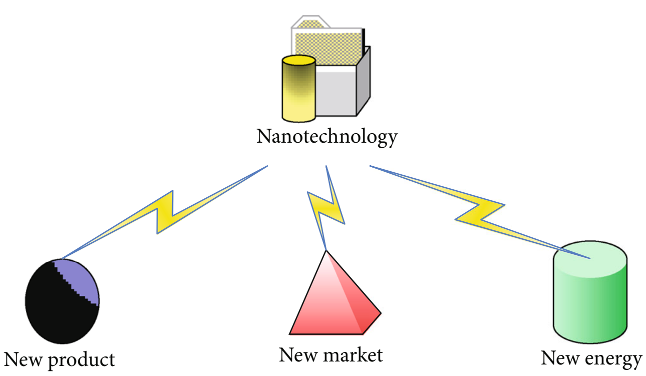

Figure 2: The economic impact of nanotechnology.

many areas related to nanotechnology. At the same time, these definitions have in common: First, they all reflect the scope of research at the nanoscale. Second, they all focus on the novel properties exhibited by matter at the nanoscale [16, 17], as shown in Figure 3:

3.2. Applications of Nanotechnology. Nanotechnology, like previous new technologies, was first used in the military field to prove its huge military value. When this technology emerged, people had glimpsed its broad prospects in the military field. The US Department of Defense clearly recognized the importance of nanotechnology a decade ago and has played an important role in supporting this field. The US Department of Defense website reported in February 2001 that the US Department of Defense announced that in 2001, it awarded $8.75 million to 16 nanometer research projects. It has also awarded 14 research institutions of $15 million annually since 2002 to carry out nanotechnology research in 15 basic disciplines and engineering fields. Nanotechnology has brought global medical care to another level, and it has opened up new windows for biopharmaceuticals and chemical pharmaceuticals with its unique structure and properties. Because there is still a lot of work in the basic theory and application development, it is still in the research and development stage. Therefore, although a lot of research on the preparation, structure, and properties of nanobiomedical materials has been carried out, it is still in its infancy. Therefore, we look forward to people's further exploration. Experts pointed out that due to the introduction of nanotechnology in the future, the production of medicines and the delivery of medicines will undergo fundamental changes [18–19], as shown in Figure 4:

3.3. Application of Nanotechnology in Badminton Health Care. The application of nanomaterials has been very extensive and can be seen everywhere in our daily life. It has a lot of applications in light industry, chemical industry, machine manufacturing, electronic product manufacturing, and other fields. Nanomaterials will play a major role in future life, and

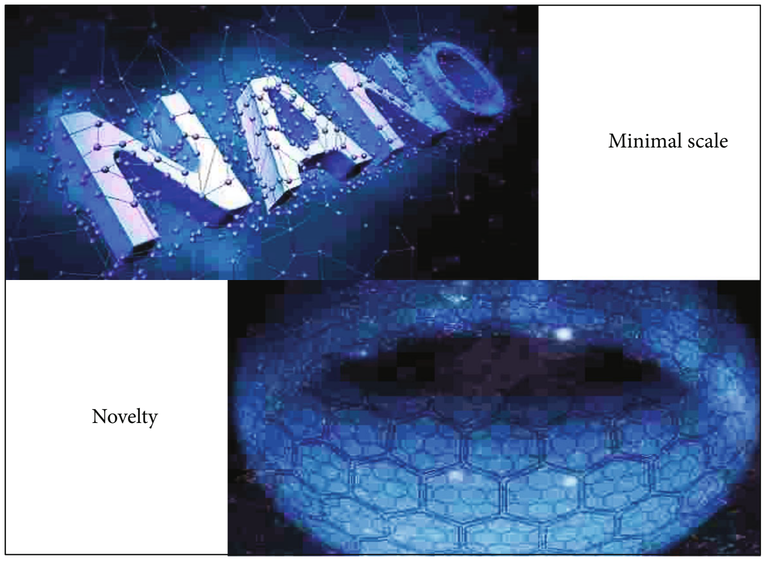

Figure 3: Nanotechnology.

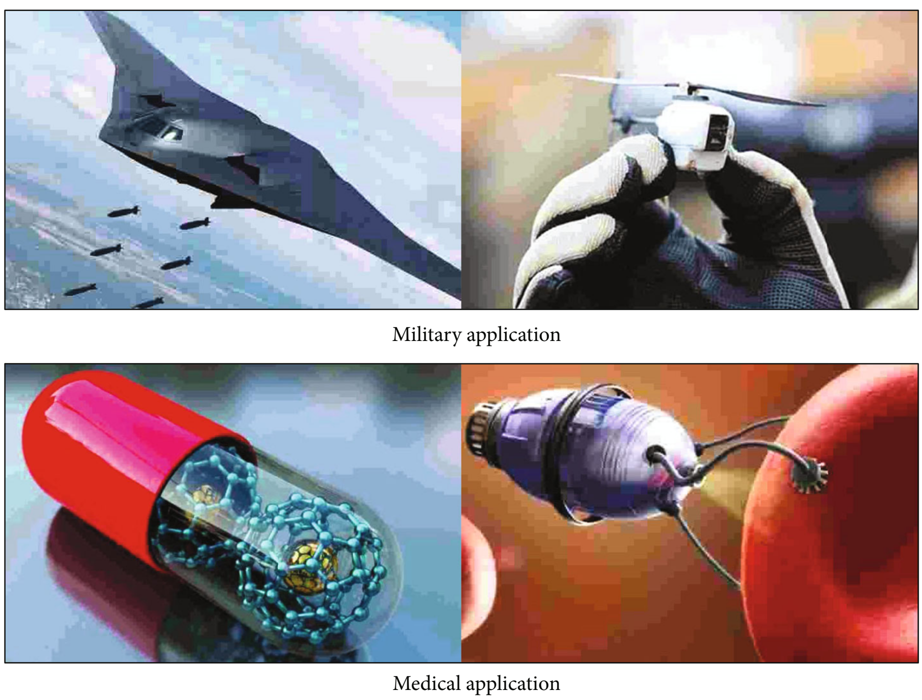

Figure 4: Nanotechnology applications.

nanotechnology will bring more variety to our lives. The dominance of nanotechnology demonstrates its social value that cannot be ignored. It is widely and strongly applied to all fields of society with its unique properties, promoting the stable and orderly development of society [20–21].

In the field of badminton, with the excellent properties of nanomaterials, nanomaterials have in-depth applications in badminton rackets, protective gear, and others, as shown in Figure 5:

In this century, the nano industry must be one of the main industries leading the development of the science and technology industry. Nanotechnology and nanomaterials have penetrated into various industries of the national economy, such as medical industry, environmental energy, computer industry, biological research, national security, and aerospace. It promotes the rapid growth of the national economy, and its economic impact will certainly exceed that of the information industry [22, 23].

3.4. Nanotechnology Hidden Markov Models. Hidden Markov model (hidden Markov model, HMM for short) is a statistical model, which is used to describe a Markov process with hidden unknown parameters. The difficulty is to determine the implicit parameters of the process from the

Nanotechnology racket Nanotechnology ball net Nanotechnology protective gear

Figure 5: Nanotechnology racket.

observable parameters. These parameters are then used for further analysis, such as pattern recognition.

Many properties of hidden Markov models are used to solve real-world practical problems. According to the different types of data processed, hidden Markov models can be divided into discrete hidden Markov models and continuous hidden Markov models. Discrete hidden Markov models are the basis of continuous hidden Markov models and are easier to understand. The remainder of this chapter will give a detailed introduction to discrete hidden Markov models and continuous hidden Markov models.

3.4.1. Elements of Hidden Markov Model. A hidden Markov model (HMM) can be described by five elements, including 2 state sets and 3 probability matrices:

The number of hidden states N is the number of unobserved states. The hidden states satisfy the Markov property, which is the actual hidden state in the Markov model. Implicit states are usually not available through direct observation.

The number of observable states M is the number of states that can be clearly observed. Its observable state is associated with the hidden state in the model. It can be obtained by direct observation. The number of observable states does not have to be the same as the number of hidden states (the number of different colored sticks thrown in the above example).

The implicit state transition probability matrix A describes the transition probability between states in the HMM (the probability of transitioning the person who throws a small stick in the example). It can be expressed as $a_{ij} \in A$. a_{ij} represents the probability of transitioning from state i to state j at time t, where $1 \le i\,; j \le N$.

The observation state radiation probability matrix B (the probability that the specified person throws the specified color stick in the example) can be expressed as $b_j(k) \in B$. b_j (k) represents the probability of selecting the observation feature as x_k from the state j at time t, where $1 \le j \le N\,; 1 \le k \le M$.

The initial state probability matrix π represents the probability matrix of the hidden state at the initial time $t = 1$. It can be expressed as $\pi_i \in \pi$; π_i represents the probability of selecting state i at time $t = 1$, where $1 \le i \le N$.

3.4.2. Training of Hidden Markov Models. When training an HMM for a given problem or specified dataset, consider the joint probability of the hidden state (S_i) and the observable state (O_i) and simplify it with the intrinsic properties of Markov chains for continuous data. The resulting joint probability:

$$\Pr(S, O) = \Pr(S_1) \prod_{t=2}^{T} \Pr(S_t|S_{t-1}) \prod_{t=1}^{T} \Pr(O_t|S_t). \quad (1)$$

3.4.3. Probability Calculation of Observable Sequences. To calculate the probability of observing the sequence $O = O_1, O_2, \cdots, O_T$, it is assumed that the model parameters λ are known, namely, the parameter values A, B, and π are all known. For a given λ, the computation is done by considering every possible sequence of states that can produce an observation sequence O. The sum of the obtained probabilities is the probability of producing the observation sequence O through the model parameters λ.

Supposing the implicit state sequence that may produce the observation state sequence O is

$$S = S_1, S_2, \cdots, S_T, \quad (2)$$

$$\Pr(O|S, \lambda) = \prod_{i=1}^{T} \Pr(O_i|S_i, \lambda), \quad (3)$$

$$\Pr(O|S, \lambda) = b_{S1}(O_1) b_{S2}(O_2), \cdots, b_{ST}(O_T). \quad (4)$$

Under the condition that the model parameter is λ, the probability that the hidden state sequence is S is calculated as follows:

$$\Pr(S|\lambda) = \pi_{S_1} a_{S_1 S_2} a_{S_2 S_3}, \cdots, a_{S_{T-1} S_T}. \quad (5)$$

Substituting formula (5) into formula (1), we get

$$\Pr(S, O) = \Pr(S|\lambda) \Pr(O|S, \lambda), \quad (6)$$

$$\Pr(O|S, \lambda) = \Pr(O|S, \lambda) \Pr(S|\lambda). \quad (7)$$

By considering every possibility that can produce an implicit state of the observation sequence O, the probability of obtaining the observation state sequence O from the model parameters λ can be obtained. The following formula is obtained

$$\Pr(O|\lambda) = \sum_{all\, S} \Pr(O|S, \lambda) \Pr(S|\lambda), \quad (8)$$

$$\pi = \begin{bmatrix} \Pr(\textit{Person 1}) \\ \Pr(\textit{Person 2}) \\ \Pr(\textit{Person 3}) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

Prior probability matrix

	Person 1	*Person 2*	*Person 3*
Person 1	0.2	0.4	0.3
Person 2	0.1	0.5	0.4
Person 3	0.4	1.5	0.1

State transition probability matri

	Person 1	*Person 2*	*Person 3*
red	0.09	0.6	0.01
Yellow	0.1	0.05	0.4
Blue	0.03	0.03	0.3
Green	0.07	0.02	0.2
Black	0.6	0.17	0.01
White	0.01	0.08	0.02
Orange	0.1	0.05	0.06

Observation emission probability matrix

Figure 6: Parameter matrix.

$$\Pr(O|\lambda) = \sum_{S_1,S_2,\cdots,S_T} \pi_{S_1} a_{S_1S_2} a_{S_2S_3}, \cdots, a_{S_{T-1}S_T} b_{S_1}(O_1) b_{S_2}(O_2), \cdots, b_{S_T}(O_T). \tag{9}$$

In order to better explain the calculation method derived from formula (8) and formula (9), let us start from the beginning again with the example of a person throwing a small stick. With the parameter values given in Figure 6, the expression is used to calculate the probability of observing the sequence $\{\text{red, green}\}$.

Here, the sequence $O = \{\text{red, green}\}$ is observed. For all hidden state sequences S, the probability of finding the observation sequence O is

$$\Pr(O|\{\text{person2, person1}\}) = 0.6 \times 0.1 \times 0.07, \tag{10}$$

$$\Pr(O|\{\text{person2, person3}\}) = 0.6 \times 0.4 \times 0.2, \tag{11}$$

$$\Pr(O|\{\text{person2, person2}\}) = 0.6 \times 0.1 \times 0.02. \tag{12}$$

The total probabilities obtained are

$$\Pr(O|\lambda) = 0.0546. \tag{13}$$

In all possible states, the probability of observing the sequence O is calculated, and in formula (13), these calculated probabilities are summed, so that the probability of observing the sequence O of the HMM, the parameter λ, is obtained. The computational complexity of using formulas (2) to (9) to calculate the probability is quite high. For example, for an HMM with N hidden states, the time complexity of the exhaustive search is $2TN^T$, where T is the length of the observation sequence. Therefore, it is necessary to find some other alternative ways to calculate the probability of observation sequence.

3.4.4. Forward-Backward Algorithm. Forward-backward algorithm is a relatively less computationally intensive method that can calculate the probability of an observation sequence. The forward variable $\alpha_t(i)$ is defined as

$$\alpha_t(i) = \Pr(O_1, O_2, \cdots, O_t, S_{t=i}|\lambda), \tag{14}$$

where $\alpha_t(i)$ is the local observation sequence probability, which represents the probability that, for a given λ, the observation sequence is state i at time t. The specific steps of the forward-backward algorithm are as follows:

Initialization: For all states i, $\alpha_1(i) = \pi_i b_i(O_1)$, where $i \in \{1 \text{ to } N\}$.

Induction: For each time point t, a value of the forward variable $\alpha_t(i)$ can be obtained, and for each time point $t = 2, \cdots, T$ and all states j ($j \in \{1 \text{ to } N\}$) recursively calculate the forward variable $\alpha_t(j)$:

$$\alpha_t(j) = \left[\sum_i \alpha_{t-1}(i) a_{ij}\right] b_j(O_t). \tag{15}$$

Termination: For a given HMM, the probability of observing sequence O can be calculated by the following formula:

$$\Pr(O|\lambda) = \sum_i \alpha_T(i). \tag{16}$$

In this method, each state at time $t - 1$ is fully computed before considering the state at time t. Therefore, for a given HMM model λ, the last state in the operation constitutes the final probability of producing the observation sequence O. It can be found that the time complexity of the forward algorithm is N^2T, where N refers to the number of hidden states and T refers to the length of the observation sequence.

The backward algorithm is similar to the forward algorithm and is used to calculate the probability of the observation sequence for a given λ. The backward variable $\beta_t(i)$ is defined as follows:

$$\beta_t(i) = \Pr(O_{t+1}, O_{t+2}, \cdots, O_T|S_{t=i}, \lambda). \tag{17}$$

As in formula (17), $\beta_t(i)$ represents the backward variable, which refers to S_i at time t, where λ is known and S_i is the hidden state. The final probability is as in

$$\Pr(O|\lambda) = \sum_i \pi_i b_i(O_1) \beta_1(i). \tag{18}$$

As described above, both forward and backward

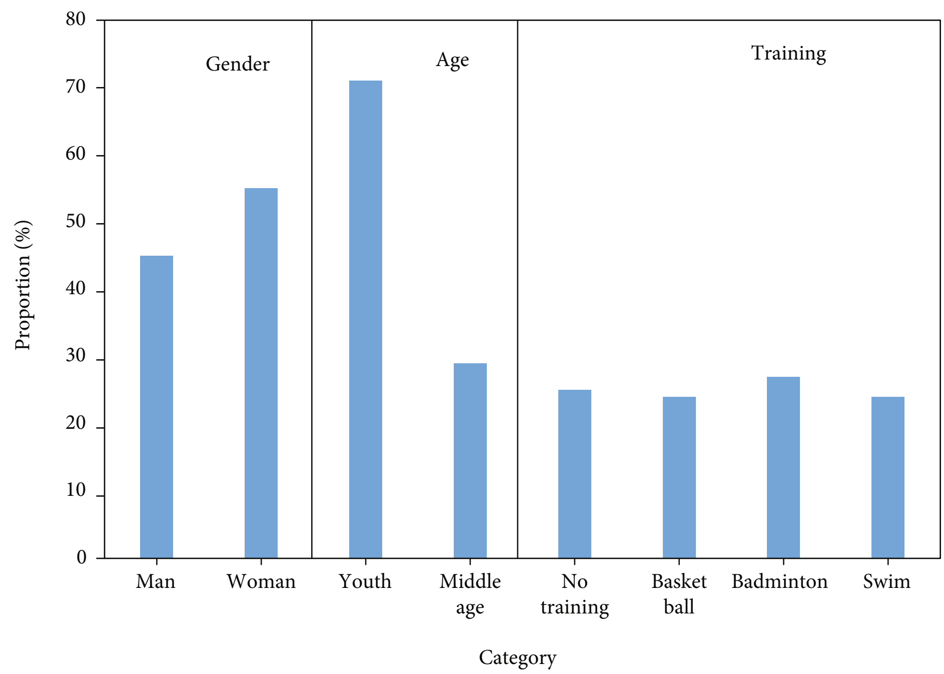

FIGURE 7: Basic information of research objects.

algorithms can be used to compute $\Pr(O|\lambda)$ to evaluate problems. Forward and backward algorithms can also be used together to solve the problem of model parameter estimation.

4. Badminton Health Care

4.1. Objects and Methods. Constitution refers to the quality of human life. It is a comprehensive and relatively stable feature of the human body on the basis of heredity and acquisition in terms of human body shape structure, physiological function, physical quality, psychological quality, and adaptability. A healthy physique is the basis for ensuring people's normal life, study, and work. Among them, a healthy physique is characterized by normal development and symmetry in the human body morphological structure. In terms of physiological function, it shows that the physiological functions of various organ systems in the human body are normal. In terms of physical fitness, it is mainly reflected in strength, speed, and endurance to meet the physical needs of general labor and sports. On the level of psychological quality, it is manifested in having psychological characteristics suitable for its age and gender and being able to withstand corresponding psychological pressure. Adaptability is reflected in the body's natural adaptability and social adaptability to resist common pathogens and enable the body to integrate into society and interact with others normally.

In order to explore the different effects of students participating in badminton extracurricular training on physical health and physical self-esteem, three primary schools (JE Primary School, QS Primary School, and CT Primary School) were randomly selected. This article is based on the grouping criteria of only participating in extracurricular training in badminton, basketball, and swimming, and not participating in any extracurricular sports training. Participation in various sports in the standard is in the range of six months to one year, and the level of sports ability is equal. Before the investigation, this article will visit and check the physical health status of all participants in the experiment. This article confirms that the participants are in good physical and mental health and explains the procedures for this experiment to the subjects. The data collectors introduced the purpose and precautions of this questionnaire

TABLE 1: List of questionnaires.

Questionnaire type	Questionnaires	Effective questionnaire	With good efficiency
Network questionnaire	100	96	96%
Paper questionnaire	30	30	100%
Add up to	130	126	96.92%

TABLE 2: Physical fitness measuring instruments and testing method.

Physical index	Measuring instrument
Height	Height meter
Weight	Weight meter
Vital capacity	Pneumatometer
50-meter run	Stopwatch
One-minute sit-ups	Count
One-minute jump rope	Stopwatch, starting whistle, and skipping rope
50×8 round trip	Stopwatch

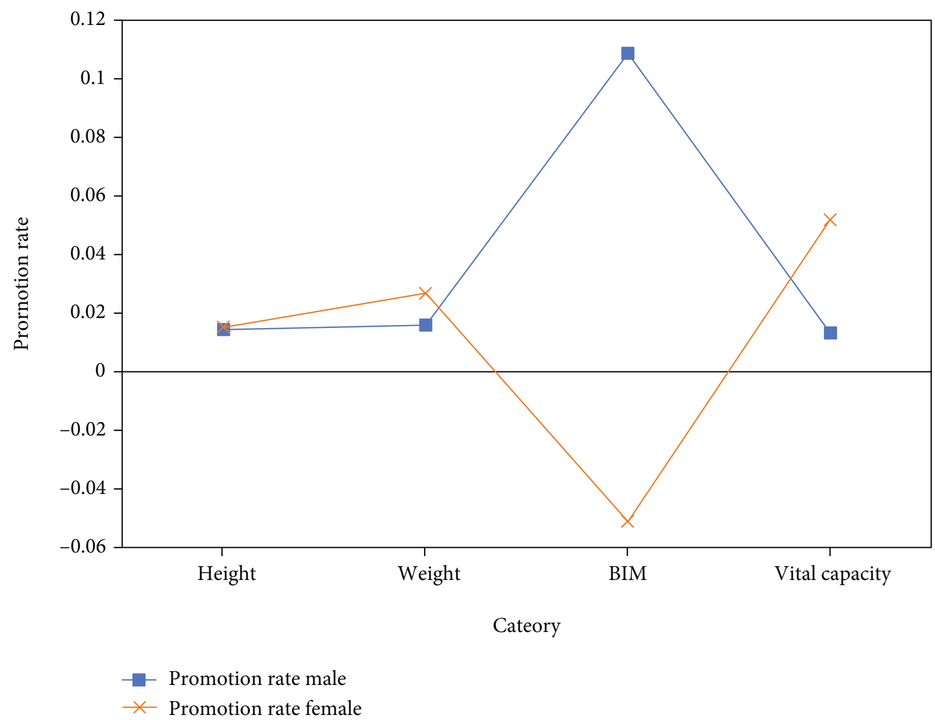

FIGURE 8: The improvement rate of badminton on physical function.

TABLE 3: Effects of badminton on body function and form.

	Training former male	Training former female	After training male	After training female
Height (cm)	169.99	162	172.45	164.46
Weight (kg)	56.99	47.72	57.9	49
BIM	20.8	18.4	23.06	17.46
Vital capacity (ml)	3739.79	2906.15	3789.6	3057.07

to the school physical education teachers and training team coaches in detail. It is convenient to answer the feedback information that is not understood during the questionnaire and data collection process in a timely manner. Physical education teachers and coaches in each school assist in distributing questionnaires, read out instructions, and explain filling requirements. It promises to keep the information filled in confidential and to fill in truthfully by the participants. In this paper, the fifth and sixth grade students of three primary schools are divided into four groups: no training, badminton, basketball, and swimming, and a total of 130 students in four groups are selected from each school. Later, due to the physical discomfort of 1 student and the failure of the assessment questionnaire for 3 students, 4 special subjects were excluded, and 126 students were retained as the research subjects of this experiment. The 126 study subjects were in good health and had no disease or other factors that would make them unfit to participate in the experiment. Among them, the number of students who participated in extracurricular training in badminton, basketball, and swimming and those who did not participate in the training were 34, 32, 30, and 34, respectively. In terms of gender distribution, there are 70 boys and 60 girls, and the proportions of each group are shown in Figure 7:

In order to explore the impact of badminton on the development of physical self-esteem among Chinese senior primary school students, this study uses the physical self-esteem scale to investigate the research subjects. The physical self-esteem scale for children is based on the PSDQ and PSPP and combines the characteristics of Chinese development and growth. It is divided into 12 different dimensions of health, appearance, strength, speed, flexibility, endurance, coordination, physical attractiveness, motor skills, physical activity, physical worth, and overall self-esteem. They collectively reflect the physical self-esteem of adolescents. The scale has a total of 78 items, and items 1, 13, 25, 37, 49, 61, 73, and 76 reflect the health subscale. 2, 14, 26, 38, 50, and 62 items reflect the physical attractiveness subscale. 3, 15, 27∗, 39, 51∗, 63, 74, and 77 items reflect the motor skills subscale. 4∗, 16∗, 28, 40, 52, and 64 reflect physical activity subscales and more. It takes about 20–25 minutes to fill in the answer, using a five-level scoring method; each subscale is scored separately and not included in the total score of the scale.

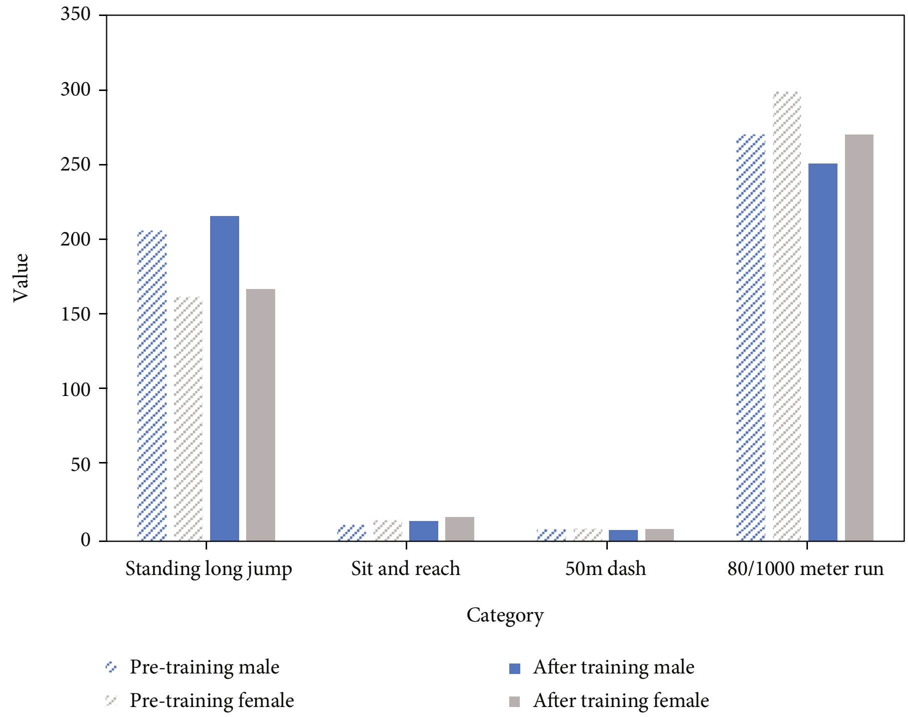

FIGURE 9: Analysis of the impact of badminton on physical fitness.

In view of the need to fill in the physical self-esteem scale questionnaire for the grouped students, the author conducted a physical fitness index test on 130 students participating in the experiment in three primary schools, and then, the paper distributed, filled in, and collected the questionnaire. After informing the students to fill in the requirements, they supervise the students to fill in the questionnaires according to their own specific conditions and subjective feelings within half an hour. Correlation analysis was performed on all questionnaires. A total of 130 questionnaires were distributed this time, 130 questionnaires were recovered, and the recovery rate was 100%. Among them, 126 are valid questionnaires, and the effective rate is 97.67%, as shown in Table 1:

The physique measuring instruments and test methods are shown in Table 2.

4.2. Physical Fitness Results. At the beginning of the design of the experiment, the body shape of the experimental subjects was changed. As the first indicator of the impact of badminton on the physique of middle school students, the reason is that height represents the growth and physical condition of human bones. Height is greatly affected by external and internal factors, including eating habits, age, and gender. Weight is a horizontal standard for judging health or not and determines a person's physical function. On this basis, the ratio of height to weight (i.e., BMI) is a long-standing internationally recognized standard for measuring body mass index. According to Chinese management, the standard is (18.5–23.9) kg/m^2, and the ideal body mass index is 22 kg/m^2. Through the experiments of the first stage, we observe the experimental results. As can be seen from Figure 8 and Table 3, through 15 weeks of badminton exercise, the experimental data of the experimental group and the control group show that in terms of body shape, the boys have $P > 0.05$ in terms of body weight and BMI value, and there is no significant effect. The height is significant at $P < 0.05$ and has an effect. However, because the height growth rate of boys and girls is about 1.5%, this is normal growth, because middle school students are in the stage of physical growth and development. For girls, $P > 0.05$ for height and weight, and $P < 0.05$ for BMI, which has a significant effect. Therefore, it can be concluded that badminton has an impact on the height of boys' and girls' BMI in terms of body shape of high school students.

In this paper, strength quality, speed quality, endurance quality, and flexibility quality are used as the indicators of this experiment. The experiments corresponded to standing long jump, 50-meter sprint, 800/1000-meter run, and forward bending while sitting. It can be seen from Figure 9 that before and after training, regardless of gender and category, there is a certain improvement. Therefore, it can be concluded that badminton can improve the aerobic endurance of high school students.

4.3. Comparative Analysis of Different Exercise Modes. It can be seen from Figure 10 that there are differences in the physical health indicators of students participating in badminton extracurricular training and other groups. (1) The sit-up scores of the students who participated in the extracurricular badminton training were higher than those of other groups, and there was an extremely significant difference with the nontraining and basketball groups ($P < 0.01$). (2) The 50-meter running scores of the students who participated in the extracurricular badminton training were higher than those of the nontraining group, and there was a significant

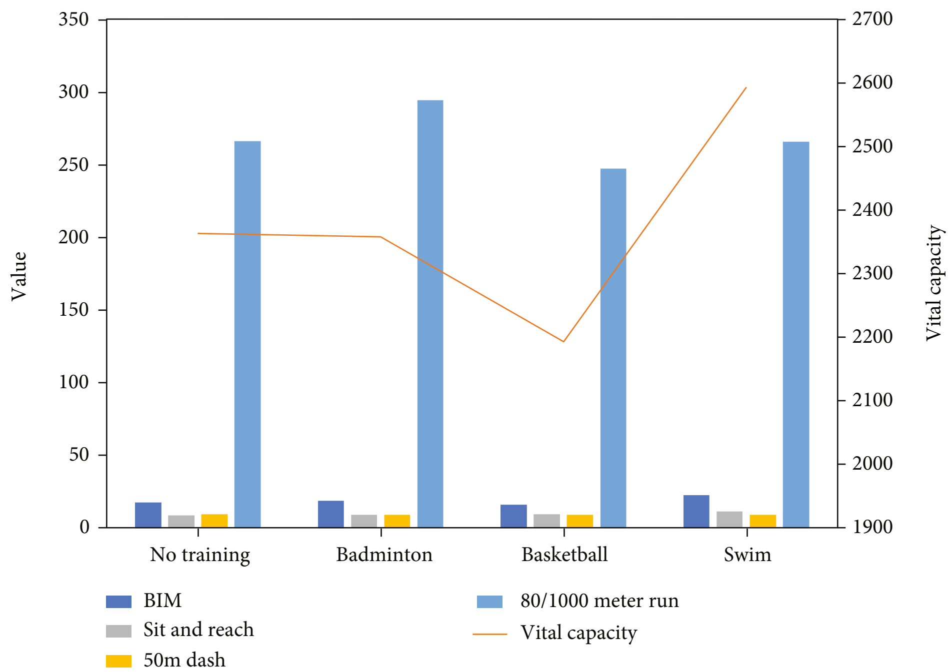

Figure 10: Comparison of health care by different sports.

difference ($P < 0.05$). (3) The vital capacity scores of students participating in swimming training were higher than those of other groups, and there was a significant difference ($P < 0.05$). (4) There was no significant difference between the scores of students participating in extracurricular badminton training and the scores of other groups in terms of BMI, one-minute rope skipping, 50∗8 round-trip running, and sitting forward bending ($P > 0.05$). In addition, it can be seen from the average situation that the average scores of students participating in badminton extracurricular training in the 50-meter run and sit-ups are higher than those of other groups. It shows that the speed quality and muscle strength quality of students participating in badminton extracurricular training are better than those of other groups.

5. Conclusion

Through one-way statistical analysis on the physical self-esteem index and overall self-esteem of the fifth and sixth grade students participating in badminton extracurricular training and the scores of students in the no-training group, basketball group, and swimming group, we can see that students who participated in badminton training had extremely significant differences with other groups in the six scales of physical attractiveness, motor skills, appearance, flexibility, coordination, and physical self-esteem ($P < 0.01$). In addition, the multiple comparisons of the scores of the senior primary school students participating in badminton training and the students in the no training group, the basketball group, and the badminton group in these six dimensions can be clearly seen: In the multiple comparison of appearance subscale scores, the appearance scores of the senior primary school students in the badminton group (3.72 points) were higher than those of the basketball group students (3.22 points). And there was a significant difference in the scores between the two groups ($P < 0.05$). In the multiple comparison of the scores of the flexibility subscale, the flexibility score of the senior primary school students in the badminton group (3.93 points) is much higher than that of the swimming group students (3.39 points) and the basketball group students' scores (3.08 points). There was an extremely significant difference in flexibility scores between the badminton group and the basketball group ($P < 0.01$), and there was a significant difference between the badminton group and the swimming group ($P < 0.05$).

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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