

Research Article

Research on Some Key Technologies of Health Management Cloud Model for Obese Children Based on Social Ecology Theory

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This research is aimed at building a new health service model for childhood obesity based on data processing by cloud computing, to effectively utilize existing resources to provide fair, accessible, systematic, and continuous health services for children with obesity. Through the questionnaire, expert interview, and building cloud platform, this research involves cloud computing technology, pushing notification about exercises and nutrition prescriptions, smart wearable devices, exercise monitoring and feedback, Internet technology, social-ecological platform, as well as technology for social-ecological intervention in childhood obesity, realized through deep integration of big data and health file storage. Furthermore, with qualitative research on the demand for social-ecological intervention in childhood obesity-related health service, this research redefines the roles of different players, establishes a cloud service platform, and comes up with an innovative service model. Against the background of the development of modern information technology, this research proposes to change the management mode for sports intervention; apply modern information technology such as big data, cloud technology, and electronic medical testing equipment; integrate resources from family, community, and school; optimize management service process; and explore a practical, efficient, and integrated health management system for obese children, to provide continuous, active, and full-range health management services for obese children, which is an effective way to improve the compliance and effect of exercise intervention for obese children and materialize a lasting mechanism of health management for obese children.

1. Foreword

Obesity is a severe epidemic that threatens human health in the 21st century. 6 to 12 years old (school-age) children are most susceptible to obesity. Childhood obesity is more harmful than adult obesity and is also more difficult to reverse. According to the China Childhood Obesity Report jointly released by the School of Public Health of Peking University and other institutions in May 2017, there were nearly 40 million school-age children with overweight and obesity in China [1], and China's absolute number of children with obesity ranks first in the world [2]. Obesity has become a major threat to children's physical health.

Many studies have discussed the theoretical and practical methods and their effects in promoting the physical health of children with obesity. In recent years, researchers have proposed many model theories of health promotion for

childhood obesity, such as the health belief model, planned behavior theory, and behavior stage change theory. It can be found that although specific interventions can achieve certain short-term effects, they still lack long-term evidence. These theories focus too much on the behavioral change at an individual level and have limited effect in explaining the effect of an intervention on maintaining long-term health behavior [3] of an individual. In recent years, scholars have gradually realized that the individual-based exercise intervention strategy will always be limited by environment and group behavior and proposed that the current research must pay attention to the change of human behavior in the natural and social environment. Therefore, in the field of health behavioral research, social ecology theory has attracted the attention of researchers.

Based on the social ecology theory and energy balance theory, we use modern information technology to integrate

various scenarios such as society, family, school, and community and realize the cooperation and information sharing between children, parents, teachers, and community doctors through Internet technology, to effectively improve the effectiveness and sustainability of sports intervention for childhood obesity. This study provides a new idea and solution for the nonmedical intervention of growing childhood obesity.

2. A Social-Ecological Interpretation of Childhood Obesity

In 1970, American scholar Murray Bookchin first put forward the concept of “social ecology,” which was continuously improved and revised and gradually developed into an important theoretical framework for explaining human social behaviors [4]. Social ecology holds that human is the most active social-ecological factor, while individual, interpersonal, community, institution, and macropolicy constitute a multilevel and multidimensional social-ecological environment for individuals. Human behavior is a comprehensive manifestation of the interaction of various social-ecological factors. Social ecology emphasizes the interaction between humans and the social environment (such as family, institution, group, and community) and its great influence on human behaviors and has become an important theory to explain complex individual social phenomena and behaviors. In the field of health promotion, social ecology theory holds that the factors affecting individual health-related behaviors are comprehensive and multilevel. The influencing factors at different levels constitute a relatively independent system. Different levels of systems interact and intervene. Joint intervention at multiple levels is a reliable solution to change individual health-related behaviors.

The traditional energy metabolism imbalance theory holds that the main reason for obesity is that energy intake is greater than consumption, resulting in energy surplus, and thus inducing obesity. However, the theory of social ecology focuses on the macrointervention in individuals, emphasizes the multilevel coordinated intervention by government, family, school, community, and medical institution, and provides a theoretical framework for a comprehensive understanding of the interaction of health-related behavioral determinants. It has been recognized as the most important theory for long-term health behavior intervention in children [5]. Boonpleng (2013) made a comparative analysis of the socio-ecological environmental factors leading to childhood obesity and found that the variance contribution rate of factors related to family, school, and community are 79%, 27%, and 2%, respectively. According to the theory of social ecology, the drastic changes in children’s lifestyle, behaviors, and habits in modern society are the main reason for the large-scale outbreak of childhood obesity, in which food desert, female employment, intellectualism, the screen age, and consumer society are regarded as five social-ecological traps leading to childhood obesity in the context of modern society [6].

The theory of social ecology has two important effects on the health service for children with obesity. The first is the

integration of intervention means. Exercise and nutrition have always been the two main means of childhood obesity intervention. In recent years, the comprehensive intervention model combining exercise, nutrition, behavioral intervention, and health education has attracted more and more attention. The second is the compounding of the intervention environment. Multilevel collaborative intervention by government, family, school, community, and medical institutions is considered to be an effective model to improve childhood obesity.

The systematic social-ecological intervention as an effective model of childhood obesity intervention has become a consensus in academic circles [7, 8]. In recent years, there are many types of research on a multisenario joint intervention under the guidance of social ecology theory [9], due to the lack of a collaborative platform and the incomplete security system, the intervention only last for a short period during which the researchers were carrying out the experiments, and it is difficult to ensure the continuity and universality of the intervention, which has become the key bottleneck of health services for children with obesity. There is an urgent need to build an effective cooperation platform that is built, established, and shared by multiple players to form a “fair and accessible, systematic and continuous” universal health service system for children with obesity.

3. Channels to Integrate Information for Social-Ecological Intervention in Childhood Obesity

The main means to prevent childhood obesity is to increase physical activity and develop healthy behaviors. The development of children’s health behaviors is influenced by many factors, such as children’s self-discipline, health behaviors of peers, upbringing, school and community environment, and macro policymaking. Comprehensive social-ecological interventions provide an effective solution for children with obesity to develop healthy behaviors and control weight. The key bottleneck of social-ecological intervention in childhood obesity is the lack of a platform and the fragmented intervention efforts. The Internet technology can expand the coverage of health services in time and space, broaden the scope of health service, optimize the allocation of health resources, share health information resources, build a new type of health education channel, realize the deep integration of Internet + sports, and provide an extremely suitable platform for social-ecological intervention in childhood obesity.

3.1. Integration of Cloud Computing Technology and Push Notification about Exercise and Nutrition Prescriptions. Exercise and nutrition are the vital “two legs” for weight control of children with obesity. Due to the shortage of professional weight control instructors and financial constraints, lack of personalized exercise and nutrition prescription guidance has become the primary obstacle for universal weight control services for children with obesity. To realize the semiautomatic generation of exercise and nutrition prescriptions, an ecological exercise prescription and energy consumption calculation system with energy consumption

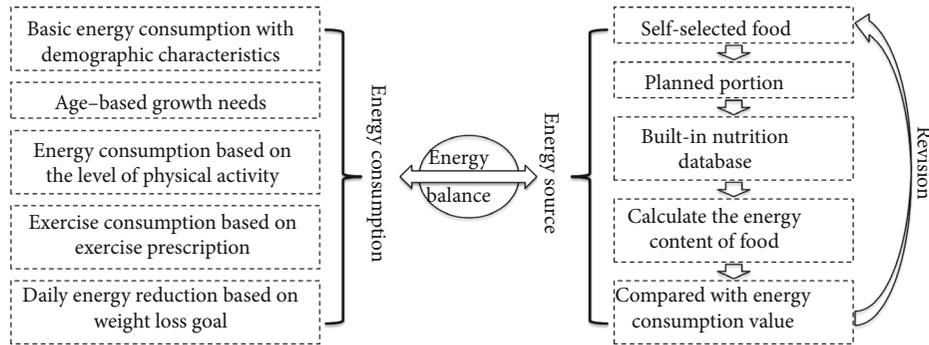


FIGURE 1: Schematic diagram of key control of exercise-nutrition prescription with “Energy Consumption” as node.

as the key control node was developed (software registration number: 2018SR401007). The key control principle is shown in Figure 1. The system allows self-selection of exercise and nutrition prescriptions according to children’s biological characteristics, weight control target, dietary habits, and exercise environment. Through cloud computing, it provides real-time calculation, feedback, and adjustment of energy consumption by adjusting exercise and nutrition prescriptions, to realize push notification for subscribed free exercise and nutrition prescriptions. The energy consumption control formula is Basic energy consumption calculated on the basis of biological characteristics + energy demand + energy consumption at a certain level of physical activity + energy consumption through exercise prescribed – average daily energy difference for weight loss = food energy supplement – food consumption.

Cloud technology, also known as cloud computing technology, is a dynamic, scalable, and virtualized way of computing resources through the Internet. The network that provides resources is called the “cloud” [10]. As the application of the next-generation information technology will produce massive health management data in the process of health management of children with obesity, cloud computing technology is the best way to store and calculate these data. The system’s digital health management platform for children with obesity is an “Internet +” digital management platform. The basic algorithms, main processes, and core ideas of the cloud platform developed by us earlier are based on the core software for the health management of children with obesity. The logical architecture and platform supporting architecture design at the network layer mainly adopt the SaaS-based cloud technology information service platform architecture. First, the network hierarchical framework is designed, mainly by integrating parts, components, middleware, service-oriented architecture (SOA), and other technologies. The subsystems of the digital cloud information service platform are loosely coupled, share the platform data, and ensure the consistency and sharing of upstream and downstream data. Then, the platform architecture—“data layer - service supervision and management layer - application service component layer - application layer”—is adopted to develop and test the platform and realize the dynamic redistribution of data calculation and content storage. In addition to the intelligent exercise and nutrition prescription calculation and push notification, the cloud

platform will also be used for big data processing and the storage of health files for school-age children mentioned in Section 2.4 Big Data and Health File Storage. It is also a platform jointly built and shared among all participants in the health management of children with obesity.

3.2. Integration of Smart Wearable Devices and Exercise Monitoring and Feedback. Exercise monitoring and timely feedback are not only important for effective implementation of exercise prescription but also an effective means to stimulate children’s internal motivation system to participate in physical exercise and improve prescription compliance. The key to the exercise-nutrition prescription set by this system is the balance of the average daily energy consumption of the body (negative energy balance if there is a weight loss target), so how to monitor the energy consumption in the process of exercise is the key to the effective implementation of exercise-nutrition prescription. Because of the biological characteristics, physical differences, characteristics of the exercises, training level, technical level, exercise environment, and other factors, it is very difficult to estimate the energy consumption of individuals by participating in the exercise. For example, for a 30 min badminton exercise, the energy consumption in the exercise process will be hugely different due to the differences in weight, gender, training level, sports environment, the level of the rival, exercise intensity, and other factors. With the development of science and technology, GPS exercise software and accelerometer applied software are widely used in exercise monitoring, and smart wearable devices gradually come into the daily life of ordinary people, making it possible to solve this problem. At present, exercise wristbands and smartphones are two mainstream wearable devices for exercise monitoring, but they are not accurate enough. Smart wearable devices for exercise energy consumption monitoring have become a hot issue in the field of sports training and physiology in recent years. We have reason to believe that with a large number of studies by researchers at home and abroad, the monitoring of exercise energy consumption will be increasingly personalized, diversified, and accurate, and more comprehensive and effective smart wearable devices will provide better hardware support for exercise monitoring [11, 12].

Responding to the fact that a management system is expected, and the current smart wearable devices are not

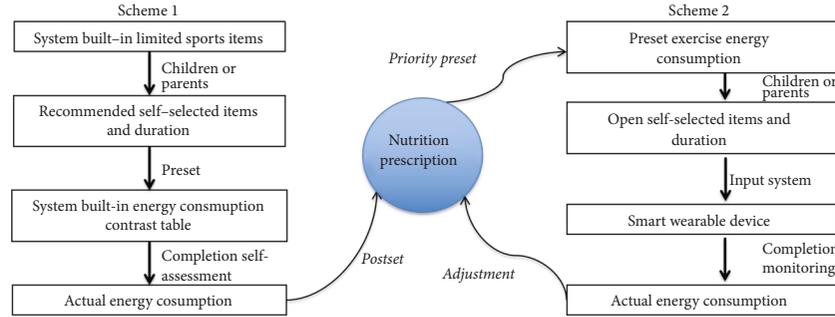


FIGURE 2: Exercise monitoring and energy consumption calculation of different priority schemes.

accurate enough, this management system provides two forms of exercise monitoring and management (see Figure 2): one is the exercise prescription priority scheme (scheme 1). Individuals (children or assisted by parents) select the exercise and duration recommended by the system. The system presets some exercises less affected by the level of skills, sports environment, the level of the rivalry, exercise intensity, and other factors, such as running, rope skipping, stair climbing, and swimming, and their energy consumption values. The children (or parents) choose the exercises and duration, then the system calculates the energy consumption value of the selected exercise prescription based on the built-in energy consumption value, and the combination of this energy consumption value and other energy consumption values is the basis for the formulation of nutrition prescription. The other is the nutrition prescription priority scheme (scheme 2). It recommends the average daily exercise energy consumption according to the biological characteristics and the weight control target and then the individual chooses the exercise mode and monitors the energy consumption by the smart wearable device during the exercise process. The nutrition prescription is set according to the exercise energy consumption, and the adjustment and balance are realized through the selection of exercise prescription. The generation of the two kinds of exercise prescriptions is based on selected and open menus, and the final energy consumption of exercise prescribed will be used as the basis for the calculation and adjustment of nutrition prescription.

3.3. Integration of Internet Technology and Social-Ecological Participants Shared Platform. The theory of social ecology holds that the formation of human behavior is affected by the comprehensive ecological environment, so the governance of childhood obesity based on social ecology must be comprehensive governance participated by government, school, community, family, and individual. Domestic scholars also believe that the comprehensive intervention based on “government-school-community-family” is an effective model to ameliorate childhood obesity, and some empirical studies have been carried out [13]. Due to the shortage of community health managers and the relative closeness of family’s model, the school-based intervention model is adopted, while research on family-or community-based intervention is relatively few. Only a few families- or community-based intervention studies have been found on

CNKI in recent years. The experimental design mainly includes the following four categories: (1) concentrated but a discontinuous promotion of exercise and nutrition knowledge in the community; (2) concentrated sports and nutrition lectures or publicity for parents of children with obesity in schools; (3) general (nonpersonalized) supervision and guidance through Wechat, text messages, and other information means; and (4) additional sports activities for children with obesity in school. At present, there are two insurmountable practical dilemmas in these experimental designs: (1) the stakeholders do not have effective cooperation and sharing, and the experimental design usually only involves one or a few social-ecological factors. The stakeholders, except parents, have no clear responsibility and motivation; (2) the cost of human resources is high, the benefit is limited, and the effect can only be maintained in the short period when the researchers are implementing the experiments. The present situation of the above research shows that Chinese scholars have fully realized that only by building a multidimensional development mechanism with deep integration of “school-family-community” can we effectively solve the important public health problem of childhood obesity, but they have been troubled by the absence of an effective and convenient management system to make these different intervention scenarios work together at the same time. It is the key node in the health management of children with obesity and is also the main reason why many intervention experiments on childhood obesity at home and abroad have obtained a lot of research evidence, but the overall intervention effect is unsatisfactory [14].

The development of Internet technology (including mobile Internet) has completely changed the lifestyle of human beings, providing unprecedented possibilities for their communication, coconstruction, and sharing. It is possible for all stakeholders of childhood obesity health services to jointly build and share information on the Internet platform. The data management layer of the system includes five components: government, parent, community, school, and children. The stakeholders upload data to the cloud platform to jointly build and expand the platform, and access data on the platform, realizing data sharing (see Table 1 for details).

3.4. Integration of Big Data and Health File Storage. As we all know, China’s traditional child health monitoring system involves establishing health files for children, mainly including information such as age, gender, height, weight, and data

TABLE 1: Information rights and responsibilities of social-ecological stakeholders on the Internet platform jointly built and shared.

	Information providing (deliver series)	Information sharing (receive series)
School	D1: conduct physique test of the student, exercise capacity test, and upload the data; upload the approved exercise and nutrition prescriptions; add arrangement for the school sports activity	R1: receive and review the exercise and nutrition prescriptions and child health assessment reports calculated by the platform; inquire about the health status of children.
Government	D2: excavate and analyze big data of child health management; adjust school health management policies; make overall plans on the rights and responsibilities in childhood obesity health management; instruct and guide relevant work in time.	R2: obtain school-age children's growth, development and health status, physical function, physical activity, lifestyle, and other big data; carry out continuous management of students' health files.
Community	D3: upload community health kiosk test data (blood pressure, blood glucose, physiques, ECG, bone mineral density, etc.); provide early warning of health risks.	R3: cooperate with children to complete the intervention prescriptions; receive child health assessment reports; inquire about child health status at any time; receives health education information push and reminders.
Parent	D4: enter children's basic information; choose exercise and nutrition prescriptions.	R4: receive the exercise and nutrition prescriptions, psychological and behavioral intervention prescriptions, and child health assessment reports calculated by the cloud platform and approved by the school and community doctors and inquire about the health status of children at any time.
Child	D5: fill in psychological and behavioral questionnaires; use wearable devices (obtained from third parties) to monitor some physiological indicators.	R5: carry out exercise and nutrition prescriptions, psychological and behavioral intervention prescriptions, and known health status.

Note: series D1-5 and R1-5 will be used in Figure 3 of this document.

from physique tests. These data are derived from the national student physique monitoring database, which provides some valuable services for the formulation of national health policies. However, its flaws are also obvious, mainly including (1) the data source is relatively single, including only the basic data about children's growth and development, while the data about medical history, health service policy, and sports activities at school are completely missing; (2) the current data are mainly static cross-sectional data, and a large number of data about children's health behaviors are not analyzed, so it cannot effectively guide the cultivation of children's health behavior; (3) these data, after being submitted, are rarely used to give feedback and guide children's health behavior, so the effect on children's health promotion is limited; and (4) the existing data do not give enough attention to children with obesity and other children with special needs, but mainly focus on general data records.

Big data about health management of childhood obesity mainly come from two sources: one is the standardized data provided by the social-ecological stakeholders in the process of participating in the childhood obesity health service including data about children's demographic characteristic, physique monitoring, physical fitness test, medical history, health service policy, sports activities at school, and other standardized big data, as well as behavioral information continuously uploaded automatically or manually through the Internet of things, wearable smart devices, RFID, and other mobile terminals for monitoring health behavior of children, but there are a large number of unformatted unconventional data. The foreseeable benefits resulted from the categorization, storage, and mining of these big data include (1) establishing systematic, continuous, and standardized health management files for school-age children, forming the most

basic part of citizens' lifelong health files; (2) providing data support for government departments to formulate policies on sports, health, and health education; (3) analyzing children's needs for the healthy ecological environment to make reasonable urban development plans, and help the development of the ecological and intelligent city in future; and (4) promoting the development of related digital industry, health service industry, and children's consumption market.

Nevertheless, it is difficult to use traditional computing models to process this TB or PB-level unstructured big data. The massive nonstandard data require more computing resources and storage resources. Cloud technology provides an elastic and scalable infrastructure for processing such big data. As mentioned in Section 2.1 Cloud Technology and Push Notification of Exercise and Nutrition Prescriptions, we use a common cloud platform to store, classify, mine, and utilize the data. However, research on digital health management is new, and it is difficult to develop a cloud-based system to process massive personal health information. The system needs to incorporate cloud storage architecture for personal health file management, large-scale concurrent data processing, and health data computing and processing. The computer technology involved in the specific design of the platform will be discussed separately.

4. Information-Based Health Service Model for Children with Obesity Driven by Social Ecology Theory

Modern information technologies, such as semiautomatic exercise and nutrition prescription push notification, exercise monitoring by smart wearable devices, and information

TABLE 2: Most mentioned words in the interviews on the causes of childhood obesity.

	Exercise	Diet	Habit	Family history	Sedentary lifestyle	Intergenerational influence	Parenting ideas	Study-related stress	Others
Education officials (4)	4	2	1		2		1	1	
Physical education teachers (6)	6	3			2	2	1	3	1
Parents (20)	20	16	12	6	10	12	2	3	4
Children with obesity (20)	20	14	6	12	2	2			3

sharing platform based on Internet and cloud technology, undoubtedly provide relatively comprehensive hardware support for accurate management of childhood obesity and greatly save human resources and economic costs. Social ecology is a theoretical framework that emphasizes multilayer comprehensive intervention. To identify social-ecological elements in health service for children with obesity and their interrelationship, clearly define the roles, rights, and responsibilities, strengthen supervision and management, optimize service strategies, establish a national health service system for childhood obesity, make up for the deficiency of sports or medical intervention, provide new insights for the promotion of children’s physical health under the background of “health of the population” and “integration of sports and medicine” are prerequisites for practical operation of the system.

4.1. A Socio-Ecological Qualitative Study on the Needs of Stakeholders of Child Health Service. To build a practical and effective service model, we interviewed 4 education officials, 6 primary school PE teachers, 20 children with obesity, and their parents in Changsha, and gradually identified the service needed, key problems, and solutions of the “Internet + Sports” socio-ecological health service system for children with obesity. The interviews are analyzed through comparing, sampling, and coding. At present, childhood obesity has become the main danger to children’s physical health in the new era. The most mentioned words in the interviews about the causes of childhood obesity (in descending order) include exercise, diet, sedentary lifestyle, family history, habit, intergenerational influence, parenting, and physiological reasons. The most mentioned words in the interview about the impact of childhood obesity on health are as follows: self-identity, physical fitness, confusion, sports exclusion, low self-esteem, and body shaming. The most mentioned words in the interview about the prevention and control of childhood obesity are exercise, diet, family support, social support, environment, safety, informatization (mobile phone), policy, and community. The function, service model, and educational content of the childhood obesity health service cloud are guided according to the findings of the interviews (see Table 2 for details).

4.2. Service Supply Reform Based on Stakeholders’ Needs

4.2.1. Layered Network-Based Socio-Ecological Collaborative Sharing. According to the theoretical framework of social ecology, adopting a holistic governance theory and system-

atic analysis method, with school-age children health management model as a benchmark, the contents of service, collaboration, and cooperative relations of each layer are defined on the supply side of health services. The stakeholders of childhood obesity health intervention include the government, school, family, community, and community hospital. The government bears the management responsibility, mainly to formulate policies, coordinate relationships, guide and supervise the implementation process, and carry out performance evaluation; the school plays a leading role, mainly responsible for the daily operation of the platform, monitoring of physical fitness of children, examination and approval of exercise and nutrition prescriptions, and arrangement of school sports activities; the families bear the main responsibilities in electing and uploading exercise and nutrition prescriptions, monitoring exercise intensity by smart devices, and assisting and supervising compliance of children; the community and community hospital are collaborators. They provide appropriate exercise resources, conduct physiological and psychological assessments, provide early warning and counseling, push health education information, and so on. The stakeholders including children with obesity jointly build and share a social-ecological network of policies, organizations, resources, and individuals, thus improving the information maintenance circle of health services for children with obesity.

4.2.2. O2O Socio-Ecological Service Model. The O2O service model starts with defining the roles of the social-ecological elements in childhood obesity health service. Offline, it puts together resources from schools and communities, teachers, community doctors, and parents to guide children to participate in exercise and nutrition intervention and improve the compliance of children; online, it makes full use of the Internet for publicity, consultation, feedback, information services and intelligent management of weight control, intelligent push notification of exercise and nutrition prescriptions, establishing and access of health files, performance management, etc., to realize management by combining online and offline health services for children with obesity.

4.2.3. Composition of Childhood Obesity Health Service Cloud. The health service cloud mainly consists of four circles. The first circle is the technical support circle based on the core exercise and nutrition push notification software. First, the “ecological exercise prescription and energy consumption calculation system” is to balance the

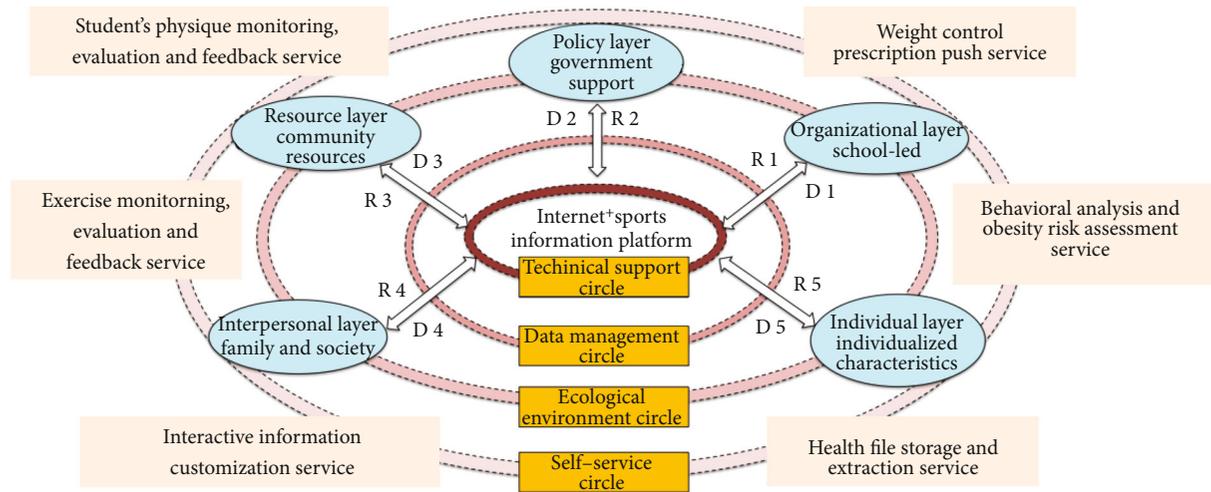


FIGURE 3: Schematic diagram of childhood obesity health service model (the specific meaning of series D1-5 and R1-5 has been explained in Table 1 of this document).

“energy consumption” of open/self-selected exercise and nutrition prescriptions (see Section 2.1 for specific methods), which can be examined and approved by community doctors and schoolteachers and implemented by the children under parents’ assistance and supervision; second, smart devices are used for exercise monitoring (see Section 2.2 for specific methods). The second circle is the data management circle. It mainly uses the cloud platform for continuous health data management, health file establishment, and access, health education library, calculation, and extraction of unformatted data. The third circle is the social-ecological environmental protection circle jointly built and shared by all stakeholders. The stakeholders upload, access, and give feedback on the cloud platform. The fourth circle is the self-service push notification circle based on the calculation by the cloud platform, including approved weight control prescription push notification, student physique monitoring, evaluation and feedback service, customized push notification, children behavior analysis, and obesity risk assessment, exercise monitoring and evaluation feedback service, and health file access service (see Figure 3 for details).

4.3. *Value Analysis of the Model.* From the perspective of social ecology, it is an innovative model of health service for children with obesity, which takes advantage of modern information technology, especially cloud computing technology. Its academic value includes (1) it innovates the research paradigm of health service for children with obesity. Driven by the theory of “social ecology,” it breaks through the limitations of microindividual intervention of evidence-based medicine, straightens out the relationships, clarifies rights and responsibilities, strengthens supervision, builds a macrohealth service system for children with obesity, and innovates the research paradigm of health service for children with obesity; (2) it expands the horizon for the research of exercise and health promotion. Relying on modern information technology, it breaks through the temporal and spatial limitations of health services, optimizes the

allocation of health resources, shares health information resources, builds new health education channels, and expands the horizon of research on exercise and health promotion. (3) It provides a better research paradigm for the study of “Internet plus health,” which makes full use of the intelligent computing technology built in the cloud platform to reduce human resources in health services and share limited intellectual resources, thereby improving the cost-effectiveness of health services.

Furthermore, the model has extensive application value: (1) based on the theory of social ecology, it enables holistic governance of the ecological elements of health services for children with obesity, breaks the institutional barrier and obstacles for the effective coupling of multiple health intervention scenarios (“government-school-family-community-medical institution”) for children with obesity, and provides fair and accessible, systematic, and continuous health services for children with obesity to reduce their health risks; (2) based on the deep integration of “Internet + Sports,” it uses artificial intelligence and cloud computing technology to realize human-computer interaction, realizes intelligent management of weight control process, fills up the personnel and technological gap in health service for childhood obesity, and provides an information platform for cooperation among multiple intervention scenarios; (3) through continuous management of children’s health data, it establishes, mines and analyzes big data related to children’s behavior and health, provides data support for monitoring, early warning, prevention, and control of childhood obesity, and provides support for formulation and coordination of sports and health policies. (4) The model monitors children’s health behaviors through intelligent wearable devices and calculates their energy consumption through software, providing relatively more accurate health services for this special group of children with obesity. (5) The highlight of the model is that it adopts the key technology—“energy balance”—to control the weight of children through exercise and nutritional intervention and to improve the effect of preventing and treating childhood obesity.

5. The Limitations of the Research and Recommendations for Future

Health intervention for children with obesity is a complex problem. It seems to be a feasible solution to integrate school, family, community, and other forces for collaborative cooperation. However, how to ensure the effectiveness of cooperation is key to the problem. The intervention combining online and offline efforts with the help of modern information technology provides a good platform for effective cooperation. This study constructs the framework of this platform, but this is only the first step to the solution of the problem, and there are still some problems to be further improved and solved: first, intelligent wearable devices are still difficult to be widely adopted among children with obesity. Therefore, it is difficult to collect all kinds of sports information, which leads to the limitation of access to the platform. Second, uploading and sharing all kinds of information require parents and students to invest some energy, which is also a challenge to overcome. Third, there is no macropolicy support on how to motivate schoolteachers and community service personnel, which also renders the operation of the platform more difficult. Fourth, the registration of children's daily nutritional intake is also a cumbersome procedure, which is a heavy workload for parents. How to correctly record children's food intake is also a problem.

To solve the problems, further research in the future mainly focuses on support by national health policies, especially on how to build an effective supporting system for children with obesity. In addition, if recommended nutritional prescriptions can be formulated by taking into consideration dietary habits of different regions and can be adjusted by parents, it will make life easier for parents and therefore will be easier to be implemented sustainably. Finally, although the energy consumption of individuals during exercise has a certain correlation with heart rate during exercise, there are great variances among individuals after all. If a more effective energy consumption formula can be developed, it will make weight control easier for children with obesity. But exercise physiology concerned needs to be further studied.

6. Summary

Social ecology is one of the most important theories to explain the development of individual health behaviors, emphasizing the comprehensive effect of social factors on individuals. The prevalence of obesity among school-age children is the main cause of chronic diseases affecting younger people, including diabetes and cardiovascular diseases. Although most empirical studies have shown that exercise and nutrition controls are the safest and most effective means of weight control, its compliance and long-term effectiveness are less than desirable. Emphasizing the coordination of community, family, and school in health services for children with obesity from the perspective of social ecology seems to be the way to solve the problem, but the cost of human resources is high, and technical personnel and intel-

lectual resources are scarce, making it difficult to be carried out in depth and width, and difficult to be continuous or widely accessible. Therefore, how to build a technology platform jointly built and shared by community, family, and school, with technical processes automated as much as possible, is an urgent issue to be addressed. It is necessary to exploit modern logistics networks, smart wearable devices, and other IT technology to develop a new health service model for childhood obesity, which is based on cloud computing data processing, makes effective use of existing resources, and provides fair, accessible, systematic, and continuous health services for children with obesity.

Data Availability

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

Disclosure

The sponsors have not been involved in study design, data collection, analysis, or decision-making related to the publication or preparation of the study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

- [1] G. Ma, *China Childhood Obesity Report*, People's Health Publishing House, Beijing, 2017.
- [2] GBD 2015 Obesity Collaborators, "Health effects of overweight and obesity in 195 countries over 25 years," *New England Journal of Medicine*, vol. 377, no. 1, pp. 13–27, 2017.
- [3] X. Sun, Y. Li, L. Cai, and Y. Wang, "Effects of physical activity interventions on cognitive performance of overweight or obese children and adolescents: a systematic review and meta-analysis," *Pediatric Research*, vol. 89, no. 1, pp. 46–53, 2021.
- [4] A. I. Zelenov and L. Chaofeng, "Social ecology," vol. 3, *Social Sciences Abroad*, 1987.
- [5] E. E. Centeio, N. McCaughy, E. W. Moore et al., "Building healthy communities: a comprehensive school health program to prevent obesity in elementary schools," *Preventive Medicine*, vol. 111, no. 3, pp. 210–215, 2018.
- [6] Z. Xiqin, "Social factors of obesity in children and adolescents in the process of modernization," *Journal of Wuhan Institute of physical education*, vol. 51, no. 3, pp. 10–15, 2017.
- [7] J. Jernigan, L. Kettel Khan, C. Dooyema et al., "Childhood obesity declines project: highlights of community strategies and policies," *Childhood Obesity*, vol. 14, no. S1, pp. S-32–S-39, 2018.
- [8] P. Henriques, G. O'Dwyer, P. C. Dias, R. M. Barbosa, and L. Burlandy, "Health and Food and Nutritional Security

- Policies: challenges in controlling childhood obesity,” *Ciênc. saúde coletiva*, vol. 23, pp. 4143–4152, 2018.
- [9] Y. Zhu, Z. Haiyan, and Z. Jiebing, “Influence of “School-Family-Hospital” health education model on children with obesity,” *Chinese Journal of Health Education*, vol. 33, no. 4, pp. 312–315+329, 2017.
- [10] Y. Dong and J. Lifang, “Data storage security technology in cloud environment,” *Electronic Technology and Software Engineering*, vol. 10, pp. 250–251, 2020.
- [11] Z. Yuemin and C. Peiyou, “Research on prediction model of college students’ bicycle energy consumption based on accelerometer,” *Journal of Shandong Sport University*, vol. 35, no. 1, pp. 80–85, 2019.
- [12] C. Qingguo, Y. Chuan, F. Jiangjiang, and F. Jiangjiang, “Research on monitoring energy consumption of walking and running with built-in accelerometer in smart phone,” *Journal of Capital University of Physical Education and Sports*, vol. 30, no. 5, pp. 473–480, 2018.
- [13] J. Yu, L. Zeyu, and X. Huiguang, “Evaluation of the effect of school-family-community comprehensive intervention on obesity among primary school students,” *Zhejiang Journal of Preventive Medicine*, vol. 27, no. 7, pp. 741–743, 2015.
- [14] Z. Zhen, Z. Jing, and Z. Zheng, “Current situation and research progress of childhood and adolescent obesity at home and abroad,” *Journal of Shanghai Jiaotong University (Medicine Edition)*, vol. 35, no. 4, pp. 601–604, 2015.