The assessment of malnutrition in children under 3 years of age in Sichuan areas of China using two different growth standards

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6,666 children under 3 years of age were selected from 231 villages in 25 townships of the Sichuan Province using a stratified random sampling design. The subjects consisted of 3,356 boys (50.3%) and 3,310 girls (49.7%); 2,510 from plain areas (37.8%),1,857 from hill areas (27.9%), and 2,299 from mountain areas (34.4%). All the children in this study had four anthropometric variables measured: body weight, length, head circumference (HC), upper-arm circumference (UAC). Three anthropometric indicators were used to measure the prevalence of malnutrition: weight-for-age (underweight), length-for-age (stunting) and weight-for-length (wasting). The prevalence of malnutrition and Z scores were calculated for male and female, respectively, by age to compare the Chinese rural children with the Chinese standard (1985) and NCHS Standard. The prevalence of moderate plus severe underweight, stunting and wasting were 20.8%,40.7% and 1.78% in boys and 19.5%, 38.3% and 2.26% in girls. The prevalence of malnutrition also varied with age. The group with the highest prevalence of malnutrition was in the first year of life, with weaning time proving to be a critical period influencing child growth and development.

Z score indicated that the growth and development of Chinese rural children was behind the Chinese Urban and NCHS populations, especially after 6 months of age.

Furthermore, the mean head circumference and upper arm circumference was lower in mildly malnourished children in each age group than in normal children, and much lower still in moderately and severely malnourished children. The influences of malnutrition were also manifested on bone and muscle development.

Key words: malnutrition, preschool children, growth standards, Sichuan, rural China, plains, hills, mountains

Introduction

A global assessment of malnutrition in children under five has been completed by UNICEF in 1990[1]. It was based on national representative data from 76 developing countries, which did not include China. The study indicated that about 36% of children under five in the developing world (excluding China) are seriously malnourished in overall terms of their weight-for-age; about 39% are stunted in terms of their height-for-age, and 8% are wasted in terms of their weight-for-height.

Growth monitoring in children has proven to be a valuable tool in the assessment of their nutritional status and in the evaluation of efforts to alleviate child malnutrition[1]. The UNICEF study is, therefore, of particular value both globally and at the national level since the data may be taken to reflect the nature and magnitude of the problem of malnutrition.

China's population exceeds 1.1 billion, with nearly 70 million under 3 years of age, 85% of whom live in rural areas. Data on prevalence of malnutrition in children under 3 years of age in rural Chinese areas are limited. Only a few studies related to this area of interest have been done[2-4].

This paper deals with an epidemiological investigation on the prevalence of malnutrition and malnutrition risk factors among children under 3 years of age. The study was carried out between March and May of 1990, in the rural areas of Sichuan Province, which is the largest province of China in both population and agricultural production. A set of systematic sensitive parameters were obtained in this study to provide a useful data base on the nutritional status and the prevalence of malnutrition and malnutrition risk factors among Chinese rural children. The anthropometric indicators of malnutrition were: weight-for-age (underweight), length-for-age (stunting) and weight-for-length (wasting). Low weight-for-age is taken to represent a composite measure of stunting and wasting. Low length-for-age (stunting) stems from a slowing in the linear growth of the child and results in a failure to achieve the expected level of stature of the reference population. Low weight-for-length relative to the level in the reference population in indicative of a state of wasting. This paper will describe the prevalence of malnutrition of children under 3 years of age in the Sichuan rural areas of China, using Chinese national[5] and NCHS standards[6].

Population sample and methods

Population sample

The sample consisted of 6,666 children under 3 years of age. selected from 231 villages in 25 townships of the

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Sichuan Province, using a stratified random sampling design. The subjects consisted of 3,356 boys (50.3%) and 3,310 girls (49.7%), 2,510 from plain areas (37.8%), 1,857 from hill areas (27.9%), and 2,299 from mountain areas (34.4%).

Methods

All the children in this study had four anthropometric variables measured: body weight, length, head circumference (HC), upper-arm circumference (UAC). All the somatic measurements were carried out by specially trained team members following a physical examination of the children and the administration of a questionnaire to their parents.

For the body weight measurements, a Chinese level Balance, made in Factory of Scales in Chengdu China, with the scale measuring up to a maximum 20kg with increments of 50g was used. With this type of level balance the child was placed in a specially designed hanging 'bag'. The reading was taken to the nearest 50g. Body weight was obtained on children without clothing or diaper.

The length measuring scales were made in Italy, and donated to Chengdu Nutrition Center by the Italy Association. They were in the form of special beds for child length measurement. The children were measured following the procedures adopted by WHO[6,7].

The head circumference and upper-arm circumference were measured using soft cotton tapes. The reading was taken to the nearest 0.1 cm. To maintain accuracy, each tape was discarded after measuring about 100 children.

About 320 medical and health workers and fifth year medical students, from the Department of Pediatrics at the West China University of Medical Sciences and local hospitals, participated in the survey teams. All of them had been strictly trained and certified before starting the survey. Each team member was specially trained for one variable only, in order to build expertise and reduce errors. Each measurement was obtained by two examiners. The measurement manager remeasured randomly selected subjects to ensure the quality and measurements.

The Kappa Test was used to describe agreements between weight and length measurements obtained by two different observers[8]. For weight, a difference was defined as exceeding 50g and for length, 1.0cm. Based on an interpretation of Kappa index where > 0.75 is excellent, 0.74-0 50 good and 0.49-0.4 fair, the measurements in this study were considered acceptable. The Kappa index for weight was > 0.66 and for length >0.65.

The data were entered into the computer at the School of Public Health, West China University of Medical Sciences (1990 and 1992) and computer-managed and analysed using SAS package at the School of Public health, University of California at Berkeley (1993). The prevalence of malnutrition and Z scores[9,10] were calculated for male and female, respectively, by age to compare the Chinese rural children with the Chinese and the NCHS standards.

The anthropometric indicators of malnutrition were: weight-for-age (underweight), length-for-age (stunting) and weight-for-length (wasting). Low weight-for-age is taken to represent a composite measure of stunting and wasting. Low length-for-age (stunting) stems from a slowing in the linear growth of the child which results in a failure to achieve the expected level of stature of the reference population. Low weight-for-length relative to the level in the reference population in indicative of a state of wasting. The reference populations used in this study are those of the Chinese standard[5] and the NCHS standard[6]. The cut-off points of the three indicators are defined in terms of the standard deviation of the two reference populations. The actual measurements -1 to -2 SD of the reference population reflect a mild state of malnutrition; those -2 to -3 SD moderate malnutrition, and < -3 SD severe malnutrition.

Results

The children were divided into 4 groups by age: from 1 to 6 months, then to 12 months, then to 24 months and then to 36 months. The malnutrition prevalence rates were expressed as a percentage of individuals below minus one (mildly malnourished), two (moderately malnourished) or three (severely malnourished) standard deviations from the median value of each of the two reference populations (Chinese and NCHS). The results of these for the weight-for-age, length-for-age, and weight-for-length, as related to the Chinese and the NCHS standards, are shown in Tables 1 to 6. The results for girls were similar to those for boys.

The prevalence of malnutrition by weight-for-age (underweight), relative to the Chinese and the NCHS standards, are presented in Tables 1 and 2, respectively. Although the standards used for data analysis gave divergent values of magnitude, both consistently showed that the prevalence of malnutrition increased with age. Of the males under 6 months, 41.8% and 9.9% were classified as malnourished (Including mild, moderate or severe malnutrition. -1 to -2 SD of the reference population reflect a mild state of malnutrition; those -2 to -3 SD a moderate malnutrition, and <3 SD a severe malnutrition), by the Chinese and the NCHS standards, respectively. By comparison, the prevalence in those aged 24-36 months of age were 50% and 71.5%.

It may be observed that the prevalence of moderate underweight at each age group, relative to the NCHS standard, was much higher than that defined by the Chinese standard. However, there was not a great difference in the prevalence of severe underweight, when related to either of these two reference populations.

The prevalence of underweight defined by the NCHS standard increased more drastically with age, progressing from 9.9% to 71.5%, than that defined by the Chinese standard (from 41.8% to 50%). The most sensitive age group to the use of a specific standard was the <6-month old (9.9% and 41.8%, NCHS and Chinese, respectively). Only in this age group did the NCHS standard diagnose considerably fewer underweight children than did the Chinese standard.

The Z scores of the weight-for-age values defined by the Chinese and the NCHS standards are presented in Figures 1a and 1b, for boys and girls, respectively. It may be readily observed that before 8 months, the Z score values of weight-for-age of the Chinese rural children, relative to the Chinese standard, are much smaller than those defined by NCHS Reference. The decline in values defined by NCHS standard in the rural sample appears to continue until about the end of the third year of life and get much smaller than those values defined by the Chinese standard.

Table 1. Prevalence of malnutrition in Chinese rural children < 3 years of age based on weight-for-age of Chinese standard population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD--2SD		-2SD--3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
Boys													
-6	465	2	0.4	18	3.8	248	53.3	142	30.0	39	8.4	16	3.4
-12	616	3	0.5	30	4.8	318	51.6	218	35.4	35	5.7	12	1.9
-24	1107	3	0.3	24	2.2	528	47.6	415	37.4	96	8.7	40	3.6
-36	1169	1	0.01	27	2.3	557	47.6	445	38.1	98	8.4	41	3.5
Total	3357	9	0.3	99	2.9	1651	49.2	1220	36.3	268	8.0	109	3.2
Girls													
-6	478	5	1.0	22	4.6	255	53.3	126	26.3	40	8.4	30	6.3
-12	616	9	1.5	32	5.2	337	54.7	182	29.5	42	6.8	14	2.3
-24	1094	5	0.5	21	1.9	539	49.2	389	35.6	101	9.2	39	3.6
-36	1122	3	0.3	35	3.1	533	47.5	458	40.8	104	9.3	43	3.8
Total	3310	22	0.6	850	2.6	1664	50.2	1155	34.9	287	8.7	126	3.8

Chang, 1985

Table 2. Prevalence of malnutrition in Chinese rural children< 3 years of age based on weight-for-age of NCHS population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD- -2SD		-2SD- -3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
	Boys												
-6	465	8	1.7	72	15.4	339	72.9	39	8.4	7	1.5	0	0
12	616	3	0.5	32	5.2	332	53.9	201	32.6	50	8.1	7	1.1
-24	1107	0	0	7	0.6	272	24.5	489	44.1	2X6	25.8	52	4.7
-36	1169	0	0	2	0.2	331	28.3	541	46.3	264	22.6	30	2.6
Total	3357	11	0.3	113	3.3	1274	37.9	1270	37.8	607	18.1	89	2.7
Girls													
-6	478	23	4.8	89	18.6	296	6.2	56	11.7	13	2.7	1	0.2
-12	616	7	1.1	35	5.6	362	58.7	164	26.6	40	6.5	7	1.1
-24	1094	2	0.2	5	0.4	325	29.7	494	45.1	242	22.1	26	2.4
-36	1122	0	0	4	0.3	308	27.4	502	44.7	276	24.6	42	3.7
Total	3310	32	0.9	133	4.0	1291	39	1216	36.7	571	17.2	76	2.3

The data base of the Fels Research Institute, Yellow Springs, Ohio (WHO, 1982).

Table 3. Prevalence of malnutrition in Chinese rural children <3 years of age based on length-for-age of Chinese standard population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD- -2SD		-2SD- -3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
Boys													
-6	465	1	0.2	6	1.2	143	30.7	182	39.1	72	15.5	61	13.1
-12	616	6	1.0	16	2.6	285	46.2	298	4X.4	85	13.8	97	15.7
-24	1107	4	0.3	15	1.3	334	30.1	425	38.4	174	15.7	155	14.0
-36	1169	0	0	5	0.4	371	31.7	420	35.9	221	18.9	152	13.0
Total	3357	11	0.3	42	1.2	1133	33.7	1325	39.4	552	16.4	465	13.9
Girls													
-6	478	2	0.4	3	0.6	140	29.3	167	34.9	80	16.7	87	18.2
-12	616	7	1.1	10	1.6	256	41.5	194	31.5	84	13.6	65	10.6
-24	1093	8	0.7	14	1.3	331	30.3	406	37.1	177	16.2	157	14.4
-36	1122	0	0	9	0.8	360	32.1	419	37.3	190	16.9	144	12.8
Total	3309	17	0.5	36	1.1	1087	32.8	1186	35.8	531	16.0	453	13.7

*Chang, 1985

Table 4. Prevalence of malnutrition of Chinese rural children < 3 years of age based on length-for-age of NCHS standard population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD- -2SD		-2SD- -3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
Boys													
-6	465	2	0.40	14	3.0	246	52.9	154	33.1	40	8.6	9	1.9
-12	616	1	0.16	8	12.9	226	36.7	228	37.0	116	18.8	37	6.0
-24	1107	1	0.09	6	0.5	180	16.3	415	37.5	345	31.2	133	12.0
-36	1169	1	0.08	0	0	108	9.2	318	27.2	407	34.8	282	24.1
Total	3357	5	0.14	28	0.8	760	22.6	1115	33.2	908	27.0	461	13.7
Girls													
-6	478	1	0.21	8	1.7	266	55.6	136	28.5	46	9.6	21	4.4
-12	616	4	0.64	8	1.3	279	45.3	215	34.9	82	13.3	27	4.4
-24	1093	3	0.27	11	1.0	224	20.5	419	38.3	312	28.5	122	11.2
-36	1122	0	0	0	0	126	11.2	339	30.2	428	38.1	229	20.4
Total	3309	8	0.24	27	0.8	895	27.0	1109	33.5	868	26.2	399	12.1

*The data base of the Fels Research Institute, Yellow Springs, Ohio (WHO, 1982).

Table 5. Prevalence of malnutrition of Chinese rural children< 3 years of age based on weight-for-length of Chinese population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD- -2SD		-2SD- -3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
Boys													
1-	462	122	26.4	151	32.6	182	39.4	6	2.5	2	0.8	0	0
6-	616	74	11.8	150	23.9	357	56.2	31	4.9	4	0.6	1	0.16
12-	1104	42	3.8	157	14.2	791	71.7	98	9.0	16	1.45	5	0.45
24-	1164	96	8.2	240	20.6	775	66.6	46	4.0	7	0.6	5	0.36
Total	3346	334	10.0	698	28.2	2105	62.6	181	5.4	29	0.9	11	0.32
Girls													
1-	470	150	30.2	168	35.7	145	30.8	5	1.1	2	0.4	0	0
6-	614	87	12.5	144	23.4	256	58.0	23	3.7	4	0.6	2	0.32
12-	1092	41	3.7	172	15.7	788	72.1	80	7.3	11	1.0	4	0.37
24-	1122	72	6.4	235	20.9	744	66.3	62	5.52	9	0.8	4	0.36
Total	3304	350	10.2	719	20.5	1933	61.5	170	5.2	26	0.8	10	0.3

Chang, 1985

Table 6. Prevalence of malnutrition in Chinese rural children< 3 years of age based on weight-for-length of NCHS population.

Months	N	>+2SD		+1SD-+2SD		SD-+1SD		-1SD- -2SD		-2SD- -3SD		<-3SD	
		N	%	N	%	N	%	N	%	N	%	N	%
Boys													
1-	462	79	17.1	179	38.7	200	43.2	3	0.65	1	0.21	0	0
6-	615	49	7.96	133	21.6	398	64.7	32	5.20	3	0.48	1	0.16
12-	1104	10	0.91	47	4.25	770	69.7	243	22.0	29	2.62	5	0.45
24-	1164	7	0.60	78	6.70	827	71.0	233	20.0	14	1.20	5	0.36
Total	3345	145	4.33	437	13.1	2195	65.6	511	15.3	47	1.46	11	0.32
Girls													
1-	476	102	21.4	198	41.6	172	36.1	3	0.63	1	0.21	0	0
6-	614	50	8.14	139	22.6	396	64.5	26	4.23	1	0.16	2	0.32
12-	1092	10	0.91	43	3.93	800	73.2	207	18.9	28	2.56	4	0.37
24.	1122	17	1.5	78	6.95	800	71.3	197	17.5	26	2.32	4	0.36
Total	3304	179	5.4	458	13.8	2168	65.6	433	13.1	56	1.96	10	0.3

The database of the Fels Research Institute, Yellow Springs, Ohio (WHO, 1982).

The prevalence of malnutrition by length-for-age (stunting), relative to the Chinese and the NCHS standards, are presented in Tables 3 and 4. The prevalence of stunting, relative to the Chinese standard, was much lower than that defined by the NCHS standard. The prevalence of stunting by the Chinese standard in the <6-month age group and in the -36:month age group were 67.7% and 67.8% respectively; and by the NCHS standard 42.5% and 86.1%, respectively. Furthermore, moderately and severely malnourished children were much lower by the Chinese standard than by the NCHS standard (totally 30.3% and 40.7%, respectively). This stunting phenomenon became more obvious with age.

The Z scores of the length-for-age values defined by the Chinese and the NCHS standards are presented in Figure 2. When stunting was assessed in terms of the Chinese standard, the Z scores hovered between -1 and -2, over the birth to 36-months age range. However, when defined in relation to the NCHS standard, the Z scores stayed predominantly above -1, then dropped precipitously, going below -2 in the 25-36 months of age. This decline in values defined by NCHS standard continued until the end of the third year life and got much smaller than those values defined by the Chinese standard. There appeared to be little or no difference between the boys (Figure 2a) and the girls (Figure 2b).

The prevalence of malnutrition by weight-for-length (wasting), relative to the Chinese and the NCHS standards, are presented in Tables 5 and 6. The relatively low prevalence of wasting may reflect a masking effect when the pattern of underweight and stunting run in parallel.

The Z scores of the weight-for-length values defined by the Chinese and the NCHS standards are presented in Figure 3. The assessment of wasting by these two standards gave considerable levels of divergence. On the whole, the fluctuations were more pronounced with the NCHS, within the -0.1 and the +0.5 levels. The scores the Chinese standard were mainly around the -0.5 value across the 36-months age range.

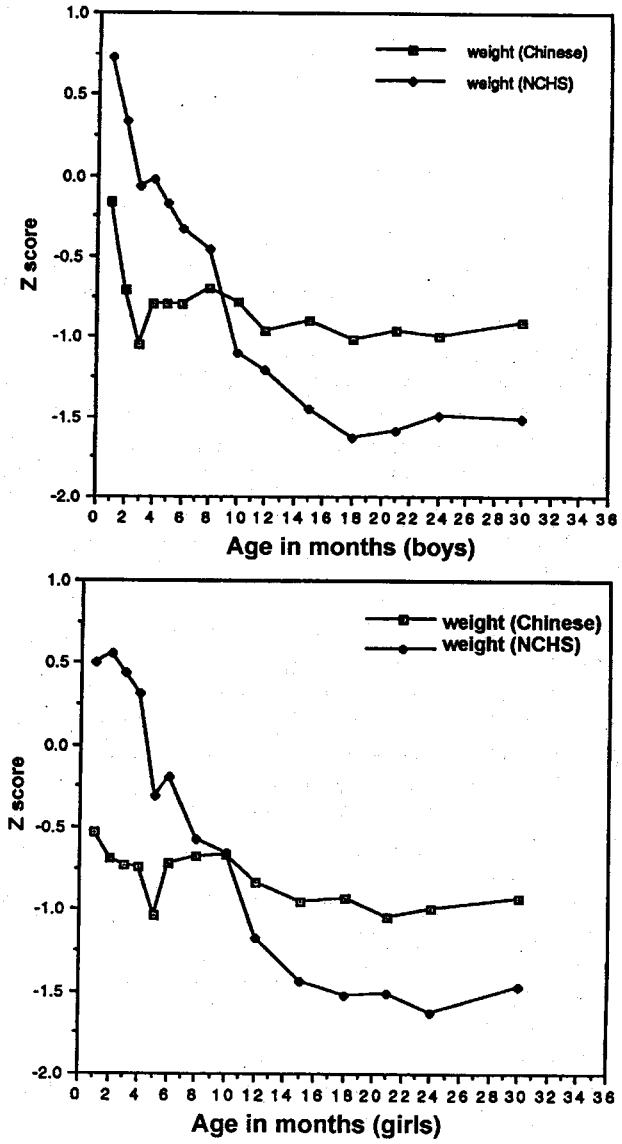
Table 7. The changes of head circumference (HC) and upper arm circumference (UAC) in malnourished children.

Month	Normal		Mild		Moderate		Severe	
	HC	UAC	HC	UAC	HC	UAC	HC	UAC
1-	38.4	12.8	37.1	11.8	36.4	10.1		
2-	39.9	13.6	38.2	12.8	38.2	12.0	36.1	10.4
3-	41.5	14.0	40.4	13.2	40.0	12.8	37.4	10.9
4-	42.7	14.5	41.4	13.5	40.5	12.8	40.1	10.9
5-	43.2	14.6	42.6	13.7	42.2	12.8	39.7	12.5
6-	44.4	14.6	43.4	13.8	43.0	13.1	41.1	11.9
8-	45.2	14.9	44.6	13.7	44.2	13.1	42.6	12.8
10-	45.8	14.9	45.0	13.9	44.3	13.3	43.6	12.8
12-	46.7	15.0	45.7	13.8	45.1	13.2	44.2	12.8
15-	47.2	14.8	46.5	13.9	45.5	13.1	44.8	12.8
18-	47.7	14.8	46.8	13.8	46.2	13.1	45.4	12.6
21-	47.8	14.8	47.3	14.1	47.3	14.0	45.7	13.2
24-	48.5	15.1	47.7	14.4	46.9	13.7	46.3	13.3
30-	49.0	15.6	48.1	14.4	48.7	13.7	46.6	13.7

The values for head circumference (HC) and upper-arm circumference (UAC) in underweight children, by the Chinese standard, are shown in Table 7. The mean values for HC and UAC of mildly malnourished children in each age group were lower than those in normal children, and

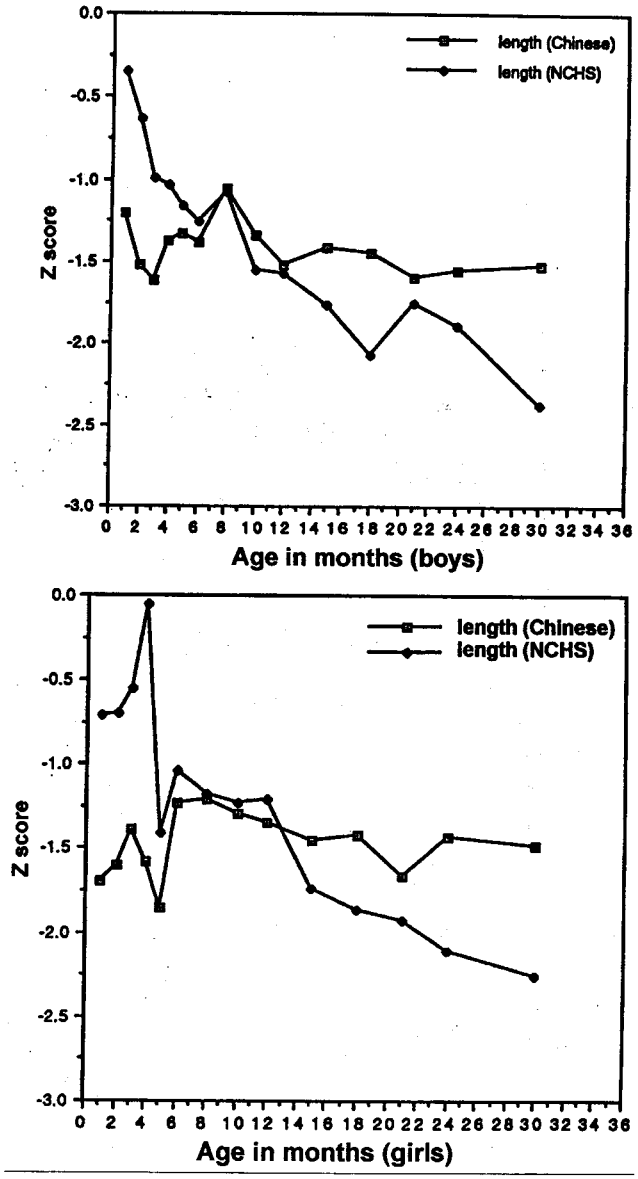
were much lower in the moderately and severely malnourished children. Thus, the changes in these anthropometric parameters paralleled those of body weight in the first three years of life.

Figure 1. Weight-for-age Z score in Chinese rural children (Chinese and NCHS standards). a) boys; b) girls.



an acceptable reference at the international level. This is nearly one-tenth of the malnourished in this age group, world-wide[1].

Figure 2. Length-for-age Z score in Chinese rural children (Chinese and NCHS standards). a) boys; b) girls.



Discussion

Child malnutrition is a global problem, especially in developing countries[11]. This study generated a useful set of data on child malnutrition in rural China, which is descriptive of the present nutritional status of the children in this population. This data set should serve as a baseline for the evaluation of growth and development in these areas.

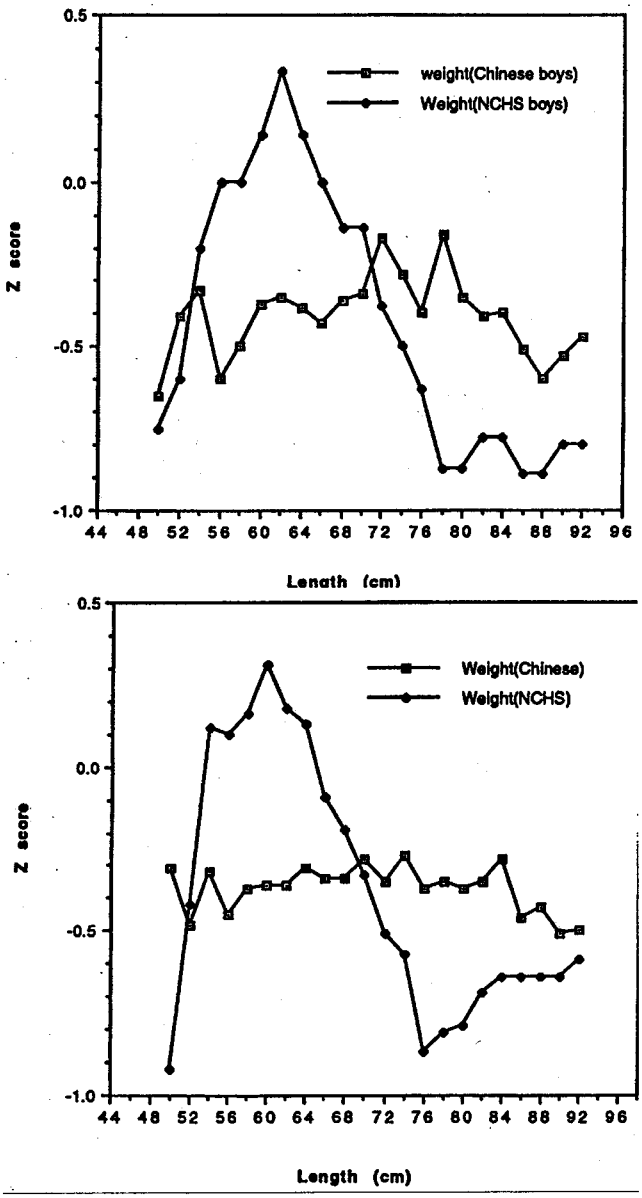
Tables 1 to 6 showed that the prevalence of underweight, stunting and wasting of children in Sichuan rural area of China were still very high. These results may well reflect the nutritional status of children in rural China. According to the results in the prevalence of malnutrition in rural China, among children 3 years or younger, there are about 12 million moderately or severely underweight (weight-for-age), 24 million stunted (length-for-age), and 1.1 million wasted children in terms of weight-for-length. All assessed against the NCHS standard, which is becoming

There was a great difference in the prevalence of malnutrition depending upon whether it was defined in terms of underweight, stunting or wasting. But growth patterns did not vary significantly by sex in this study. A lack of major difference on growth retardation associated with sex has been reported in Latin America and other countries[12].

When the data presented in Figures 1 and 2, and in Tables 1 to 4, are considered along with those of the means of weight-for-age and length-for-age in Chinese urban and rural areas[13], three points could be made: first, before 6 months of age, Chinese rural children grew in a pattern consistent with the Chinese and the NCHS standards. However, the Chinese standard classified more of the > 6 month age group as malnourished than did the NCHS standard. This emphasises the impact of the differences in the distribution of values in these two standards. Second,

after six months of age, the NCHS standard population grew steadily, but the growth of the Chinese populations slowed down. This may explain the much higher prevalence of total malnutrition and moderate malnutrition after 6 months of age measured against the NCHS standard as that compared with the Chinese standard. Third, the Chinese rural population grew at the slowest of all.

Figure 3. Weight-for length Z score in Chinese rural children (Chinese and NCHS standards). a) boys; b) girls.



In the rural population of this study, the prevalence of stunting was the highest, reaching 73.9% and 71.8% for boys and girls, respectively. Generally, stunting is a reflection of chronic under nutrition and high rates Of infection although it is possible that genetic factors may contribute to these prevalence levels. A related hypothesis may be that malnutrition exerts selective pressure against children who are small for genetic reasons. Whatever the reason, stunting has been repeatedly reported to lead to reduced growth rates from which children seldom recover by catch-up growth during more favourable periods[14].

By contrast, wasting reflects the presence or absence of episodes of stress at the time of measurement. These episodes of stress can be caused by chronic factors and/or by acute factors[15]. Children might be able to reduce their rate of linear growth without altering weight-for-length status when faced with chronic problems of mild or moderate severity[14,16]. On the other hand, severe chronic problems, such as seasonal scarcities of food and chronic diarrhoea, lead to significant wasting and stunting[11]. As the severity and duration of the malnutrition increase, children cease to grow altogether and the process of body wasting begins. Therefore, when the prevalence of underweight and stunting were compared with the prevalence of wasting, there was considerably fewer wasted children.

The highest prevalence in this data set is for stunting, followed by underweight, and then by wasting. However, health practitioners in developing countries are well aware that when young children show poor gain in weight and length, or worse yet when they lose weight, they are in grave danger of dying[17]. Wasting in children is a sign of severe malnutrition in the extreme.

Many studies have shown that children in urban areas have much better environmental conditions for growth than do children in rural areas[18]. These environmental factors include economic status, food supply, nutrition, health care, sanitation, parent education, public benefits, and family planning. All these factors play very important and complex roles in child growth, especially in early life. In China, most of the illiteracy is in rural areas. Only 68% of rural population have access to safe water, and 80% are provided with health services, compared with 87% and 100%, respectively, in urban areas[19]. Furthermore, the health resources and service utilisation in the urban areas are much greater than in rural areas. The per capita health service fund allocated by the government of China in urban areas is 4.34 times the amount in the rural areas[20]. There is no doubt that child health care lags far behind all other services in much of China[21].

The mean HC and UAC values of mildly underweight children in each age group were lower than those in normal children, and much lower in moderately and severely underweight children. The mean HC represents the development of the bone system of the body and the head which is easily influenced by growth factors. Robert Balazs reviewed the scientific evidence in this area, and showed that nutritional deprivation can affect the structural and biochemical development of the brain[22,23]. Severe nutritional deprivation in early life substantially impairs human mental development, which is significantly influenced by social factors as well[23]. These findings indicate that under nutrition is a very important non-genetic factor influencing the development of central nervous system, and ultimately the intellectual performance. However, most of the physical changes are apparently reversible, and behavioural performance can be influenced by various social as well as nutritional factors. The significance of the change of HC at the individual level in reflecting the change of mental development is not clearly elucidated. More research is needed in this area.

UAC is very useful in screening for severe malnutrition[24]. Growth faltering usually begins between ages 6 and 12 months. UAC has proven to be a valid and simple screening measure for protein energy malnutrition in children 12-60 months of age. When compared to standard

anthropometric indices, it performs best in the prediction of weight-for-age[25]. However, UAC performs somewhat less well in detecting individual children who are wasted or stunted[26,27,28].

In summary, the nutritional status of children under three years of age in Sichuan rural China is not satisfactory. More work has to be done in improving child nutritional status and decreasing child malnutrition. In the long term, more attention will need to be given to the improvement of the food supply, sanitary conditions, nutrition and health education, public benefits and economic levels in rural China. The enormity of the problem, and its social and health consequences requires nothing short of a strong political and professional will in order to concentrate the major effects of the next decade on the main health and nutrition problems of the rural children in China.

The assessment of malnutrition in children under 3 years of age in Sichuan areas of China using two different growth standards

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用兩種生長發育標準對中國四川農村3歲以下兒童營養不良的評價

摘要

采用隨機整群分層抽樣法從25個鄉中的231個村得到6666名3歲以下的四川農村兒童. 其中男孩3356名 (50. 3 %), 女孩3310名 (49.7%). 2510人來自平原地區 (37.8%), 1857人來自丘陵地區 (27.9%), 2299人來自山區 (34.4%). 每位 兒童均測得四項體格發育指標: 體重, 身長, 頭圍及其上臂圍. 分別采用 中國同齡兒童標準人群 (1985年)和NCHS參照人群作爲標準年齡分組和性別, 以年 齡別體重, 年齡別身高, 身高別體重三種體格發育指標來判斷營養不良的程 度. 本組兒童中, 重度低體重, 身材矮小和消瘦兒的患病率分別爲 20.8 %, 40.7 % 和 1.78 % (男童)以及19.5 %, 38.3 % 和2.26 % (女童). 營養不 良患病率與 年齡 組有關. 最易發生在出生后第一年.

Z積分顯示四川農村兒童的生長發育明顯落后于 中國同齡兒童標準人群 (1985年)和NCHS參照人群. 在輕度營養不良兒童, 其平均頭圍值就明顯低于 同齡正常兒. 中 重度 營養不良兒頭圍值的減小更明顯.

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