Nutritional status of preschool children in poor rural areas of China*

Chang Ying,1 Zhai Fengying,2 Li Wenjun,3 Ge Keyou,4 Jin Daxun,5 & M. de Onis6

Described are the main findings of the first large-scale nutrition monitoring project carried out over a 4-year period in China. The nutritional status of nearly 10 000 preschool children in 18 comparatively poor rural areas in seven provinces was followed each year over the period 1986–89 in order to identify their major nutritional problems and improve their growth and development. Physical measurements were made and dietary surveys and biochemical tests were performed on a subsample of the children. The proportion of stunted and underweight children was far higher than the national average. Based on the possibilities offered by local circumstances, the prevalences of stunting and underweight were lowered and anaemia was greatly reduced. Along with the progress in nutrition monitoring, major efforts were made to train health workers, as well as to encourage increased production of green vegetables, poultry, and small livestock. The wealth of information collected and the experience gained may serve as a baseline record, the project currently being expanded to cover 100 counties throughout China.

Introduction

Along with the steady growth in agricultural production and the rapid development of the national economy in recent years, the standard of living in China has been raised significantly. A national nutrition survey carried out in 1982 showed that the difficulties in providing sufficient food and clothing had basically been solved and that nutritional status had been greatly improved (1). On the other hand, the survey also indicated that there were still shortcomings in the diet of preschool children, whose dietary intake of protein, calcium, and riboflavin was inadequate and whose energy intake was only 90% of the required amount.

Because of the vastness of the country and differences in circumstances, development in China has not been totally balanced, and there are still certain localities where children’s height and weight are less than the national average. Recognizing these problems, the Chinese government launched a project in these disadvantaged areas aimed at evaluating the nutritional status of children, the major problems that remained, and trends in development. Explored also were measures for making improvements in line with local conditions in order to improve children’s nutritional status, promote their growth and development, and reduce the prevalence of nutritional deficiency diseases; at the same time, nutrition personnel were trained and provided with working experience.

Materials and methods

Conducted for the first time in China, the 5-year project (1985–89) to monitor and improve the nutritional status of preschool children reported here was a collaborative effort between the Ministry of Public Health and UNICEF, and was carried out by the Institute of Nutrition and Food Hygiene, Beijing, in collaboration with the epidemic prevention stations in seven provinces.

In order to assess growth problems in rural areas, 18 relatively poor survey sites (townships) with an annual per capita income of 200–500 yuan (US$ 55–135) were selected according to their economic and geographical conditions, level of communications, population structure, dietary habits, and standard of living in the provinces of Guangdong, Jiangxi, Guizhou, Sichuan, Gansu, Hunan, and Hubei. The average annual per capita income of the rural population in China in 1985 was 398 yuan (US$ 107). A pilot study was first conducted in Jiangxi Province in 1985, and formal work began in the other six provinces in 1986.

---

1 Professor, Institute of Nutrition and Food Hygiene (INFH), Chinese Academy of Preventive Medicine (CAPM), Beijing, China.
2 Acting Chief, Department of Community Nutrition, INFH, CAPM, Beijing, China.
3 Research Associate, INFH, CAPM, Beijing, China.
4 Director, INFH, CAPM, Beijing, China.
5 Professor, INFH, CAPM, Beijing, China.
6 Scientist, Nutrition Unit, World Health Organization, 1211 Geneva 27, Switzerland. Requests for reprints should be sent to this author.

Reprint No. 5458
The survey subjects included 500 preschool children under 6 years of age from all or a number of villages in each survey site. Physical measurements (height, weight and arm circumference) were taken every year (1986–89) from May to June from a total of nearly 10 000 children, who were examined physically for nutritional deficiency diseases. A subsample of these children was interviewed using the 24-hour recall method to assess their diet, and blood samples were collected from about 5000 of the children for biochemical testing. Data were also collected on socioeconomic conditions.

The body weight of each child was measured using a beam-balance platform scale (maximum capacity, 50 kg; accuracy, 25–50 g); the children wore only light underwear or clothing of known weight, which was then subtracted from the total. Infants unable to sit up were weighed in a container of known weight. All the scales were adjusted to zero before being used. A recumbent measuring board was used for children under 3 years of age and a stadiometer for children older than 3 years; measurements were made to the nearest 0.1 cm. A spectrophotometer or a miniature haemoglobin photoelectric colorimeter, which uses a cyanomethaemoglobin method, was used to determine the haemoglobin concentration.

The growth data were interpreted using the international growth reference median values (2). Height-for-age, weight-for-age, and weight-for-height z-scores were calculated following WHO recommendations (2, 3).

Since 1985, nutrition interventions have been implemented at all the surveillance sites. The interventions varied according to the specific situation in the various provinces, but in general included the following:

— Training of more than 11 000 field workers in different aspects of nutrition.
— Control projects for anaemia in children (mainly involving fortified foods and iron supplements for pregnant woman).
— Promotion of home gardening and animal raising by increasing the varieties of and area set aside for vegetable crops, increasing the production and consumption of soya beans, and developing family animal husbandry and fruit-tree cultivation.

— Popularization of knowledge on nutrition through the mass media such as radio, bulletin boards, slides, films, and posters. Breast-feeding was advocated and mothers received instructions on good baby-feeding practices.
— Dissemination of knowledge on health, with the aim of improving the situation in rural areas and controlling those diseases that are prevalent among children.
— Establishment of township committees to manage the activities related to nutrition.

The implementation of all or part of these measures during the study period was expected to have a positive impact on indicators of child nutritional status.

### Results

**Physical growth and development**

**Height-for-age.** Low height-for-age (stunting) signifies a slowing of skeletal growth and is a principal indicator of long-term nutritional experience or growth impairment caused by malnutrition in the past. Stunting is frequently associated with poor overall economic conditions, chronic or repeated infections, as well as inadequate nutrient intake (3). The prevalence of stunting among the children in the surveillance sites was >40% over the study period, with a prevalence of severe stunting (below–3 SD from the international reference median value) of around 14% (see Table 1). This prevalence was considerably higher than the national average for China (32% below –2 SD of the international reference median value) and also higher than the national average for rural areas (36%), as estimated in the 1987 national growth survey (25). As shown in Fig. 1, there was a large variation between provinces. The prevalence of stunting was highest (>50%) in the study areas in Guizhou, Hunan and Guangdong and lowest (23%) in Hubei.

### Table 1: Prevalence of moderate and severe malnutrition among the study children, 1986–89

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;−2 SDa (%)</td>
<td>&lt;−3 SDa (%)</td>
<td>&lt;−2 SD (%)</td>
<td>&lt;−3 SD (%)</td>
</tr>
<tr>
<td>Weight-for-age</td>
<td>9984</td>
<td>27.5</td>
<td>4.0</td>
<td>9805</td>
</tr>
<tr>
<td>Height-for-age</td>
<td>9911</td>
<td>42.9</td>
<td>14.5</td>
<td>9739</td>
</tr>
<tr>
<td>Weight-for-height</td>
<td>9921</td>
<td>2.7</td>
<td>0.3</td>
<td>9741</td>
</tr>
</tbody>
</table>

* % of children below −2 or −3 standard deviations of the WHO/NCHS international reference median values.
Nutritional status of children in rural China

Fig. 1. Nutritional status of preschool children in select-ed poor rural areas of China, 1989.

[Graph showing nutritional status distributions by province]

The height-for-age z-score distribution for Chinese children was similar for both boys and girls (Fig. 2). Compared with the reference population, the distributions of the nutritional indicators for both sexes are shifted to the left. The variance, as reflect-
ed by the spread of the distribution for each sex, is similar to that of the reference population, suggesting that most children shared similar nutritional and socioeconomic conditions. The leftward shift in the distributions away from the reference population does not appear to have been caused by a subgroup of children who were unusually short.

The prevalence of stunting among children of different ages for each of the study years is shown in Fig. 3. The pattern of stunting by age group was similar throughout the study period with a steep rise in prevalence during the first year of life up to the 40–50% level and a levelling off thereafter.

Weight-for-height. Low weight-for-height (wasting) indicates a deficit in tissue and fat mass compared with the amount expected for a child of the same height or length, and may result either from failure to gain weight or from actual weight loss. One of the main characteristics of wasting is that it can develop very rapidly, but under favourable conditions can be quickly reversed. Thus, low weight-for-height is commonly used to assess acute or recent malnutrition (3).

The prevalence of wasting among the surveyed children is within the range expected for the reference population (<3% for all 4 study years) (Table 1), indicating that there was no significant level of acute malnutrition. However, the distribution of z-scores, which is similar for both sexes, is shifted slightly to the left of that for the international reference population (Fig. 2).

There was a lack of substantial acute undernutrition in all seven provinces (Fig. 1), although as with low height-for-age, the prevalences in Hunan and Guizou were generally higher than those in the other provinces. The prevalence of wasting among children according to age group was quite different from that for height-for-age; the prevalence of wasting was greatest among those aged 6–24 months of age and tended to decrease among older children (Fig. 3).

Fig. 2. Distribution of z-scores for a) height-for-age, b) weight-for-height, and c) weight-for-age for the Chinese study children in 1989, compared with the international reference values.

[Graphs showing z-score distributions]
Weight-for-age. Low weight-for-age (underweight) is a combined index that reflects both height-for-age and weight-for-height data. Thus, use of this indicator alone does not permit a distinction to be made between wasting and stunting; however, for this very reason, it may be an appropriate index for certain applications.

The prevalence of low weight-for-age among the surveyed children was 24–28% for all study years, which is higher than the national average for China (21.3%) and also somewhat higher than the average for rural areas (23.7%) (25); also the prevalence of children <−3 SD of the median of the international reference population was about 4% (Table 1). Guizhou had the highest prevalence of underweight, followed by Hunan and Guangdong, with prevalences above 30%. The lowest prevalence of underweight (12.7%) was in Hubei (Fig. 1).

The distribution of z-scores for weight-for-age is very similar to that for height-for-age, shifted to the left of that of the reference population, and showing an overlap for the Chinese boys and girls surveyed (Fig. 2). The pattern of low weight-for-age by age group was also similar for all four study years to that of height-for-age, with a steep rise in prevalence (up to 30–35%) during the first year of life, followed by a slight drop to the 25–30% level.

Table 2 shows the change in the prevalence of the three anthropometric indicators over the period 1986–89. There was a consistent improvement in all three indicators from 1986 to 1989.

The relationship between the children’s current nutritional status and family income, parental illiteracy and birth order is summarized in Table 3. Per capita income was strongly negatively correlated with the indicators of nutritional status—the lower the income, the lower the prevalence of stunting and underweight. The opposite was observed for illiteracy, which was strongly positively correlated with nutritional status—the lower the parents’ level of education, the higher the proportion of children stunted or underweight. Interestingly, the prevalence of stunting and underweight was inversely proportional to the proportion of first-born children among those surveyed (correlation coefficient, −0.63 and −0.68, resp.). In other words, the larger the proportion of first-born children surveyed at each site, the lower the proportion of those with low height-for-age and weight-for-age. The opposite was observed for birth orders of two or more, with the prevalence of stunting and underweight being positively correlated with the proportion of second or later births (r = 0.65 and r = 0.69, resp.).

Anaemia

The prevalence of anaemia (haemoglobin <11.0 g/dl) among the various age groups from 1986 to 1989 is shown in Table 4. Poor iron nutritional status is a serious problem in the study population, with the highest prevalences being among the 6-month and 1-year age groups. For children older than 1 year the prevalence gradually dropped with increasing age. Most of the anaemia cases were mild, with very few severe cases (haemoglobin <8 g/dl).

The prevalence of anaemia among children exhibited a downward trend over the study period. Comparison of the prevalence in 1986 and 1989 reveals that there was a statistically significant decrease of anaemia over the 4-year period among all age groups (Table 4).

Dietary survey

The results of the dietary survey indicate that at 4 months of age only 5% of the infants were bottle-fed. With the exception of four study sites in Guangdong and Hunan, exclusive breast-feeding rates were
in the range 64–93%. Some areas in these two provinces have a high mixed feeding rate because of traditional practices. This may account, in part, for the high prevalence of wasting among the children there.

Most children aged 6–12 months had not been completely weaned. The commonest supplementary foods for this age group were rice and wheat flour, followed by sugar. Only at a few study sites were animal milk and eggs used. Thus, inadequate nutrient intake could be related to the high prevalence of malnutrition within this age group. For most children in the 1-year age group the amount of supplementary food was greater than that for infants aged 6–12 months, but this was mainly accounted for by an increased intake of cereals.

Children aged 2–5 years mainly ate cereals (rice and wheat). Some potatoes or sweet potatoes and a small amount of soya beans and bean products are also available in most areas. The intake of vegetables at the various sites ranged from an average of less than 10 g per to 250 g per day. The average intake of fruit for each age group was 22–27 g per day. Hardly any milk was given to over-2-year-olds. The average intake of eggs for the various age groups was 12–16 g per day, that of meat 12 g per day, and that of fish 5 g per day.

In general, 75–89% of the energy of children aged 2–2 years was provided by vegetable sources, of which cereals accounted for 66–81%; only 5–14% was obtained from foods of animal origin. Cereals were also the major source for protein in the diet of children, accounting for 60–84%; 7–23% was provided by foods of animal origin, while the proportion provided by soya bean protein was relatively low.

The results of the study show that the energy intake of the children was adequate (98–102% of the Chinese recommended daily intake (RDA)), but that intake of protein, calcium, vitamin A, and riboflavin was only 76–81%, 23–29%, 42–75%, and 50–56% of the RDA value, respectively.

Discussion

Children at the surveillance sites were both shorter and lighter than the international reference population; they also had higher prevalences of stunting and underweight than the national averages for China (25). This is in agreement with data from other parts of China, indicating that beginning at the weaning period, the growth of rural children lags behind that of their urban counterparts (4, 5, 25). However, there was a lack of significant acute malnutrition in all seven study provinces and the prevalence of wasting was within the range expected for the reference population. The combination of a high prevalence of stunting with no evidence of wasting is a common observation in many populations (6).

There is now sufficient evidence to demonstrate that the growth of children from the higher socioeconomic levels in poor countries is comparable to that of the international reference population, even though the children in the general population of poor countries are markedly stunted (7, 8). Also, reports of significant secular improvement in childhood growth and adult height in Asian countries (9), and studies documenting dramatic improvement in the growth of Asian children exposed to improved environmental or nutritional circumstances (10), question the role of genetic factors in the differences among populations in childhood growth. The high prevalence of stunting among the study population is probably related to environmental factors, mainly nutrition and slower socioeconomic development, and not to differences in the growth potential of Asian children. This is supported by the strong negative correlation between the nutritional status indicators and the income and parents’ level of education, and by the growth pattern of other more developed areas of China.

The steep rise in the prevalence of stunting among the surveyed children during their first year of life and the steady level in the 40–50% range thereafter, confirms the importance of correct nutrition in infancy and supports the hypothesis that generalized growth failure is an active process in the

Table 4: Percentage age-specific prevalence of anaemia (haemoglobin level <11 g/dl) among the study children, 1986–89

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>1986</th>
<th>1987</th>
<th>1988</th>
<th>1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5–0.99</td>
<td>62.3 (704)</td>
<td>60.2 (709)</td>
<td>54.2 (725)</td>
<td>51.0 (760)</td>
</tr>
<tr>
<td>1.0–1.99</td>
<td>49.9 (1051)</td>
<td>45.5 (1017)</td>
<td>42.6 (1225)</td>
<td>41.4 (1164)</td>
</tr>
<tr>
<td>2.0–2.99</td>
<td>37.7 (988)</td>
<td>33.7 (831)</td>
<td>28.3 (1149)</td>
<td>27.5 (1083)</td>
</tr>
<tr>
<td>3–5.99</td>
<td>28.4 (1929)</td>
<td>25.8 (1961)</td>
<td>18.8 (2576)</td>
<td>17.6 (2283)</td>
</tr>
</tbody>
</table>

* Figures in parentheses are the numbers of children.

b P <0.01.
6–18-month age range and is essentially irreversible after this (11). Future efforts to improve nutrition in rural areas of China should therefore focus on children about 1 year of age (12). This is very important since longitudinal and cross-sectional studies indicate that growth failure in infancy is not regained in later childhood and adolescence (13–17).

Implementation of the various nutrition interventions could have had a positive impact on the nutritional status of the children at the surveillance sites. The proportion of wasted, stunted, and underweight children aged >2 years was reduced by various degrees between 1986 and 1989. As expected, weight-for-height exhibited the greatest relative improvement, although its initial overall low level did not leave much room for improvement. None the less, its prevalence decreased from 6.7% in 1986 to 3.5% in 1989 (a 50% reduction) among 1-year-olds, who had the highest baseline prevalence of wasting. The small reduction in the prevalence of stunting over such a short period was expected, since linear growth is a slower process, and even under favourable conditions takes a relatively long time to show improvements (3).

The high prevalence of anaemia among the study infants and young children should be given serious consideration. A major contributory cause could be the low availability of iron in Chinese cereal-based vegetarian diets, but the relative importance of other factors should be investigated. However, the significant downward trend in the prevalence of anaemia among the study children from 1986 to 1989 may be related to the implementation of the projects to overcome this condition. The findings suggest that integration of health promotion and health education with the supply of fortified foods and drugs could have a considerable effect on the prevention and treatment of anaemia. A population-based prevention programme is required, especially during the first 2 years of life.

The results from the dietary survey clearly indicate that there is a need for the timely and adequate provision of weaning foods for breast-feeding infants over 6 months of age. Attention should be paid to increasing their intake of foods of animal origin, such as eggs and milk. Efforts should also be made to increase the intake of protein, calcium, and riboflavin of children aged ≥2 years. Under existing conditions, increasing the intake of soya beans, soya bean products, and eggs may be one way to improve the situation. Also, further exploration of the insufficient intake of vitamin A and of ways to improve the children’s diet should be studied.

The few available studies on the growth of vegetarian children (18–22) provide some evidence that a vegetarian diet, when followed early in life, may cause nutritional deficiencies that could potentially disrupt the growth of infants and small children; furthermore, young children placed on extreme vegetarian diets may experience growth stunting (23). Children who change from a purely vegetarian diet to a less restrictive diet experience a marked growth spurt over the 2-year period following the change (22). As concluded by Jacobs & Dwyer, both height and weight differences, but particularly height, are affected most during the early stages of growth for children raised on extreme vegetarian diets (24).

Nutritional requirements during crucial stages of development must be met in order to ensure the optimal growth of Chinese children living in rural areas. A variety of measures to improve nutrition should be explored in such areas, paying attention to pregnant women and infants, breast-feeding mothers, and children aged 0–3 years as priority groups.

Embodying a mass of surveillance information and specific experience, the findings of the study may serve as a baseline record of the current nutritional status of children in poor rural areas of China, as well as a useful reference for the implementation of similar investigations in other areas. The improvement over the 4-year study period in the general nutritional status, based on the assessment of growth and anaemia, is encouraging. Nevertheless, the continuation and expansion of what has already been achieved is a considerable challenge. At present, a second phase of the collaborative project is under way, covering the period 1990-1994, and the number of study sites has been increased to include a total of 100 counties throughout the 27 provinces and autonomous regions of China.

Acknowledgements
The study was supported by the Chinese government and UNICEF. We are grateful to the many individuals in the seven provinces involved in the study for making this project possible; to Dr R. Parker (UNICEF) for his support in planning and implementing the project; and to Mr Yang Yueheng for his assistance during the training period.

Résumé
Etat nutritionnel des enfants d’âge préscolaire dans les régions rurales pauvres de Chine

Cet article décrit les résultats du premier projet de surveillance nutritionnelle à grande échelle réalisé sur une période relativement longue en Chine. Ce projet avait pour objectif d’identifier les principaux
problèmes nutritionnels, d’en découvrir les causes et d’élaborer des mesures appropriées fondées sur la surveillance périodique de l’état nutritionnel des enfants d’âge préscolaire dans des régions sélectionnées, afin de l’améliorer et de favoriser la croissance et le développement chez ces enfants.


Parallèlement aux progrès de la surveillance nutritionnelle, d’importants efforts ont été réalisés dans la zone étudiée pour améliorer les connaissances des agents de santé sur la nutrition. Un matériel et des méthodes didactiques uniformisés ont été utilisés à cette fin, l’accent étant mis sur les problèmes actuels et sur l’amélioration de la formation en matière de nutrition. Dans le cadre de leur travail quotidien, les stagiaires ont communiqué à la population locale des informations concernant la nutrition, et en particulier sur l’alimentation correcte des enfants. Dans tous les sites de surveillance, la production de légumes verts, l’élevage de volailles et de petit bétail, l’amélioration des approvisionnements en aliments variés et l’utilisation des méthodes indigènes de production de denrées alimentaires convenant à l’alimentation des enfants ont été encouragés, compte tenu des conditions locales. Toutes ces mesures ont eu un impact bénéfique sur l’état nutritionnel des enfants.

Par l’ampleur des données de surveillance recueillies et l’importance de l’expérience acquise, ce projet peut servir de base de référence pour l’état nutritionnel actuel des enfants des régions rurales pauvres de Chine et pour la mise en place d’investigations analogues. Le projet est en cours d’élargissement à 100 départements répartis dans toute la Chine.

References


