



# The Application of Computer Medicine in the Investigation of the Health Status of Left-Behind Children Aged 6–12 in Xiangxi

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## Abstract

In the computer-aided diagnosis system, the use of medical database data mining and knowledge discovery technology is of great significance and necessity of development. To understand the health status of left-behind children in ethnic minority areas, a questionnaire survey and computer-aided technology were used to diagnose and investigate the health status of left-behind children aged 6–12 years in Xiangxi, Hunan Province, such as body shape, physical function and personal cognition. The comparison results show that the body shape, function and perception of left-behind children are not optimistic. The countermeasures are to strengthen policy support, school physical education and the supervision consciousness of the guardian, make the government, schools and families form a joint force, establish a scientific work and leisure system, improve the quality of life, and effectively build the health level of left-behind children.

**Keywords** Left-behind children · Health · Computer-aided diagnosis · Computer-aided diagnosis system · Minority ethnic groups · Xiangxi

## 1 Introduction

Left-behind children are children (6–16 years old) who are receiving compulsory education. They are left in rural families because their parents or one of their parents is out of work (on business) and are cared for by trustees. According to the National Women's Federation in the National Left-behind Children and the Situation of Migrant Children in Urban and Rural Areas, up to now the number of the left-behind children in rural areas has reached 61 million 20 thousand, accounting for 37.7% of the total number of rural children and 21.88% [1] of the total number of children in China. With the development of society, the rural population is constantly flowing to the city, and the number of left-behind children is still growing. The left-behind children have serious problems in their physiological, mental health and social adaptability, which has become a popular topic of concern in all walks of life. The left-behind children are

rarely involved in physical exercise, of poor physical quality, with isolated character, weak collective concept, and lack of competitive spirit. What more, left-behind children are reluctant to participate in physical exercise because of their inferiority, timidity, loneliness, and poor sense of cooperation. They have become a vulnerable group in schools and playmates, and the physical condition of left-behind children is not optimistic. In the situation of promoting quality education, paying attention to the physical status of students as well as to the health development of the left-behind children, this problem is prominent. The education and healthy development of rural left-behind children has become the focus of our government [2]. Although Chinese scholars have conducted a series of studies on the physical condition of rural left-behind children, they stay at the theoretical level, lack empirical research and analysis, and are not targeted and practical. Under such situation, the author makes a field test and an analysis of the physical health condition of 6- to 12-year-old left-behind children in Xiangxi minority areas, trying to summarize strategies to promote the health of these children in the minority areas.

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## 2 Method

Compared to the other seven counties and cities in Xiangxi Autonomous Prefecture, Longshan County is special in many aspects, such as having a large population, large land area, and many parents of school-age children going out to work. Therefore, Longshan County has many children left behind. The physical health status of 6- to 12-year-old children in rural areas of the county (including left-behind and non-left-behind children) was selected as the research object of this paper. With a random sampling of left-behind children and non-left-behind children, 200 left-behind children and 200 non-left-behind children all aged from 6 to 12 in Longshan County were surveyed, investigated, and analyzed. A total of 400 questionnaires were issued, and 388 copies collected. 382 questionnaires were valid, and the effective response rate of the questionnaire was 95.5%, of which 196 were left-behind and 186 were non-left-behind children. The 400 6- to 12-year-old children's physical health survey questionnaire mainly includes: body shape index (height, weight), body function index (body temperature, heart rate, breathing, blood pressure, vital capacity), individual perception indicators (appetite, energy, face color, sleep, diet, pain), and health-related problems of the left-behind children. The questionnaires were anonymously filled in. The survey was measured and recovered on time. The survey data were counted and processed.

## 3 Results and Discussion

### 3.1 Difference of Body Shape

Human body shape refers to the relationship between the height, circumference, and weight of a person's body. The BMI index is a generally used measure to evaluate the relationship, which is the body mass index. The value of BMI is recognized worldwide as a classification method for assessing the degree of obesity, and the WHO also uses BMI to define underweight and overweight.  $BMI = \text{weight (kilogram)} / \text{height square (meter)}$ . In growing childhood and prepuberty, the index increases with age and is relatively stable in the adult, middle, and late stages of youth. The height and weight of 6- to 12-year-old left-behind children and the non-left-behind children in Longshan County of

Xiangxi minority area were measured, and relevant data were obtained. The average BMI index was used to assess the physical fitness between the left-behind children and the non-left-behind children (Table 1).

Generally speaking, the higher or lower the BMI index, the worse is the physical health (Chinese standard of BMI index:  $BMI \leq 18.4$  is lean,  $BMI = 18.5-23.9$  is normal,  $BMI = 24.0-27.9$  is overweight, and  $BMI \geq 28.0$  is obese). If the difference is above 0.01, it is significant. Through data comparison, it is found that although the height difference between the two groups is not great, the average BMI ratio of the left-behind and the non-left-behind children of Xiangxi minority is significant. The BMI of the former is greater than that of the latter, which indicates that the two groups have great differences in body shape level. From the trend of how BMI mean value changes and the difference between 6- and 12-year-old left-behind children and non-left-behind children, it can be seen that with the growth of the left-behind children, the ratio difference increases gradually from 0.22 to 0.94, which indicates that the body shape of the left-behind children gradually becomes "thin and long" with age. The average BMI value of the seven groups of 6- to 12-year-old left-behind children is 15.90, which is significantly lower than the average value of the average age of children of the same age group (6–12 years) in China (16.55). This could be relevant to the long time that the left-behind children's parents go out to work, and the long time for the children to stay in the farm and do housework. Statistics show that that after the parents go out to work, for the left-behind children, the percentage of daily chores increased from 27 to 57%, while the proportion of frequent farm work increased from 14 to 24%. At the same time, for the children being left behind for longer periods of time, parents' supervision is insufficient, resulting in left-behind children studying and living without routine and eating a large number of snacks in the absence of a normal diet. This decreased quality of life makes the left-behind children underweight. Investigation showed that the number and frequency of getting sick for left-behind children were obviously higher than those for non-left-behind children.

### 3.2 Differences in Physical Function

Body function refers to the life activity of the organs and systems of the human body. This analysis measured the common physical function indexes of school-aged children

**Table 1** Body shape condition (average BMI) of children aged 6–12 years of Longshan County in Xiangxi Autonomous Prefecture ( $n = 382$ )

Age	6	7	8	9	10	11	12
Left-behind children	14.94	15.11	15.65	15.82	16.28	16.44	17.07
Non-left-behind children	15.16	15.45	15.85	16.23	16.83	17.22	18.01
BMI ratio difference	0.22	0.34	0.20	0.41	0.55	0.78	0.94

(6–12 years old). To compare the scientific nature of the study, a total of seven age groups from 6 to 12 years old were randomly selected from the 382 scales. At each age stage, six left-behind children and non-left-behind children were selected, which is a total of 84 samples including both males and females (42 for each). The body function factors such as body temperature, heart rate, respiration, blood pressure, and vital capacity were counted in 84 children (including 42 left-behind children with half males and half females, and the same to non-left-behind children) (Table 2).

In terms of body temperature, the process of heat production and heat dissipation basically remains balanced. Although human body temperature slightly fluctuates by age, sex, day and night, environment, and sports factors, it tends to be stable, so as to ensure the normal metabolism of the human body. The body temperature is usually 36–37 °C, and the oral-tested temperature is normal at 36–37.2 °C. Measurement results displayed that the average temperature of the 6- to 12-year-old left-behind children in Xiangxi was 36.6 °C, and the average body temperature of the non-left-behind children was 36.8 °C. Both are at the normal range of 36–37 °C, indicating that the difference of temperature factors is not obvious. Although there are differences in heart rate, respiration, and blood pressure between the children left behind and the non-left-behind children, it fluctuates in the normal range. The difference between the two in vital capacity was as large as 75.93 ml. Compared to the non-left-behind children, the vital capacity of the left-behind children was generally lower. At the age of 6–12 years, with the increase of age and vital capacity, it is found that the increase of lung capacity of the left-behind children is slower than that of the non-left-behind children. The lung capacity of male students of the same age was significantly greater than that of women, but the growth rate of the annual lung activity of girls was greater than that of boys.

### 3.3 Difference of Individual Perception

Most scholars believe that self-rated health can be regarded as a reliable indicator to reflect the health status. It integrates the aspects of both subjective and objective health status, and is aligned with objective indicators such as physical health status. It can be a supplement to an objective health condition or can be regarded as an objective health

indicator. Perception is the subjective and objective reflection of objective things perceived by the sensory organs in human brains. The individual perception mainly includes the self-perception test of the left-behind children’s and the investigators’ personal understanding or judgment. During the investigation, some sub-health status was perceived by asking the left-behind children about their feelings and by observing their performance on their physical health status. With the assistance of professional investigators to observe and analyze the external characteristics of left-behind children, this research forms an overall understanding of left-behind children's physical health. Factors such as appetite, energy, complexion, sleep, dietary habit, and pain of the left-behind children in Xiangxi were investigated and analyzed. According to the individual perception and comprehensive analysis of children and investigators, the score of each factor was calculated by percentage (Table 3).

Food is the main source of human energy, and people get nutrition through food. A regular and rational dietary habit of children is a necessary element to maintain life activities and ensure the normal conduct of learning and life. Loss of appetite and overeating are both illnesses, so it is possible to understand the health status of peoples’ body through their dietary habit. Adults sleep for 6–8 h a day and children sleep about 8–10 h. Sleep disorders, sleepless nights, and daytime sleepiness are all unhealthy manifestations of sleep disorders. The survey found that the scores of appetite, energy, complexion, sleep, dietary habit, and other aspects of left-behind children were lower than those of non-left-behind children. More specifically, non-left-behind children in sleep and diet score 20 points higher than left-behind children.

**Table 3** Individual perception of 6- to 12-year-old children in Longshan County of Xiangxi Autonomous Prefecture (*n* = 382)

Factors	Left-behind children (score)	Non-left-behind children (score)	Difference (score)
Appetite	78	91	13
Energy	80	86	6
Complexion	75	92	17
Sleep	70	93	23
Diet	65	87	22
Pain	92	63	–29

**Table 2** Physical function status of 6- to 12-year-old children in Longshan County of Xiangxi Autonomous Prefecture (*n* = 84)

Factor (average value)	Left-behind children	Non-left-behind children	The difference
Body temperature (degrees)	36.6	36.8	0.2
Heart rate (beats per min)	79	81	2
Breathing (BPM)	21	22	1
Blood pressure (mmHg)	99.27/61.43	102.35/63.54	3.08/2.11
Vital capacity (ml)	1141.53	1217.46	75.93

From the perspective of dietary habit, the left-behind children of Xiangxi minority area have poor diet. Only 26.5% of them could eat sufficient food on time, 21.3% have unbalanced dietary routine, 16.6% overeat, and 35.6% eat more snacks than ordinary meals. Obviously, left-behind children lack perfect supervision. Most children can only meet their basic daily life, and their nutritional status and living habits are relatively poor [3].

There are many kinds of pains. Many common temporary pains (such as temporary muscle soreness, etc.) do not affect the health status, most of which are insignificant. However, sickness is indicated if the pain is continuous, or gradually aggravates, or with other positive symptoms. The patient should undergo examination, diagnosis, and symptomatic treatment under such circumstances. The survey showed (Table 3) that the score of body pain perception (92 points) of left-behind children was significantly higher than that of non-left-behind children (63 points), with a difference of 29 points. With further interviews, it was learned that the left-behind children were lacked guardians and care from their parents, which resulted in loneliness and confusion in their heart. The pain perceptions of the left-behind children was manifested as physical injury, and the internal manifestation was psychological suffering from depression. On the contrary, the situation of non-left-behind children was much better. They were taken better care of with both physical and mental comforting, reducing a lot of unnecessary worries and injuries.

#### 4 Factors Affecting the Health of the Left-Behind Children in Xiangxi

Health is the right of citizens to enjoy the integrity of the physical functions of their bodies and the content of maintaining a sustained, stable, and good mental state. Therefore, the main content of the right of health is about their physical and mental health. However, the minority left-behind children are in a special living environment, and their guardianship is "marginalized". Compared with other children of the same age, their physical health is not promising, and there are many reasons. This research investigates 196 left-behind

children aged 6–12 years in Longshan County and lists the related factors affecting their health in ethnic minority areas (Table 4).

Longshan County is located on the eastern side of the Yunnan Guizhou Plateau and is adjacent to the western Hubei Mountains. The terrain is high in the north and low in the south. It is a strongly eroded mountain area. The valleys are deep and crisscross with the steep slopes. The mountains are broken and undulating, and the farmland is dispersed. There are more than 420 thousand ethnic minorities in Longshan County, which is more than 70% of the total population of the county. Among them, there are about 300 thousand Tujia people, second to the Miao, which is about 80 thousand. The living conditions are generally not quite satisfactory. It was learned by the field investigation that the 6- to 12-year-old left-behind children of the ethnic minorities (primary school) go to primary schools in their hometown. Left-behind children in residence bring their own food to eat, most of which are pickled cabbage and chili cause. They rarely have meat for protein and vegetables for other nutrition. Some left-behind children have growth retardation and severe malnutrition because of family poverty, low living standards, and insufficient nutrition. It is reported that the negative effects of childhood malnutrition on individual development are lifelong. Economic poverty and low living standard were the main factors affecting the health of the left-behind children in ethnic minority areas, accounting for 47.96% of the total number of respondents (Table 4).

Secondly, the participation degree of physical exercise is low, which accounts for 41.33% of the total number of people in the survey. There is a great lack of physical exercise for rural left-behind children [4]. Research shows that effective physical exercise can enhance the physical fitness of left-behind children and improve their physical health [5]. Children's health and habits largely depend on the influence of their parents. The participation of parents and other elders will affect the children. The lack of supervision and companionship of left-behind children's parents, lack of understanding of physical exercise by the next generation elders (grandparents), and the main emphasis only on the cultural and academic achievements of their grandchildren without paying attention to the physical condition of their

**Table 4** The effect factors of left-behind children's health in minority area (multiple choices,  $n = 196$ )

Factors	Number of people	Proportion (%)	Precedence
Poor economy and low living standard	94	47.96	1
Low degree of participation in sports exercise	81	41.33	2
Guardianship and careless negligence	65	33.16	3
More farm work and heavy housework	53	21.94	4
Less sleep time	36	18.37	5
Other	27	13.78	6

grandchildren result in the low participation of left-behind children in physical exercise, and about 90% of left-behind children do not participate in out of school physical exercise at all. Due to the lack of supervision, the physical quality and physical fitness of the vast majority of left-behind children are not optimistic [6].

Thirdly, guardianship is inattentive with carelessness and neglect. At the age of 6–12 years, children are physically active and curious about the outside world. They are weak in self-control without their parents around, which leads to unintentional injury and even death. In addition, the guardianship is mostly taken over by grandparents and older aged relatives when their parents go out to work. Many left-behind children should also help with the farm work and household duties after school. When such burden exceeds the limit that the children could bear, it will affect the health status of left-behind children to a certain extent. Sufficient sleep has a positive effect on restoring body fatigue, promoting appetite, accelerating excretion, and improving the body's immunity to various diseases. Most of the families of the left-behind children in ethnic minority areas are poor, forcing them to study hard and work hard. They study for a long time in the evening and have less time for rest, which affect their health status.

## 5 Countermeasures and Suggestions

### 5.1 Strengthening the National Support

The problem of left-behind children is not only related to the common development of all ethnic groups, but also to the fate of the country. So the government's care for the left-behind children of ethnic minorities is the key to solve the problem. In recent years, China has launched relevant policies on strengthening the care and protection of rural left-behind children, which clearly focuses on the physical and mental health development of left-behind children [7]. First of all, the government should formulate rational regulations and policies to better implement the national Scientific Outlook on Development. Plans should be made with the overall consideration, and the connection between the community and the countryside should be strengthened. It is necessary to set up a working committee for the left-behind children to make plans and take measures. A better atmosphere and environment for the healthy growth of the left-behind children should be provided, and the healthy development of the left-behind children should be promoted. Secondly, we should reform the household registration and social security system. We should break the barriers in the educational system, gradually eliminate the gap between urban and rural areas, gradually weaken the restrictions of household registration systems in the urban and rural areas,

and make sure that the children of migrant workers who fly to the city live together with their parents. Equal educational opportunities and social rights should be provided to the left-behind children of ethnic minorities. Finally, we should improve the legal guardianship system for the left-behind children, protect the right of health for the rural left-behind children, encourage people to take care of the left-behind children, offer help to the children who are in trouble, and let the minority rural left-behind children grow up healthily and happily.

### 5.2 Creating an Atmosphere of Social Care

At present, the whole society is paying more and more attention to the physical and mental health of left-behind children. Institutions at all levels, schools, and scholars are looking for a variety of methods and means to promote the mental health of left-behind children [8]. Among them, a harmonious social environment is crucial for the left-behind children as they grow up. Everyone in the society should care about the health of the left-behind children, so that they can be kept away from disease and face the world positively. First of all, people from all walks of life should make good use of various methods of promotion such as social media and the Internet to arouse the whole society's attention to the physical and mental health of the left-behind children in ethnic minority areas. Secondly, government departments should pay more attention to the sports life of left-behind children [9]. Organizations at the grassroots levels from all walks of life should hold sports activities for the left-behind children, to let them receive moral education, establish a sense of self-sufficiency, and promote the healthy development of their body and mind. Thirdly, on the heavy academic and household burden of the minority left-behind children, the village committee and the guardians should try to lighten the labor burden of the left-behind children as much as possible. To improve their health status, we should improve their health care and shorten the cumulative time of homestay of the minority left-behind children.

### 5.3 Strengthening the School Fitness Education

School is an important place for children to study and live. There are many problems in school physical fitness education in underdeveloped rural areas where left-behind children gather, such as venues, teachers, and leadership awareness [10]. We should pay more attention to the education department and the school leaders to improve the rural left-behind children's sports education and increase acceptance [11]. At the same time, we should also standardize the rules and regulations of physical education for rural left-behind children [12], and require physical education teachers to effectively take various measures according to

the characteristics of children to improve students' physique and promote their healthy growth. First, physical education teachers in ethnic minorities' areas should study the left-behind children's physiological and psychological characteristics, inheritance, and development of traditional ethnic sports. For example, with Miao and Tujia waving dance, music and dance can be used to enrich the teaching content of the physical education curriculum, reform teaching methods and means, and improve the health of the minority left-behind children interested in sports. Second, we should establish a health record for the minority left-behind children, establish a long-term exercise mechanism, and set up personalized exercise prescription taking into account their differences as per guidelines. Third, we should set up purposeful and colorful after-school sports activities. Sports activities can enhance positive self-awareness, improve positive emotions, and increase the response efficiency to stressful events [13]. Fourth, teachers and left-behind children's guardians should sign a minority left-behind children's health condition and home visiting agreement, and a parent hotline should be opened up to strengthen the supervision and management of their physical and mental health.

#### 5.4 Strengthen the Supervision Consciousness of the Guardians

Family sports participation and intervention in parents' words, deeds, and ideas play a very important role in guiding and promoting children's sports behavior. Therefore, family sports should be fully carried out and plays an important role [14]. A warm family atmosphere is beneficial to left-behind children's physical and mental health. Children would not grow up healthily without a good parent–child relationship, or without reasonable living habits and diet. Therefore when parents are not around, guardians should be chosen and there should be regular contact with the parents. Parents should keep abreast of their children's mental and physical health, so as to make the children feel the love and care of their parents. On the other hand, we should pay close attention to children's growth and communicate with children as closely as possible. We should help them in time when they make mistakes, comfort them when they feel lonely, encourage them when they make progress, and pay attention to the all-round development of their physical and mental health.

## 6 Conclusion

The issue of left-behind children results from the country's modernization, urbanization, and market development. Solving the problem of left-behind children is an important part of our current social equity, social and economic development, and social stability. It is also related to the

future development and hope of our country. The physical and mental health of the left-behind children in the minority areas is not only the problem of parents and the rural areas of the left-behind children, but also an overall social problem that should be faced by the whole society together. We should jointly create the environment and space for the healthy growth of the left-behind children in the minority areas. It is a systematic project that requires the government, school, and family to form a joint force. We should quickly develop the economy of ethnic minority areas and implement policies and regulations to protect the left-behind children. We should also improve the teaching quality of school physical education in minority areas and provide better living conditions so as to better improve the health level of the minority left-behind children.

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**Availability of Data and Materials** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

#### Declarations

**Conflict of Interest** The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

**Consent** Not applicable.

**Ethical Approval** Not applicable.

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