Original Article

Undernutrition status of children under 5 years in Chinese rural areas - data from the National Rural Children Growth Standard Survey, 2006

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Purpose: To assess the nutritional status among rural children under five years in China relative to WHO Child Growth Standards 2006, and to explore risk factors for undernutrition. Design: Cross-sectional study of rural areas in 10 provinces of China. A total of 84,009 children under five recruited through multi-level sampling. Main findings: A total of 17.92% of children have at least one form of undernutrition. The prevalence of stunting, underweight and wasting, were 14.59%, 7.19% and 3.07%, respectively. The corresponding mean z-score in height-for-age, weight-for-age, and weight-for-height were -0.732, -0.410 and -0.001. An upward trend with age in stunting and underweight was observed, and higher risks noticed among older children in contrast with children under 6 months in terms of stunning and underweight. The inter-provincial variation of undernutrition remains very large. Low birth weight, multi parity, preterm birth, multiple birth, maternal illiteracy, low provincial GDP, and low household income are identified as significant factors associated with stunting. Parity shows no corresponding significant relationship with underweight, and wasting was not found to be associated with either preterm or multiple births. Conclusion: The nutritional status among children under five in rural areas of China, although greatly improved in the past decades, still lags behind the WHO Child Growth Standards. Stunting and underweight occur mostly before two years of age. Intervention strategies and programs should be developed to target the preventable risk factors.

Key Words: undernutrition, children under five years, China, rural area, WHO Child Growth Standard

INTRODUCTION

Undernutrition in children is a significant concern in many developing countries. It is commonly reported using three related but different indicators based on anthropometric measures: stunting, underweight and wasting.[1] It has been widely shown that child malnutrition status affects personal performance, health and survival, eg, physical growth, morbidity, mortality and cognitive development.[2] There are also potential adverse effects on the society and the future generations.[3-5] Children under five years, as a group, are considered among the most vulnerable.[6]

China has experienced a tremendous improvement in nutritional status since the reform started in 1978. According to the national nutrition surveys, underweight and stunting in children under five declined by about half between 1990 and 2000, from 19.1% to 11.2% for underweight and from 33.4% to 16.1% for stunting.[7] This indicates that China had achieved its Millennium Development Goal (MDG) by 2002.[8] A downward trend has been reported among children, ie, the prevalence of underweight and stunting among children under five years national wide lowered by 24.4% and 30.8% respectively, from 2002 to 2006.[9] However, the changes in economic and health-related factors did not take place in a uniform manner across the nation.

In some rural areas, poverty, environmental and other major problems still exist.[10] These might well have adverse impacts on household food security; as well as source, availability and quality of health care, important underlying determinants of undernutrition.[11] Accordingly, the wide-spread variation in contributing factors may be associated with regional variation in terms of children's nutritional status. For example, only 0.25% of children under six were observed as being undernourished in Beijing in 2007;[12] whereas the prevalence of stunting was

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21.2% in some rural areas of Yunnan province during the same period.[13]

Few representative data at a national level concerning the current undernutrition status among children under five in rural China, with reference to the WHO Child Growth Standards (WHO-CGS) are available.[14] Using data from the National Rural Children Growth Standard Survey in China conducted in 2006 (mainly for updating the previous National Children Growth Standard established two decades ago), we evaluated the nutritional status among children under five, based on their height, weight, age and gender.

MATERIALS AND METHODS

Subjects and sampling procedure

Children who lived with an agricultural-registered parent in rural areas for a duration of at least two thirds of their age, were identified as rural children and eligible for this survey. A total of 84,009 rural children under 5 years from 10 Chinese provinces were enrolled into the latest National Children Growth Standard Survey (NCGSS) in 2006. To maintain consistency and comparability, the 2006 NCGSS was conducted in the same ten provinces as in 1985 (ie, in Jilin, Shanxi, Gansu, Xinjiang, Jiangsu, Sichuan, Jiangxi, Hunan, Guangxi and Guizhou) with only minor adjustments to some of the counties. First, ten provinces were selected from a total of 31 provinces in mainland China. Thereafter, four counties from each province were sampled except for Jilin province which has five counties recruited to achieve the sample size requirement for each province. A total of 41 counties were recruited. This was followed by 3-6 towns/villages, depending on their population size, to be selected from each county.

In three of the ten provinces, ie, Xinjiang, Guangxi and Guizhou, the proportion of the non-Han ethnic group living there is markedly higher than other areas of China; up to 40-60%. In the present dataset, 55% of the children in these provinces were of non-Han ethnicity, hence, they were slightly over-sampled relative to expectations. Nevertheless, because the provincial samples were drawn in proportion to the eligible population, and because ethnicity is controlled in the central analyses, this minor difference should not have a significant impact on the conclusions concerning the prevalence of undernutrition.

Survey

The survey was conducted from June to October, 2006. Socio-demographic and birth data were collected from a parental survey, including ethnicity, child gender, parental education and occupation, household income, and gestational age. Provincial variables included economic status and geographic location. The officially-reported yearly provincial gross domestic product (GDP, hundred billion RMB Yuan/per year) in 2005 was adopted as the indicator for provincial economic status. The 10 provinces were divided into Southern and Northern areas according to a customary definition based on geographical location: 6 Southern provinces (Jiangsu, Sichuan, Jiangxi, Hunan, Guangxi and Guizhou) and 4 Northern provinces (Jilin, Shanxi, Xinjiang and Gansu).

Anthropometric measurements

The anthropometric measurements of children were collected at the same occasion, including weight and height/length, taken by centrally-trained staff using the same calibrated instruments. Measurements were taken 1 hour after a meal, with subjects wearing light indoor clothing and for infants, with diapers removed. Body weight (kg) for newborns was measured to the nearest 10 grams with a newborn weigh in scale (EBS-20). After 1 month of age, children were measured to the nearest 50 grams with level-type platform scales (RGT-50). Height/length (cm) was measured to the nearest 0.1 centimeter with a standard infantometer for children less than 2 years, and height was measured for the older children (SZG-180).

Statistics

Descriptive data were presented including frequencies, percentages, means, and standard deviations. The differences in the prevalence between genders were tested using χ^2 tests.

Age in months was calculated as age in days divided by 30.42. Nineteen age groups were adopted when presenting the anthropometry measurements results of weight and length/height, which were defined with different age intervals for some analyses. The older the ages, the wider the age intervals. Six age groups were used for prevalence of undernutrition and risk factor analyses.

Weight-for-age (WFA), height/length-for-age (HFA) and weight-for-height/length (WFH) were evaluated relative to the WHO Child Growth Standards 2006.[14] Corresponding Z-scores were calculated for WFA (WAZ), HFA (HAZ), and WFH (WHZ) by using the SAS macro provided for the assessment of growth and development of children.[15]

According to WHO recommendations, stunting is defined as HAZ <-2, underweight as WAZ <-2 and wasting as WHZ<-2.[16] The indices HAZ and WHZ reflect chronic and acute undernutrition, respectively. The WAZ index is less specific and combines both chronic and acute undernutrition,[17] but it was included because of its common use in the literature. General linear mixed models (Glimmix) were adopted to explore multi-level risk factors of the three undernutrition indicators, with province as a random variable and the province nested within geographical location. The individual-level factors included in the final models were those considered theoretically important, such as household economic situation, premature birth, parental age and educational level, etc. Parental age was computed by averaging the maternal and paternal ages. Given the highly correlated parental educational levels and the importance of maternal role in early childhood, educational status of the mother was used in the final models. Statistical significance was determined at α=0.05 for two sided tests. All data were analyzed using SAS v9.1.[18]

There are small amounts of missing data for some variables so the actual numbers reported for each variable may slightly vary.

RESULTS

Table 1 presents descriptive characteristics of the children and parents. The children are approximately equally divided by gender. More than 80% of children were of Han

Table 1. Descriptive characteristics of socio-demographic and birth variables of children

Characteristics		Number	%
Gender (n=84009)	Boys	42746	50.9
	Girls	41263	49.1
Ethnicity (n=83995)	Han	68788	81.9
	Non-Han	15207	18.1
Age (months, n=84009)	0-5	16615	19.8
	6-11	12790	15.2
	12-23	21106	25.1
	24-35	11957	14.2
	36-47	11287	13.4
	48-60	10254	12.2
Low birth weight† (n=74950)		1709	2.3
Preterm ‡(n=83974)		1444	1.8
Multiple birth (n=83975)		698	0.8
Birth parity (n=83994)	1	53853	64.1
	2	26801	31.9
	≥3	3340	4.0
Paternal education (n=83932)	College	2137	2.6
	High school	9683	11.5
	Middle school	55505	66.1
	Elementary or less	16607	19.8
Maternal education (n=83888)	College	1411	1.7
	High school	6222	7.4
	Middle school	53822	64.2
	Elementary or less	22433	26.7
Paternal age (mean±SD, years)		83910	30.3±5.0
Maternal age (mean±SD, years)		83846	28.0±4.8

†Low birth weight: birth weight less than 2500 grams; ‡ preterm: gestational age less than 37 weeks

Table2. Gender- and age-specific means of weight and height (length): children under 5 years from 10 provinces, China (n=83707†)

Age groups‡ (month)	Boys						Girls					
	Weight (kg)			Height/length (cm)			Weight (kg)			Height/length (cm)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
0~	1413	3.26	0.41	1413	49.9	1.92	1348	3.16	0.41	1348	49.4	1.89
1~	1354	4.95	0.81	1354	55.8	2.82	1301	4.68	0.84	1301	54.8	3.06
2~	1381	6.00	0.90	1381	59.4	2.98	1354	5.64	0.82	1354	58.4	2.89
3~	1357	6.83	0.96	1357	62.1	2.73	1315	6.29	0.88	1315	60.7	2.76
4~	1363	7.41	1.01	1363	64.2	2.87	1367	6.90	0.95	1367	62.9	2.78
5~	1366	7.85	1.03	1366	66.1	2.89	1394	7.29	1.02	1394	64. 6	2.76
6~	2158	8.26	1.11	2158	67.9	2.90	2070	7.67	1.09	2070	66. 5	2.79
8~	2248	8.78	1.16	2248	70.6	3.11	2138	8.21	1.15	2138	69.2	3.22
10~	2107	9.18	1.17	2107	72.9	3.07	2069	8.57	1.20	2069	71.4	3.09
12~	2606	9.70	1.22	2606	75.5	3.19	2566	9.08	1.25	2566	74.2	3.48
15~	2672	10.21	1.36	2672	78.3	3.37	2616	9.66	1.33	2616	77.0	3.43
18~	2686	10.74	1.38	2686	80.9	3.68	2612	10.23	1.42	2612	79.8	3.71
21~	2724	11.24	1.43	2724	83.2	3.80	2624	10.73	1.38	2624	82.1	3.80
24~	3039	11.97	1.54	3039	86.5	4.33	2829	11.39	1.45	2829	85.4	4.32
30~	3154	12.80	1.60	3154	90.2	4.37	2935	12.25	1.57	2935	89.1	4.44
36~	2824	13.82	1.82	2824	94.2	4.88	2665	13.16	1.68	2665	92.8	4.62
42~	2952	14.58	1.87	2952	97.4	4.91	2846	13.98	1.80	2846	96.3	5.04
48~	2735	15.43	1.96	2735	100.9	4.97	2695	14.90	1.87	2695	99.9	4.86
54~60	2456	16.15	2.10	2456	103.7	4.96	2368	15.57	2.04	2368	102.7	5.06

†There were 302 children aged from 4 days -< 1 month subtracted from the total number 84009.
‡ Age groups: 0~ referring to infants from birth to 3 days; 1~ referring to children older than 30.4 days but under 60.8 days. The remaining age groups may be deduced by analogy.

ethnicity. Only 2.3% and 1.8% of subjects were reported to have low birth weights or were preterm at birth, respectively. The high proportion of first-born children (64.1%) is as expected for children of this age in rural China. The majority of parents received no more than middle school education (fathers, 85.9%; mothers, 90.9%).

Table 2 shows the gender- and age-specific means of body weight and height/length. The gender and age patterns follow those expected for samples of children at these ages. The mean birth weight and length were 3.26 kg and 49.9 cm for boys and 3.16 kg and 49.4cm for girls. At 1 year of age, mean weights of girls and boys were 1.7

and 1.9 times greater than those at birth respectively, and boys and girls had mean lengths of 25.6 cm and 24.8 cm greater compared with their new-born counterparts.

Figure 1 illustrates the patterns of mean HAZ, WAZ and WHZ relative to 2006 WHO-CGS, by age and gender.[14] The mean WAZ and WHZ in both genders increased sharply within the first four months and then decreased with age. Mean HAZ started its rapid downward trend shortly after birth and then ramained fairly stable after 2 years, with small fluctuations around -1 z relative to the the growth standard. The girls demonstrated higher mean WAZ and HAZ compared to boys until approximately 30-36 months of age, with a reversing pattern thereafter. Overall means of z-score of HFA, WFA and WFH with all ages pooled were -0.732 (boys -0.779; girls -0.678, p<0.001); -0.410 (boys -0.420; girls -0.396, p=0.001); and 0.001 (boys 0.018; girls -0.016, p<0.001), respectively.

Considering both genders, 17.92% had at least one form of undernutrition, with 19.39% for boys and 16.38% for girls. The overall prevalence of stunting, underweight, and wasting were 14.6% (boys 15. 9%; girls 13.3%, p<0.001); 7.19% (boys 7.6%; girls 6.8%, p<0.001); and 3.1% (boys 3.4%; girls 2.7%, p<0.001), respectively. Among those who were experiencing undernutrition, 65.2% occurred as single form of undernutrition, while the 34.8% experienced more than one designation of undernutrition.

Figure 2 presents the patterns of the prevalence of stunting, underweight and wasting in both genders. The age patterns in terms of the prevalence in stunting and underweight were qualitatively similar, although consistently higher for stunting. In girls, stunting prevalence progressively increased after birth, reaching a peak at the age group of 36-47 months (20.4%), and then decreased thereafter; whereas, the boys experienced a slower reduction in stunting prevalence after the peak at age two years (19.4%). The prevalence of wasting was comparatively low and stable across the age groups (<5%) and was similar between genders.

Figure 3 illustrates the prevalence of stunting and the rank order of prevalences across the ten provinces sampled, ranging from 4.2% in Jiangsu to 38.3% in Guizhou province. Guizhou and Guangxi, the two provinces located in southwest China, had the highest prevalence of stunting among the 10 provinces. The eastern coastal province of Jiangsu had a prevalence of stunting less than 5%. Provincial prevalences varied from 1.1% to 17.9% for underweight, and from 1.1% to 5.8% for wasting, with a slight shuffle of ranking order compared with that of stunting, ie, with provinces Xinjiang, Jiangxi and Sichuan shifting their ranking position between 3rd and 5th.

Table 3 presents the predictors of stunting and under

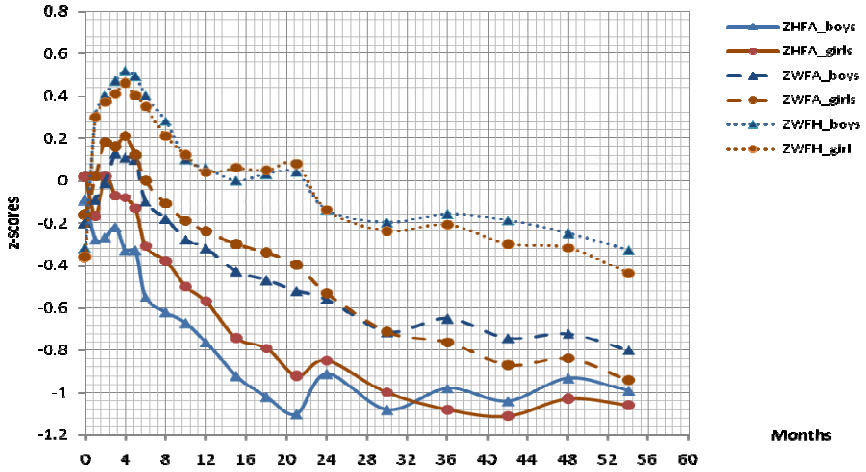

Figure 1. Z-scores of WFA, HFA and WFH for Childre. ZHFA refers to z score of height/length-for-age, ZWFA refers to z score of weight-for-age, and ZWFH refers to s score of weight-for-height/length.

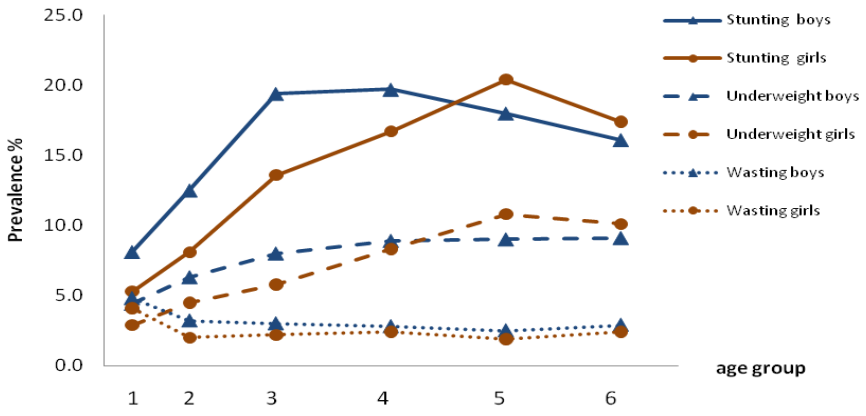

Figure 2. Prevalences of underweight, stunting and wasting among children, relative to 2006 WHO Child Growth Standards, by gender and age group: Children under 5 years of age from 10 provinces, China (n=84009). †Age group categories from 1 to 6 are referring to 6

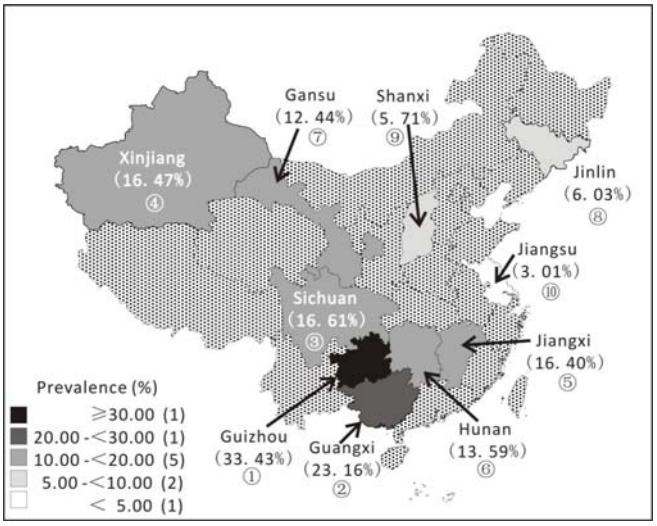

Figure 3. Prevalence of stunting among children under 5 Years in ten rural provinces rural

Table 3. Adjusted individual- and provincial-level risk factors for stunting, underweight and wasting

Variables		Stunting		Underweight		Wasting	
		AOR†	95% CIs	AOR†	95% CIs	AOR†	95% CIs
Individual level							
Gender	1-boys, 0-girls (ref),	1.24	(1.18, 1.30)	1.14	(1.07, 1.21)	1.30	(1.19, 1.42)
Age (month)	48-60	2.43	(2.21, 2.67)	2.74	(2.42, 3.10)	0.60	(0.51, 0.70)
	36-47	2.96	(2.71, 3.24)	2.87	(2.55, 3.23)	0.54	(0.47, 0.63)
	24-35	2.73	(2.50, 2.98)	2.38	(2.11, 2.68)	0.59	(0.52, 0.67)
	12-23	2.61	(2.41, 2.82)	1.88	(1.69, 2.10)	0.53	(0.47, 0.60)
	6-11	1.51	(1.38, 1.66)	1.45	(1.28, 1.64)	0.52	(0.45, 0.60)
	ref: 0-5		1.00		1.00		1.00
Parity	1	1.38	(1.23, 1.55)	-	-	-	-
	2	1.26	(1.13, 1.40)	-	-	-	-
	ref: ≥3		1.00	-	-	-	-
Maternal education	College	0.53	(0.42, 0.68)	0.31	(0.20, 0.48)	0.67	(0.44, 1.02)
	High school	0.53	(0.47, 0.59)	0.53	(0.45, 0.62)	0.63	(0.51, 0.78)
	Middle school	0.68	(0.64, 0.72)	0.70	(0.66, 0.76)	0.86	(0.77, 0.95)
	ref: Elementary school or less		1.00		1.00		1.00
Household income (RMB/yr)		0.81	(0.78, 0.84)	0.78	(0.73, 0.83)	0.85	(0.79, 0.92)
Provincial level							
GDP (10 billion/yr)		0.99	(0.99, 0.99)	0.99	(0.98, 0.99)	0.99	(0.99, 1.00)
Geographical location	1-South, 0-North (ref)	3.46	(2.48, 4.83)	4.29	(2.79, 6.58)	1.51	(1.05, 2.45)

†AOR: adjusted odd ratio; Parental age, ethnicity, multiple birth, low birth weight and preterm status were adjusted.

weight at both individual and provincial levels. At the individual level, boys have a higher prevalence than girls for stunting, underweight, and wasting, with adjusted odds ratios ranging from 1.1 for underweight to 1.3 for wasting. The second six months of life are associated with increases in undernutrition relative to the first six months and even greater increases are seen thereafter. Low birth weight is associated with substantially increased prevalence of malnutrition, although parity is only significantly associated with stunting. Preterm birth and multiple births are associated with stunting and underweight but not wasting. Maternal education and household income are associated with all three forms of undernutrition.

Maternal education status was used as an individual level predictor and provincial illiteracy rates were highly related to economic status, so only two potential provincial indicators, provincial GDP and geographic location were included in the models of undernutrition. Both of these provincial-level variables retained in the final model for stunting, underweight and wasting, with the southern provinces demonstrating substantially increased risk for malnutrition compared with the Northern provinces.

DISCUSSION

Greatly improved malnutrition status in Chinese populations residing in rural areas was demonstrated by comparing these survey results with data on rural children from the 1980's and 1990's. The overall prevalence decreased by 7.4% and 5.4% for stunting and underweight, respectively, compared with those in 1998.[19] The time-related improvement was even greater (approximately 26% and 18%) when compared with levels in the late 1980's.[20] According to WHO guidelines,[21] these time-related

changes indicate that the severity of malnutrition in China's rural areas has moved from the category "serious" in the 1980's up to the grade of "poor" in the 1990's, and the recent level that would be considered as "acceptable". The temporal decreases in the prevalence of stunting and underweight are reflected in the increase of mean z-score for height-for-age and weight-for-age, with approximately 1 z-score unit increment in HAZ and 0.8 unit increments in WAZ.

Compared with the only study to have reported relative to new WHO-CGS and focused on a poor area in China (n=8041) during the same period,[22] the prevalence of stunting from our study are lower. For example, the overall prevalence in our study was 14.6% compared with 30.2%, and that of underweight were 7.2% and 10.2%, respectively. Whereas, the results of the two studies were very similar in terms of wasting prevalence (3.1% vs. 2.9).[22] The discrepancy between these two studies may primarily be due to the different study areas. Wang's study was focusing on mid-western provinces of China which are defined as the poorest area in China. Whereas the present study, covering ten provinces across China, would be more representative for the nation-wide undernutrition status among rural children. Although nutritional status has been improving dramatically over time in rural China, according to mean WAZ (-0.73) and HAZ (-0.41), growth of Chinese rural children under five years is still lagging behind the WHO standards. In contrast with their urban counterparts, rural children from another study have 3-5 times higher prevalences in stunting and underweight,[23] while the heights of Chinese urban children have recently been reported to have reached or even surpassed the WHO-CGS.[24]

It is estimated that 20 million babies are born each year in China and 70% of them live in rural areas. Consequently, an estimated 10 million children would become stunted every 5 years, if the present pattern of nutritional status is not reversed (14.6% for stunting). A study involving Hong Kong Chinese children indicated that the lag-behind in growth could also possibly be due to epigenetic constraints on growth .[25]According to the criterion by van Buuren,[26] ie, $\pm$0.5 SDs as 'thresholds' for deviation from the WHO-CGS in a specific population, Chinese children living in poor rural area, are on or cross the border of the definition for the deviation from the WHO standards. Nevertheless, for Chinese children living in rural area, this new WHO-CGS may encourage actions to optimize their growth.

Provincial variation in nutritional status remains great, ranging from 3.01% stunted in Jiangsu to 33.43% in Guizhou. The latter, located in Southwest China and one of the poorest areas in China, had a prevalence of 65% in stunting in 1989.[20] The stunting prevalence in Guizhou was almost halved within 16 years. However, undernutrition remains as a significant health problem and continues to be classified as "serious" in severity. This could have resulted from the great diversity in economic status provincially. Geographical location could also contribute to the variation of undernutrition, as indicated by the regression models. Children living in the Northern China are far less likely to be stunted or underweight (adjusted OR: 0.283 and 0.233, respectively). This growth advantage has been observed previously for older children.[27] These differences may be associated with the food varieties, feeding practices, climatic environment, illumination duration, and so on, although unmeasured or poorly measured socioeconomic or health related factors may also contribute. A marked age pattern of stunting and underweight among children under five years is demonstrated in this study, both in z-score and in prevalences; suggesting advantageous nutritional status in the first 4 months with worsening in nutritional status thereafter. It is consistent with the result from the regression models, which indicated the older children bore a significantly greater risk of stunting and underweight compared to infants 0-5 months. This may be associated with breastfeeding at the early ages and inappropriate complementary feeding practices afterward. Even though this survey is cross-sectional, it could be reasonably inferred that the children's malnutrition problems including stunting and underweight, are most likely to occur in the first two years of life, and very likely to remain as an ill-health issue at least in the following three years. It has been observed elsewhere that inadequate food intake in the first two years of life was primarily responsible for growth stunting.[28]

As shown in the final models, both macroeconomic environment and household income were significantly related to undernutrition status. With the current economic development in China, most rural areas have the capacity to improve infant and child feeding.[29] However, rising prices for protein-containing foods, lack of sufficient knowledge, and misconceptions about early child feeding could still lead to undernutrition among children.[28] A gender difference in nutritional status was observed in this survey, with statistically higher prevalences in all three forms of undernutrition and in the corresponding lower mean Z-scores compared with their female counterparts found in boys. This is consistent with Wang's results.[22] It may be due, at least partially, to increased bio-vulnerability of the male gender. The prevalence of stunting was also observed to be marginally related to parity, ie, the lower the parity, the smaller the risk of stunting (eg, first/second vs third or greater in stunting, OR=0.724 and 0.795, respectively), although the point estimates were within the 95% CI of each other. Previous studies have also found a parity effect.[21] Food quality and availability, narrow birth interval, and poor maternal health care associated with parity could be related to poorer maternal nutrition status prior to or during pregnancy. Lower maternal educational level also showed an adverse impact on their offspring's nutrition status. Understanding of the related predictors provides direction for future intervention.

Interestingly, in this study, some different characteristics of wasting were noticed in contrast with stunting and underweight, ie, comparatively higher z-score, lower prevalence, high consistency over decades and across the population, different response with age in regression models (opposite to stunting and underweight, regression model of wasting showed that the risk was almost halved after 6 months). We speculate that those children who encounter wasting might have their own growth particularities which might be due to some different metabolism

mechanism, rather than merely relate to acute undernourished.

Limitations may exist in the presented data although our survey followed the well developed sampling strategies and data collection methods. Han and non-Han children were pooled together to evaluate the whole picture of the undernutrition, with the latter slightly over-sampled. It is unlikely that the ordinal patterns of undernutrition prevalence by province or region would be affected by such over-sampling. Furthermore, because ethnicity was adjusted in the regression models those determinants of undernutrition will be unaffected by any over-sampling.

The prevalence of low birth weight and preterm birth are comparatively lower than those found in other reports.[30] These differences might be due to parent reporting methods. More detailed information regarding actual feeding practices and food intakes was not available in this study due to the initial purpose of the survey. Consequently, while additional nutritional factors may be important, few conclusions can be made. Most of previous Chinese studies referenced in this paper's estimated prevalences for stunting, underweight and wasting using the NCHS reference.[7,9,20] Using the NCHS reference cut-offs may enlarge the prevalence gap in stunting but narrow that of underweight.[3] Even with this difference in reference data used, the main conclusions regarding historical trends are sound.

Conclusion

The nutritional status among rural children under 5 years of age in China has been greatly improved in the last decades. However it is still, on average, lagging behind the WHO Child Growth Standards. Stunting and underweight are the main undernutrition related problems and mostly occur before 2 years of age. Significant provincial variation still exists.

Variables such as macroeconomic status and household income, maternal educational level, parity, multiple parturition and geographical location are demonstrated to be contributing factors to the three forms of childhood undernutrition.

Age trends of stunting and underweight indicate the importance of early intervention. The extended gap between HAZ and WAZ suggests a synchronized timing relative to age in improvement of acute and chronic nutrition status. It poses a challenge for future intervention especially in children's height growth.

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AUTHOR DISCLOSURES

None of the authors had a personal or financial conflict of interest.

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Original Article

Undernutrition status of children under 5 years in Chinese rural areas - data from the National Rural Children Growth Standard Survey, 2006

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中国 5 岁以下农村儿童的营养状况–2006 年全国农村儿童成长标准调查

目的：采用世界卫生儿童生长发育标准（2006）评估中国 5 岁以下农村儿童的营养状况，探讨儿童营养不良的危险因素。设计：本研究对中国大陆 10 个省份进行了横断面调查，采用多阶段抽样方法共纳入 84009 名 5 岁以下儿童。结果：17.92%的儿童至少存在一种形式的营养不良，矮小，低体重和消瘦的流行率分别为 14.59%, 7.19% 和 3.07%。年龄别身高，年龄别体重和身高别体重的 z 值分别为-0.732, -0.410 和-0.001。矮小和低体重的患病率随年龄增长而呈现上升趋势，年长儿童矮小和低体重的风险显著高于 6 个月以内儿童。儿童营养不良在各省份间分布十分不平衡。低出生体重、多胎（双胞胎或多胞胎）、早产、多子女、母亲是文盲、所在省份经济状况差以及家庭低收入是导致矮小的危险因素。在上述危险因素中多子女与低体重无显著相关性；多胎和早产则与消瘦无显著相关。结论：中国 5 岁以下农村儿童的营养状况虽然有了显著提高，但是仍然落后于世界卫生组织推荐的标准。矮小和低体重仍是目前 2 岁以内儿童的主要营养不良问题。应该根据其可控危险因素制定相应干预项目和干预措施，促进中国农村儿童健康。

关键词：营养不良、5岁以下儿童、中国、农村地区、世卫儿童成长标准