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Nutritional Status of Students in Poverty-Stricken Areas

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Abstract

Objective: In this study, we aim to understand the nutritional status of students in poverty-stricken areas of Inner Mongolia and their links with academic performance and to provide a scientific basis for the designated nutrition intervention and health education in students. **Methods:** In Zhalaiteqi County students' physical health survey data and learning achievement scores from 2012 to 2013 were selected as research data, and the nutritional status of the students was judged by statistical analysis of physical data. **Results:** The malnutrition rate was 22.21%, the overweight rate was 6.0%, and the obesity rate was 3.81% in 2012. The detection rate of the male normal group was 80.22%, and the detection rate of the female normal group was 75.63%. The difference was statistically significant ($\chi^2 = 27.036$ $P < 0.05$). **Conclusion:** The nutritional status of students in poverty-stricken areas in Inner Mongolia cannot be neglected. Weight loss and obesity have a negative impact on students' academic performance. Effective measures should be taken to control the present situation.

Keywords

Nutritional Status, Poor, Learning Achievement, Results Evaluation, Anemia

1. Introduction

The nutrition and health levels of students in rural areas, especially in poor

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areas, not only seriously affect the students' physical and mental health but also raise an important issue that our country's public health faces. For the implementation of the "Opinions of the General Office of the State Council on Implementing Nutritional Improvement Programs for Compulsory Education in Rural Areas" and nutrition improvement programs to 26 million rural compulsory education students in 699 poor counties in Mongolia, eight pilot counties in inner Mongolia participated in the "Plan" [1]. Zhaji is a key county in the monitoring and evaluation of the nutrition and health status of students. The purpose is to greatly improve the nutrition of compulsory education students. This study focuses on students who face prominent health problems in different stages for the formulation of corresponding preventive control measures and strategies. The data of constitutional investigation in Inner Mongolia from 2012 to 2013 were analyzed. The results are reported as follows.

2. Research Object and Method

2.1. Research Object

According to the 2012 National Student Physical and Health Survey Implementation Plan and the Rural Compulsory Education Students' Nutrition Improvement Plan, students' nutrition and health monitoring and evaluation of technical programs must use [2] cluster random sampling method that considers regional representation. Of the eight pilot counties that were selected for implementation, Zhalaiteqi County was regarded as the key monitoring county. Cluster sampling was conducted on the basis of stratification. That is, the survey schools were identified, stratified by grade, and finally clustered by class. The number of classes should meet the minimum number of research samples. A total of 1622 students from the first grade of primary school to junior middle school were included in the survey, of which 738 were male and 884 were female. Data, including the semestral final exam scores in Chinese, Math, and English; height; and weight of all students were collected. The hemoglobin of only 1426 students were tested on-site because of restrictive conditions. From these students, 1043 had undergone annual tests in 2012 and 383 had undergone annual tests in 2013. No significant difference in the composition of pupils was observed ($P > 0.05$). The selection criteria for students are students who have taken the final exam of the current year and have achieved correct results. These students are decently obtained the relevant data; The sample size was calculated according to the calculation formula of the cluster sampling. The calculation standard was 95% confidence, and the result was within 10% of the overall true rate. The minimum sample size required for this study was 1153 people.

$$N = \frac{Z_{1-\alpha/2}^2 (1-P)}{\varepsilon^2 P}$$

2.2. Method

The National Students Constitution and Health Investigation and Testing Rules

[3] require height and weight measurements. BMI (BMI, Body Mass Index) was calculated through the equation BMI = body weight (kg)/height^2 (m^2). A hemoglobin collection method using the cyanidation of the high-speed rail method was performed in advance. A unified approach to pass blind national standards and quality control assessment was also implemented. We collected the examination scores one by one according to class name to prevent missing data.

2.3. Judgment Criteria

Growth hysteresis evaluation criteria were based on the sex specific height growth retardation ranges of Chinese children aged 6 - 15 [4]. Light, moderate, and severe weight loss were evaluated according to sex specific BMI screening weight loss threshold ranges for Chinese children aged 6 - 15 [5]. Overweightness and obesity were screened by the age- and sex-specific BMI criteria recommended by the 2013 China Obesity Group [5]. The prevalence of anemia was calculated after removing the influencing factor of altitude and compared with reference values published by the WHO [6]. The specific classification criteria are shown in the table below [7].

Age	Male				female			
	Thin	Normal	Overweight	Obesity	Thin	Normal	Overweight	Obesity
6-	≤13.4	13.5 - 16.7	16.8 - 18.4	≥18.5	≤13.1	13.2 - 16.9	17.0 - 19.1	≥19.2
7-	≤13.9	14.0 - 17.3	17.4 - 19.1	≥19.2	≤13.4	13.5 - 17.1	17.2 - 18.8	≥18.9
8-	≤14.0	14.1 - 18.0	18.1 - 20.2	≥20.3	≤13.6	13.7 - 18.0	18.1 - 18.8	≥19.9
9-	≤14.1	14.4 - 18.8	18.9 - 21.3	≥21.4	≤13.8	13.9 - 18.9	19.0 - 20.9	≥21.0
10-	≤14.4	14.5 - 19.5	19.6 - 22.4	≥22.5	≤14.0	14.1 - 19.9	20.0 - 22.0	≥22.1
11-	≤14.9	15.0 - 20.2	20.3 - 23.5	≥23.6	≤14.3	14.4 - 21.0	21.1 - 23.2	≥23.3
12-	≤15.4	15.5 - 20.9	21.0 - 24.6	≥24.7	≤14.7	14.8 - 21.8	21.9 - 24.4	≥24.5
13-	≤15.9	16.0 - 21.8	21.9 - 25.6	≥25.7	≤15.3	15.4 - 22.5	22.6 - 25.5	≥25.6
14-	≤16.4	16.5 - 22.5	22.6 - 26.3	≥26.4	≤16.0	16.1 - 22.9	23.0 - 26.2	≥26.3
15-	≤16.9	17.0 - 23.0	23.1 - 26.8	≥26.9	≤16.6	16.7 - 23.3	23.4 - 26.8	≥26.9

2.4. Statistical Analysis

Collected data were entered twice and analyzed by SPSS 19.0. Statistical methods include descriptive statistics, the rank sum test, analysis of variance, and the χ^2 test, where test level $a = 0.05$ and $P < 0.05$ were used to determine statistical significance.

3. Results

3.1. Overall Nutritional Status

As can be seen from **Table 1**, of the 1622 students surveyed in the past two years, 1219 had normal nutritional status, with a detection rate of 77.79%, and 248 were malnourished, with a detection rate of 22.21%. The nutritional status of

Table 1. Distribution of nutritional status in different age groups.

Age	Subjects Number	Thin (%)	Normal (%)	Overweight (%)	Obesity (%)
7	186	38 (20.43)	126 (67.75)	11 (5.91)	11 (5.91)
8	243	18 (7.40)	203 (83.55)	13 (5.35)	9 (3.70)
9	225	12 (5.33)	194 (86.22)	13 (5.78)	6 (2.67)
10	207	8 (3.86)	177 (85.52)	14 (6.76)	8 (3.86)
11	237	41 (17.30)	142 (59.92)	20 (8.44)	34 (14.34)
12	169	3 (1.77)	153 (90.53)	9 (5.33)	4 (2.37)
13	132	34 (25.76)	58 (43.94)	3 (2.27)	37 (28.03)
14	103	8 (7.77)	86 (83.49)	8 (7.77)	1 (0.97)
15	120	4 (3.28)	108 (90.16)	7 (5.83)	1 (0.83)
total	1622	166 (10.24)	1247 (76.88)	98 (5.94)	111 (6.84)

( ) The middle number indicates the detection rate.

students according to age distribution showed that the malnutrition rates of students aged 7, 11, and 13 were high, accounting for 32.26%, 40.08%, and 56.07% of their age groups, respectively ($\chi^2 = 12.209$ $P < 0.05$). The occurrence of weight loss and obesity in 13-year-old students were significantly higher than those in other age groups. The wasting detection rate was 26.52% and the obesity detection rate was 28.03%, with no significant difference ($\chi^2 = 8.656$, $P > 0.05$). In adolescence, rapid growth and development occurs, and the demand for nutrients is large. Thus, student nutritional status has a direct impact on growth and development.

3.2. Comparison of Nutritional Status of Male and Female Students

Table 2 shows that in 2012 and 2013, no significant difference exists between the nutritional status of males and females regardless of age group. The difference was mainly concentrated in weight, and the rates of weight loss and obesity in female were higher than those in male. The rates were 11.70% > 5.28% and 10.25% > 3.38%, respectively, with statistical significance ($\chi^2 = 136$, $\chi^2 = 110$, $P < 0.05$). The detection rate of girls with growth retardation was significantly higher than that of girls in adolescence (4.47% > 2.89%). The detection rates of normal BMI was 80.22% for the male group and 75.63% for the female group. Therefore, the male body constitution was mostly better than that of the female group ($\chi^2 = 27.036$, $P < 0.05$).

3.3. Nutritional Status of Male and Female Students in Different Years

Table 3 and Table 4 show that the differences among the nutritional status of students in 2012 mainly fluctuated between the age of 11 and 13. The malnutrition rates were 75.81% and 69.39%, respectively, which were higher than normal. However, by 2013, the rates of malnutrition in these two groups were 23.81%

Table 2. Distribution of sex nutritional status.

Gender	Subjects Number	Thin (%)	Normal (%)	Overweight (%)	Obesity (%)
male	738	74 (10.03)	592 (80.21)	47 (6.37)	25 (3.39)
female	884	121 (13.69)	627 (70.93)	51 (5.77)	85 (9.62)
total	1622	195 (12.02)	1219 (75.15)	98 (6.04)	110 (6.78)

( ) The middle number indicates the detection rate. Note: Comparison of nutritional status of male and female students, $\chi^2 = 27.036$, $P < 0.05$.

Table 3. 2012 nutritional status of students in the distribution.

Age	Subjects Number	Thin (%)	Normal (%)	Overweight (%)	Obesity (%)
7	81	2 (2.47)	63 (77.78)	7 (8.64)	9 (11.11)
8	30	1 (3.33)	24 (80.01)	4 (13.33)	1 (3.33)
9	70	4 (5.72)	61 (87.14)	2 (2.86)	3 (4.28)
10	62	6 (9.68)	48 (77.42)	4 (6.45)	4 (6.45)
11	88	26 (29.55)	30 (34.09)	5 (5.68)	27 (30.68)
12	66	5 (7.58)	57 (86.36)	2 (3.03)	2 (3.03)
13	98	31 (31.63)	30 (30.61)	1 (1.02)	36 (36.73)
14	70	7 (10.00)	54 (77.14)	8 (11.43)	1 (1.43)
15	24	0 (0.00)	22 (91.67)	2 (8.33)	0 (0.00)
total	589	82 (13.93)	389 (66.04)	35 (5.94)	83 (14.09)

( ) The middle number indicates the detection rate.

Table 4. 2013 distribution of nutritional status across different age groups.

Age	Subjects Number	Thin (%)	Normal (%)	Overweight (%)	Obesity (%)
7	105	36 (34.29)	63 (60.00)	4 (3.80)	2 (1.91)
8	214	15 (7.01)	179 (83.64)	11 (5.14)	9 (4.21)
9	181	9 (4.97)	158 (87.29)	11 (6.08)	3 (1.66)
10	157	13 (8.28)	129 (82.17)	11 (7.01)	4 (2.54)
11	147	13 (8.84)	112 (76.19)	15 (10.21)	7 (4.76)
12	117	11 (9.40)	96 (82.05)	8 (6.84)	2 (1.71)
13	40	9 (22.50)	28 (70.00)	2 (5.00)	1 (2.50)
14	35	3 (8.57)	32 (91.43)	0 (0.00)	0 (0.00)
15	37	2 (5.41)	33 (89.18)	2 (5.41)	0 (0.00)
total	1033	111 (10.75)	830 (80.35)	64 (6.20)	28 (2.70)

( ) The middle number indicates the detection rate.

and 30.00% respectively, and the nutritional status improved ($\chi^2 = 4.972$ $P < 0.05$). In 2013, the detection rate of normal people in all age groups of 7 - 15 years old was average, indicating that the students' nutritional status were improved. Table 5 was obtained by comparing the student hemoglobin test results

Table 5. Hemoglobin distribution of students in 2012 and 2013.

Year	Subjects Number	hemoglobin grouping		total
		anemia	normal	
2012	589	46 (7.8)	543 (92.2)	589
2013	1033	65 (6.3)	968 (93.7)	1033
Total	1622	111 (6.84)	1320 (92.57)	1622

( ) The middle number indicates the detection rate.

obtained in 2012 and 2013. The student anemia detection rate was 7.8% in 2012 and 6.3% in 2013, 1.5% lower than the previous year and statistically significant ($\chi^2 = 6.000$ $P < 0.05$). This result proves again that the nutritional status of students improved.

3.4. Relationship between Student's Nutritional Status and Academic Performance

The data was inputted in SPSS19.0. Calculating for the Spearman correlation coefficient, rs = 0.187 when $P < 0.01$ is statistically significant, and rs = 0.187 > 0 indicates that the variables are positively correlated. Hence, as students' BMI increases, their academic performance improves. In addition, an analysis of variance was made between student BMI and academic performance. The results showed that F = 18.420 when $P < 0.01$, indicating that the difference was statistically significant and that a relationship exists between BMI and academic performance. The average BMI of students with failing, average, and excellent academic performances were 16.489357, 17.221001, and 17.632167, respectively. From these three sets of data, the BMIs of students with medium and outstanding academic performances were in the normal range, while the BMIs of students with failing performances were in the malnourished range. Considering our results and previous results, we surmised that the better the nutritional status of students in poor areas are, the better their academic performance is.

4. Discussion

In summary, children and adolescents in puberty have special nutritional requirements. Given that this stage is a period of strong growth and development of the human body, naturally, reasonable nutrition or absence of the need for additional nutritional supplements is needed for the majority of young people to have healthy and strong bodies. Adequate nutrients can promote adolescent growth and development, brain function, and mental development. The data used in this research is from 2012 to 2013. The data is relatively old and has certain limitations, but the results are authentic and reliable. You can compare them with the latest data to get the comparative results and verify the poor areas nowadays whether the nutritional status of the students has improved.

The monitoring results show that the detection rate of malnutrition among students in impoverished areas in Inner Mongolia was 22.21% higher than that

of students in Hohhot in 2009 [8], which was lower than that of primary and secondary school students in rural areas of Jiangxi Province in 2012 [9]. The undernourishment of students includes both weight loss and overweight. The results are inconsistent with the 2010 National Student Health Survey [10], which indicates that students in poor areas of Inner Mongolia have a prominent malnutrition. The possible causes of malnutrition include unreasonable diet, poor diet, lack of sufficient nutrients for growth and development, living conditions, living environment, nutritional level, and huge differences from conditions in developed regions. Malnutrition can have many effects on students, including inattention, weight loss, anemia, and indigestion [11] [12], which affects their learning. In the long run, malnutrition will not only seriously affect human growth and intellectual development, but also affect mental health. In 2012 and 2013 data from poor areas in Inner Mongolia, the detection of malnutrition in girls is mainly based on student weight loss and overweight, which were inconsistent with the 2010 National Student Physical Health Survey [10], which indicated that malnutrition among students in the poor areas of Inner Mongolia is prominent. Possible reasons that contribute to malnutrition include unreasonable diet, poor diet, absence of adequate nutrients for growth and development, living conditions, living environment, nutrition level, and large difference from the conditions of developed areas. Malnutrition can have many effects on students, including lack of concentration, weight loss, anemia, and indigestion [11] [12] and thus affects their learning. In the long run, malnutrition not only has serious consequences on body growth and mental development but also affects mental health. In the data from poverty-stricken areas in Inner Mongolia in 2012 and 2013, the detection rate of malnutrition among girls is higher than that of boys, and this result is consistent with those of domestic research [13] [14], although the difference is nonsignificant. Moreover, the growth retardation detection rate of Inner Mongolia students in poor areas is lower than that of Guangzhou students [15], and the detection rates of overweightness and obesity of Inner Mongolia students in poor areas are lower than that reported by the 2010 National Student Physique and Health Survey [10]. In the hemoglobin data in 2013, the total anemia among students in poor areas in Inner Mongolia was 6.3%, lower than the prevalence of total anemia in rural students in Leye County of Guangxi Province (9.43%) [16] but higher than that of 10- and 11-year-old students from Shanghai (2.7%) [17]. Anemia may be attributed to insufficient intake nutrients for body growth and development. As students gradually progress into adolescence, rapid growth and learning pressure occur. Some family conditions are not good, and thus students tend to stop paying attention to breakfast. Adolescent girls also experience menstrual cramps and blood loss. However, with the implementation of the Nutrition Improvement Program for Rural Compulsory Education Students in 2011, the detection rate of overweightness and obesity in rural areas approach that of the national level, suggesting that the nutritional status of rural and even impoverished students does not fully represent the entire nutritional status of students. Many students still

weight loss. Therefore, we will continue to implement the Nutrition Improvement Program for Rural Compulsory Education and adopt effective intervention strategies and measures as early as possible to control a small number of students. Obesity and improvement of weight loss and mitigating stunting will be the focus of future work. In view of the nutritional status of students in impoverished areas in Inner Mongolia, we propose the following suggestions: 1) Continue to implement the student nutrition improvement plan and increase funding to supervise the daily meals of students. Appropriate foods should be added to their meals, such as certain fish, shrimp, vegetables, and dark fruit supply. Animal liver and nuts intake once a week should be ensured. Continue as well to provide students with milk, both for nutrition and to improve the quality of students' meals. 2) The local government should enhance education and publicity so that every parent understands the current importance of nutrition and actively cooperates with the school to provide students with food security at home and a good eating environment. The government should also combine local conditions, expand the beneficiary population and coverage, expand the focus of monitoring, and provide a more comprehensive and feasible basis for the next step of the plan. Relevant departments should expedite the nutrition legislation process and implement the student nutrition meal plan as an urgent task.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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