

Original Article

Analysis of dynamic change of nutrition status in primary school children of Furong District of Changsha City from 2019 to 2020

Yanyan Li¹, Xuan Xu¹, Boyu Tan², Shuting Fan¹, Xuan Peng¹, Danxia Peng¹, Shuping Liu¹, Yun Chen³, Jinghui Yao³

¹Department of Pediatric Endocrinology, Genetic Metabolism and Cardiology, Hunan Provincial People's Hospital (The First Affiliated Hospital of Hunan Normal University), Changsha 410006, Hunan, China; ²Department of Pharmacy, Shanghai Children's Hospital, Shanghai Jiao Tong University, Shanghai 200062, China; ³Department of Pediatric Orthopedics, Center for Orthopaedic Surgery, The Third Affiliated Hospital of Southern Medical University, Guangzhou 510630, Guangdong, China

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Abstract: Objective: To analyze the nutritional status of primary school children in Furong District of Changsha from 2019 to 2020. Methods: The physical examination data of students from 35 primary schools (grade 1-6) in Furong District of Changsha in Hunan Provincial People's Hospital from September 2019 to October 2020 were analyzed retrospectively. General information of all children was collected for statistical analysis of malnutrition among children of different gender and age groups. Result: The overnutrition rate was 32.73% in 2020. This was 7.42% higher than 25.31% in 2019. The undernourishment rate was 4.70% in 2020. This was 3.94% lower than 8.64% in 2019. In 2019 and 2022, the obesity and overweight rates of boys were higher than those of girls (both $P < 0.05$). The rates of growth retardation (0.36%, 0.37%) for boys were higher than those for girls (0.27%, 0.24%). The rates of mild wasting (4.31%, 2.36%) were lower than those for girls (4.00%, 2.39%) in 2020 and 2019. The rates of moderate and severe wasting (4.06%, 1.98%) were higher than those for girls (2.75%, 1.47%). In 2020, the undernourishment rate for boys decreased by 4.02% compared to 2019. The undernourishment rate for girls decreased by 2.91% compared to 2019. The growth retardation rate for boys increased by 0.01% compared to 2019. The growth retardation rate for girls decreased by 0.03% compared to 2019. The mild wasting rate for boys decreased by 1.95% as compared to 2019. The mild wasting rate for girls decreased by 1.61% as compared to 2019. The moderate to severe emaciation rate in boys was 2.08% lower in 2020 than in 2019 and 1.28% lower in girls than in 2019. The malnutrition rates of children aged 6-11 decreased by 4.20%, 4.85%, 3.83%, 9.45%, 6.65%, and 6.45% in 2020 compared with that of 2019. Conclusion: Compared to 2019, the primary school students in Furong District had abnormal nutritional status in 2020. It is necessary to strengthen the management of children's health care to ensure the healthy growth of children.

Keywords: Nutrition status, obesity, growth retardation, primary school students, childcare

Introduction

With the sustained development of China's national economy, people's living standards have been significantly improved in terms of food consumption behaviors, dietary patterns, and lifestyles [1]. This change has led to excessive energy intake among primary and secondary school students, and the growing problems of obesity and overweight. The nutrition and

health status of children has attracted attention from the whole society. Students' nutritional status is one of the important indexes to evaluate students' health. Nutrition status can be divided into good nutrition and malnutrition. Malnutrition can be divided into undernourishment and overnutrition. Primary and secondary school students are generally undernourished or over-nourished. A survey showed there was a malnutrition rate of 3,952 primary school stu-

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dents in Rashtriya Bal Swasthya Karyakram, Fatehgarh Sahib district, Punjab province, India, reached 21.39% [2].

Undernutrition can be manifested as no weight gain or loss and gradual loss of subcutaneous fat. In severe cases, muscle atrophy, motor function development delay, and mental retardation occur. These children have poor immunity and are extremely vulnerable to gastrointestinal diseases such as dyspepsia. Overnutrition refers to a condition where energy absorbed by the body far exceeds the energy consumed by the body, resulting in an excessive energy reserve. Excess nutrition causes the rise of blood lipids and blood glucose metabolism disorders, and overweight in some children, affecting the growth and development [3]. An abnormal nutritional status harms students' physical and mental health and significantly increases the incidence of diseases in their adulthood [4]. There are 38 primary schools in the Furong District of Changsha City. Mastering the health status of primary school children in Changsha and the main problems will help the government to formulate a scientific school health work plan and promote the healthy growth of students. There are few studies on the analysis of children's nutritional status in this region. The latest investigative data are lacking [5]. This study investigated and analyzed the nutritional status of primary school children in Furong District of Changsha from 2019 to 2020.

Objects and methods

Objects

The physical examination data of students from 35 primary school (grade 1-6) in Furong District of Changsha who underwent physical examination in Hunan Provincial People's Hospital from September 2019 to October 2020 were analyzed retrospectively.

Inclusion criteria: ① Han nationality; ② No religious belief; ③ Parents of children who met the inclusion criteria orally agreed to participate in relevant surveys and measurements in this study.

Exclusion criteria: ① Incomplete information; ② Non-permanent residents of Furong District, Changsha City.

This study was approved and recognized by ethics committee of Hunan Provincial People's Hospital (E2019012).

Methodology

Height and weight were measured in strict accordance with the Measures for the Administration of Physical Examination of Primary and Middle School Students and Technical Requirements for Physical Examination of National Students. Children's scales were used for weight measurement. The instrument was reset before the next read. The kids were weighed with an emptied bladder and the removal of coat, shoes, and hat. Height was measured in an upright position with arms naturally drooping, heels together, and toes open at an angle of 60 degrees. The sled was moved slowly down until it touched the top of the head and the data was read.

Criteria for growth retardation: annual height growth rate ≤ 4 cm/y, birth weight greater than 2500 g, and bone age delay > 2 years than actual age [6]. More than 5% less than the reference BMI value of the same sex and the same age group was emaciation. The BMI greater than or equal to 95% of the reference value of the same sex and the same age group was considered overweight. The median (M)-2 standard deviations(s) of BMI less than the children of the same age and the same sex were moderate emaciation. The children of the same age and the same sex whose BMI was less than M-3s were severe emaciation [7].

Quality control

Before the survey, all the investigators completed the training related to the investigation methods of nutritional status under the guidance of professional physicians. The measurement materials and measurement methods were unified.

Statistical methods

To ensure the accuracy of the data, double entry was adopted during the investigation. SPSS v22.0 software was used for data processing. The classified variables were expressed as (%) and analyzed using χ^2 test, α was set at 0.05.

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Table 1. General information of included children

General information		2019		2020	
		n	%	n	%
Gender	Male	21000	53.52	22208	53.32
	Female	18235	46.48	19440	46.68
Age (years)	6	7183	18.31	7364	17.68
	7	6515	16.61	7375	17.71
	8	6405	16.32	7303	17.54
	9	6401	16.31	6596	15.84
	10	6328	16.32	6521	15.66
	11	6403	16.27	6489	15.58
Normal nutritional status		26000	66.27	26062	62.58
Overnutrition	Obesity	4615	11.76	6748	16.20
	Overweight	5314	13.54	6882	16.52
	Total	9929	25.31	13630	32.73
Undernourishment	Growth retardation	132	0.34	135	0.32
	Mild wasting	1745	4.45	1056	2.54
	Moderate and severe wasting	1429	3.64	765	1.84
	Total	3306	8.64	1956	4.70

Table 2. Prevalence of malnutrition among children of different genders

Time	n		Obesity		Overweight		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
2019	21000	18235	3009 (14.33%)	3240 (15.43%)	1606 (8.81%)	2074 (11.37%)	6249 (29.76%)	3680 (20.18%)
2020	22208	19440	4402 (19.82%)	2346 (12.07%)	4119 (18.55%)	2763 (14.21%)	8521 (38.37%)	5109 (26.28%)
χ^2	0.327		386.323		253.834		0.434	
<i>P</i>	0.568		< 0.001		< 0.001		0.510	

Results

General situation

According to the inclusion exclusion criteria, 39235 and 41648 children examined in 2019 and 2020 were included in this study. The distribution of gender, grade, and nutritional status of all the subjects are shown in **Table 1**.

The overnutrition rate was 32.73% in 2020. This was 7.42% higher than 25.31% in 2019. The obesity rate was 16.20%, which was 4.44% higher than 11.76% in 2019. The overweight rate was 16.52%, which was 2.98% higher than 13.54% in 2019. The undernourishment rate was 4.70% in 2020, which was 3.94% lower than 8.64% in 2019. The growth retardation rate was 0.32%, which was 0.02% lower than the 0.34% in 2019. The mild wasting rate was 2.54%, which was 1.91% lower than the 4.45% in 2019. The moderate and severe wasting rate

was 4.70%, which was 3.94% lower than the 8.64% in 2019.

Prevalence of overnutrition among children of different genders

As shown in **Table 2**, in 2019, the obesity and overweight rates of boys (14.33% and 15.43%) were higher than those of girls (8.81% and 11.37%) ($P < 0.05$). The obesity rate and overweight rate (19.82%, 18.55%) of boys in 2020 were higher than those of girls (12.07%, 14.21%) ($P < 0.05$). In 2020, the overnutrition rate of boys increased by 8.61% compared with 2019. The obesity rate increased by 5.49% compared with 2019. The overweight rate increased by 3.12% compared with 2019. In 2020, the rate of overnutrition of girls increased by 6.10% compared to 2019. The rate of obesity increased by 3.26% compared to 2019. The rate of overweight increased by 2.84% compared to 2019. The increase in the rate of

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Table 3. Prevalence of undernourishment among students of different ages

Time	Age	n	Obesity	Overweight	Total
2019	6	7183	800 (11.14%)	932 (12.98%)	1732 (24.11%)
	7	6516	701 (10.76%)	767 (11.77%)	1468 (22.53%)
	8	6405	769 (12.01%)	737 (11.51%)	1506 (23.51%)
	9	4153	792 (19.07%)	868 (20.90%)	1660 (39.97%)
	10	4097	794 (19.38%)	969 (23.65%)	1763 (43.03%)
	11	4155	759 (18.27%)	1041 (23.05%)	1800 (43.32%)
2020	6	7401	1204 (16.27%)	1267 (17.12%)	2471 (33.39%)
	7	7426	1168 (15.73%)	1130 (15.22%)	2298 (30.95%)
	8	7369	1164 (15.80%)	1104 (14.98%)	2268 (30.78%)
	9	6715	1164 (17.33%)	1104 (16.44%)	2268 (33.78%)
	10	6551	1079 (16.47%)	1022 (15.60%)	2101 (32.07%)
	11	6512	1036 (15.91%)	1131 (17.37%)	2167 (33.28%)

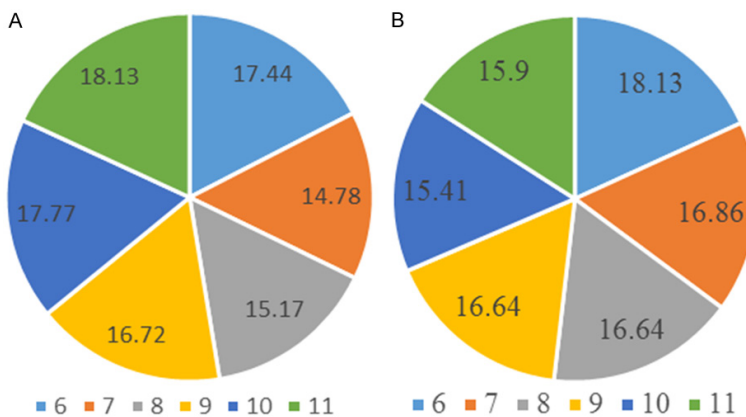


Figure 1. The nutrition surplus rate of children of different ages in Furong District of Changsha in 2019 and 2020 (Note: A: The nutrition surplus rate of children of different ages in 2019; B: The nutrition surplus rate of children of different ages in 2020).

excess nutrition between 2020 and 2019 was higher for boys than for girls.

Prevalence of overnutrition among children of different ages

As shown in **Table 3** and **Figure 1**, the obesity and overweight rates for children aged 6, 7, and 8 were higher in 2020 than in 2019, with increases of 9.28%, 8.42%, and 7.27%, respectively. The obesity and overweight rates of children aged 9, 10, and 11 in 2020 were lower than those in 2019, and decreased by 6.19%, 10.96%, and 10.04%, respectively. In 2019, the excess nutrition rate of children showed an increasing trend with the age. The excess nutrition rate of 11-year-old children was the high-

est. In 2020, the excess nutrition rate of children showed a downward trend with the age. The excess nutrition rate of 10-year-old children was the lowest.

Prevalence of undernourishment among students of different genders

As shown in **Table 4**, the rates of growth retardation (0.36%, 0.37%) for boys were higher than those for girls (0.27%, 0.24%). The rates of mild wasting (4.31%, 2.36%) were lower than those for girls (4.00%, 2.39%) in 2020 and 2019. The rates of moderate and severe wasting (4.06%, 1.98%) were higher than those for girls (2.75%, 1.47%). In 2020, the undernourishment rate for boys decreased by 4.02% compared to 2019 and the undernourishment rate of girls decreased by 2.91% compared to 2019. The growth retardation rate for boys increased by 0.01% compared to 2019 and the growth retardation rate for girls decreased by 0.03% compared to 2019. The mild wasting rate for boys decreased by 1.95% compared to 2019 and the mild wast-

ing rate for girls decreased by 1.61% as compared to 2019. The rate of moderate to severe emaciation decreased by 2.08% for boys and 1.28% for girls as compared to 2019.

Prevalence of undernutrition among students of different ages

As shown in **Table 5** and **Figure 2**, the malnutrition rates of children aged 6-11 decreased by 4.20%, 4.85%, 3.83%, 9.45%, 6.65%, and 6.45% in 2020 compared with that of 2019. In 2019, malnutrition rates were highest among children aged 7 and lowest among children aged 11. In 2020, malnutrition rates were the highest among children aged 8 and the lowest among children aged 11.

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Table 4. Prevalence of undernourishment among students of different genders

Time	n		Growth retardation		Mild wasting		Moderate and severe wasting		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2019	21000	18235	76 (0.36%)	56 (0.27%)	906 (4.31%)	839 (4.00%)	852 (4.06%)	577 (2.75%)	1834 (8.73%)	1472 (7.01%)
2020	22208	19440	82 (0.37%)	53 (0.24%)	525 (2.36%)	531 (2.39%)	439 (1.98%)	326 (1.47%)	1046 (4.71%)	910 (4.10%)
χ^2	0.327		0.277		1.279		1.029		1.981	
P	0.568		0.599		0.258		0.310		0.159	

Table 5. Prevalence of undernutrition among students of different ages

Time	Age	n	Growth retardation	Mild wasting	Moderate and severe wasting	Total
2019	6	7183	20 (0.28)	243 (3.38)	301 (4.19)	564 (7.85)
	7	6516	22 (0.34)	314 (4.82)	310 (4.76)	646 (9.91)
	8	6405	21 (0.33)	318 (4.96)	253 (3.95)	592 (9.24)
	9	4153	35 (0.84)	325 (7.83)	228 (5.49)	588 (14.16)
	10	4097	24 (0.59)	265 (6.47)	179 (4.37)	468 (11.42)
	11	4155	10 (0.24)	280 (6.74)	158 (3.80)	448 (10.78)
2020	6	7401	31 (0.42)	113 (1.53)	126 (1.70)	270 (3.65)
	7	7426	21 (0.28)	187 (2.52)	168 (2.26)	376 (5.06)
	8	7369	19 (0.26)	223 (3.03)	157 (2.13)	399 (5.41)
	9	6715	21 (0.31)	169 (2.52)	126 (1.88)	316 (4.71)
	10	6551	18 (0.27)	192 (2.93)	103 (1.57)	313 (4.78)
	11	6512	25 (0.38)	172 (2.64)	85 (1.31)	282 (4.33)

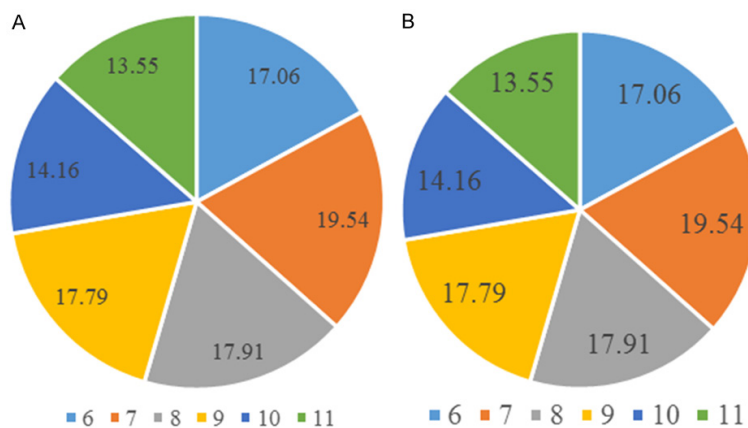


Figure 2. The undernutrition rate of children of different ages in Furong District of Changsha in 2019 and 2020 (Note: A: The undernutrition rate of children of different ages in 2019; B: The undernutrition rate of children of different ages in 2020).

Discussion

Nutritional status is a sensitive indicator of children's health. According to the results of the 2019 national survey on students' constitutions and health, although the malnutrition among students has continuously improved in the past 10 years, the rates of overweight and

obesity have increased [8, 9]. Many studies have pointed out that overweight and obesity in children and adolescents have an impact on obesity, diabetes, and cardiovascular diseases in adulthood [10, 11]. This study showed that the excess nutrition rate of primary school students in Furong District of Changsha City in 2020 was 32.73%, which was 7.42% higher than 25.31% in 2019. The malnutrition rate was 4.70% in 2020, which was 3.94% lower than 8.64% in 2019. The main reason may be the rapid economic development of Changsha, and the elevated quality of people's material life index [12, 13]. Since 2016, the regional government has actively invested a large amount of energy in diet health education, food safety, and dietary nutrition security, in accordance with the relevant requirements of the "Healthy China 2030 Planning Outline", to ensure the healthy diet of students [14, 15].

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According to the survey on undernourishment and overnutrition among students of different genders, the rates of obesity and overweight for boys were higher than those for girls in 2019 and 2020, which was like the related reports [16]. This may be because the physical development of primary school children is rapid, and the demand for a variety of nutrients is high, causing too much high-energy food intake. The survey found that compared with girls, boys preferred high-calorie foods such as carbonated drinks. Boys did not care about their body shape when compared with girls [17]. The results showed that the growth retardation rate and moderate to severe weight loss rate of boys were higher than those of girls, but the comparison was not statistically significant. This may be because of the excessive concentration of included samples. The government and schools need to pay more attention to children's malnutrition.

It is known that changes in height and weight due to age are related to the growth and development of children. This study investigated the undernourishment and overnutrition of children at different ages in 2019 and 2020. The results showed that the over-nutrition rate of children showed an increasing trend with age in 2019. The over-nutrition rate of children aged 11 was the highest. The malnutrition rate shows a downward trend among children of different ages, with the lowest among children of 11. In 2020, the rates of over-nutrition and under-nutrition showed a downward trend. This may be because of the expansion of interventions to prevent child malnutrition in the region in 2020. The study suggested that differences in children's nutritional status, growth, and development caused by age exist. In the work of child health care, targeted measures should be formulated according to the needs of children of different ages for nutrients.

The results of this study showed that the undernourishment rate in 2020 decreased by 3.94% compared with that in 2019. The malnutrition rate of children of different sex and age in 2020 decreased compared with that in 2019. The reason for this result is that in recent years, all schools in the Furong District have strengthened the publicity of recess meals and paid attention to nutritious meals, enhancing the students' nutrition [18]. The overnutrition rate

in 2020 increased by 7.42% compared with that in 2019, indicating that the problem of overnutrition for primary school children in 2020 was very prominent in our district. Based on several data surveys, the following measures were taken in the Furong District of Changsha City. Nutrition and health education is conducted for parents and students in a planned way so that they can establish the concept of reasonable diet to the maximum extent in life. Professional nutrition experts and doctors are arranged to carry out classroom explanations and other forms of education and publicity. This helps the parents and children understand the causes and harms of malnutrition and obesity, and receive the knowledge about reasonable nutrition and balanced diet, to establish scientific dietary hygiene habits [19]. Measures are taken to correct children's bad dietary behaviors, improve the quality of breakfast, and increase the intake of good protein of eggs, milk, and bean products [20]. The study pointed out that Chinese mothers' dietary quality scores had a significant impact on children's energy intake. The specific manifestations are as follows: The influence of mother's dietary pattern on children's nutrition intake increases gradually with the children's age, but multi-generation cohabitation has the opposite effect. Grains, vegetables, beans, and meat that the mother ate had a positive effect on children's nutrition intake. In the process of correcting children's dietary habits, the same attention should be paid to the intervention of their parents' dietary habits [21]. Schools continue to implement the recess meal, to strengthen the supply of nutritious meals, to ensure the nutrition supply of students.

Studies have shown that bad living habits, such as overeating, fast food intake, eating before bedtime, long video screen time, and short sleep at night, are risk factors for overweight and obesity of primary school students. Outdoor activities above medium intensity are protective factors for overweight and obesity of primary school students [22]. While strengthening nutrition, emphasis should be placed on health knowledge education and the cultivation of good eating habits and a healthy lifestyle of primary school children. Children's sports and outdoor activities should be increased to reduce the risk of excessive nutrition. Race, region, and climate affect children's nutritional status.

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When formulating and implementing various policies and measures, the climate and living habits of residents in Changsha should be considered.

In conclusion, compared with 2019, the rate of undernutrition decreased in 2020, but the rate of overnutrition increased significantly. Malnutrition exists among primary school children in the Furong District. It is necessary to strengthen the health care education to ensure the healthy growth of children. The deficiency of this study is that it only explored the differences of children's nutritional status in children with different gender, age, and different time. In the future, more data can be collected to analyze the related factors of malnutrition and explore the nutritional status of children and the distribution characteristics of various diseases. Dental caries and low vision are often the focus of children's health care in Changsha at this stage. The prevention and control of anemia and physical dysfunction cannot be ignored. In the future, further analysis of children's physical development and the distribution characteristics of various diseases are also needed. Disease management should be strengthened to ensure children's healthy growth.

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Disclosure of conflict of interest

None.

Address correspondence to: Yun Chen and Jinghui Yao, Department of Pediatric Orthopedics, Center for Orthopaedic Surgery, The Third Affiliated Hospital

of Southern Medical University, Guangzhou 510630, Guangdong, China. E-mail: chenyun19860909@outlook.com (YC); yaojinghui2004@163.com (JHY)

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