

## Original Article

# The relationship between socioeconomic development and malnutrition in children younger than 5 years in China during the period 1990 to 2010

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**Background and Objectives:** More than 30 years of socioeconomic development in China has improved living conditions which contributed to a steep decline in malnutrition prevalence of children under 5 years. To elucidate the role of socioeconomic development in improving nutritional status and to identify appropriate policy priorities for intervention in nutrition improvement for younger children. **Methods and Study Design:** We collected data on socioeconomic development, education, cultural and recreational services, food consumption, average family size and malnutrition prevalence from national surveys. **Results:** From 1990 to 2010, Gross Domestic Product (GDP) per capita increased from 1644 Chinese Yuan (CNY) to 30,015 CNY; average disposable income and food expenditure per capita significantly increased in urban and rural areas; per capita consumption for education increased from 112 CNY to 1628 CNY and from 15.3 CNY to 367 CNY for other cultural services; illiteracy rate decreased from 15.9% to 4.1%; average family size from 3.97 to 3.10; and prevalence of stunting and underweight decreased from 33.1% to 9.9% and 13.7% to 3.6%, respectively. However, anaemia prevalence did not obviously decline between 1992 and 2000. After adjusting confounding effects of variables, negative relationships were observed between GDP per capita, average family size and stunting or underweight prevalence. However, no association was observed between illiteracy rate and prevalence of stunting and underweight, and there was no correlation between GDP per capita, illiteracy rate, average family size and anaemia prevalence. **Conclusions:** Our results indicated that economic development cannot solve all nutritional problems and comprehensive national developmental strategies should be considered to combat malnutrition.

**Key Words:** socioeconomic development, children, malnutrition, anaemia, China

## INTRODUCTION

It is well recognized that the importance of child nutritional status as a sensitive indicator for tracking the nutritional and health status of general populations,<sup>1,2</sup> because children are the most vulnerable group to health and nutritional threats, and any change in their growth and development can impact overall socioeconomic development.<sup>3-7</sup> The more far-reaching impact is that inadequate nutrition in childhood may negatively affect their school performance,<sup>8</sup> thus lowering adult incomes,<sup>9</sup> which in turn has negative implications for national long-term sustainable development.<sup>10,11</sup> Malnutrition and anaemia among younger children hampers proper growth and brain development. These factors are in turn associated with their living environment, and with different socio-cultural measures such as average disposable income, expenditure on food and education, mother's educational status and age, family size and the overall living standard of the household.<sup>3,6,12-15</sup>

In China 30 years ago, malnutrition and nutritional anaemia in children under 5 years was a severe public health problem due to poverty, food shortages and insecurity, large families and illiteracy.<sup>16-18</sup> Since the 1980s, though, China as well as most of the emerging developing

countries have been undergoing rapid change; more than 30 years of socioeconomic development has significantly improved this situation. For example, from 1990 to 2010, Gross Domestic Product (GDP) per capita increased by 17 times,<sup>15,19</sup> the illiteracy rate decreased significantly from 15.9% to 4.1%<sup>20,21</sup> and family size was reduced from 3.97 to 3.10,<sup>22</sup> which likely contributed to rapid nutritional improvement and a steep decline in the prevalence of malnutrition in children younger than 5 years.<sup>15,23</sup> At the same time, the prevalence of underweight and stunting among children under 5 years significantly decreased from 1990 (underweight from 13.3% to 3.6 and stunting from 33.3% to 9.9%).<sup>15</sup> However, child malnutrition remains prevalent and affects the growth of children

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and economic development, and the prevalence of anaemia among children under 5 years remained between 16.5% and 12.6% without an obvious decline in China from 1992 to 2010.<sup>15,23,24</sup>

To summarize, the experience of China in the socioeconomic development and reduction in malnutrition rates among younger children can provide important insights for improving living conditions in most developing countries. However, there are few studies on systematic analysis of relationship between socioeconomic development and malnutrition in children younger than 5 years in China. The present study analysed the nationwide relationships between several variables, such as socioeconomic development including GDP per capita, illiteracy rates, average family size and food consumption. These data were available from several previous National representative sampling surveys related to children's nutritional improvement, with indicators of malnutrition including underweight, stunting and anaemia in children younger than 5 years from 1990 to 2010. The aim of this study was to elucidate the role of socioeconomic development in improving the nutritional status, and to discuss appropriate policy priorities and strategies for intervention in nutrition improvement for younger children.

## METHODS

Data on the prevalence and trends in key nutritional problems in children under 5 years and information on socioeconomic development were obtained from nationally representative surveys. Those undertaken by the National Bureau of Statistics of China (NBSC) gave information on education, cultural and recreational services, and food consumption and average family size from <http://data.stats.gov.cn/english/easyquery.htm?cn=C01>. Key data on malnutrition was supplied by the China Food and Nutrition Surveillance System (CFNSS)<sup>16,23,24</sup> and the National Nutrition Survey (NNS).<sup>17,25</sup> All data were obtained from publications or reports which are readily available in the public domain, therefore ethics approval was not required.

### Variables

GDP per capita was calculated based on Chinese Yuan

(Ren Min Bi, CNY); 100 CNY was equal to about 16.3 United States Dollars (USD) at the end of 2013. Engel's coefficient refers the ratio of consumption for foods to the proportion of whole consuming spending in one family. The illiteracy rate was defined as the percentage of illiterate people in the total population aged 15 years and above.<sup>26</sup> Average household size refers to the number of people living together, including children aged 0-5 years. Stunting was defined with reference to length or height-for-age z scores of less than -2, and being underweight was determined with reference to weight-for-age z scores of less than -2, based on the WHO Child Growth Standard (2006). The condition of being anaemia was defined as having a haemoglobin level of less than 110 g/L.<sup>27</sup>

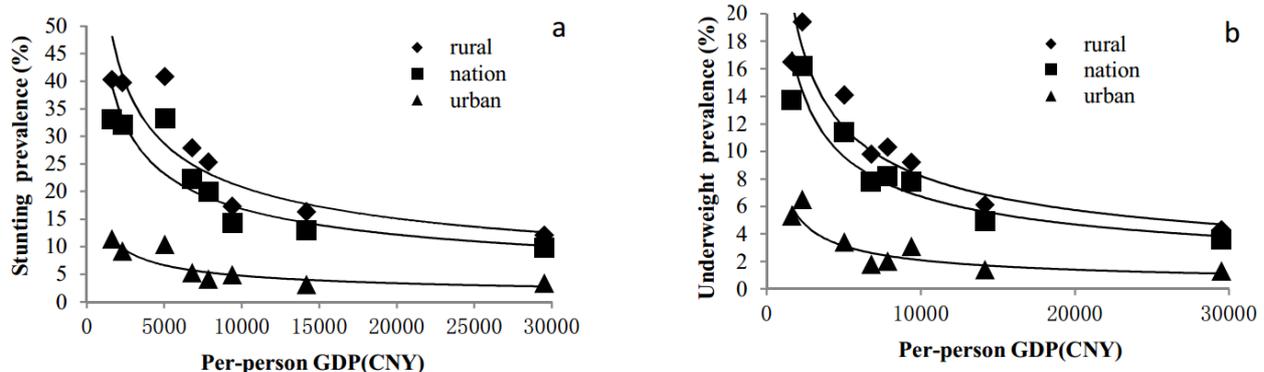
### Statistical analysis

SAS software (version 9.1, SAS Institute Inc., Cary, NC) was used for the statistical analysis. An ordinary least-squares regression model was used to estimate the impact of socioeconomic development trends on the prevalence of malnutrition. Stunting, underweight and anaemia were selected as proximal determinants, and contextual variables relating to economic development were included (GDP per capita, illiteracy rates and family size). Frequency procedure was used to assess the relationship. The trends in malnutrition over time were modelled as non-linear and varying in line with socioeconomic development.<sup>28</sup> Spearman rank-order correlation coefficients were used to analyse the relationships between such factors as economic development, educational level, family size, and the prevalence of malnutrition in children younger than 5 years. A *p* value of less than 0.05 resulting from the Spearman rank-order correlation calculations was defined as a significant correlation.

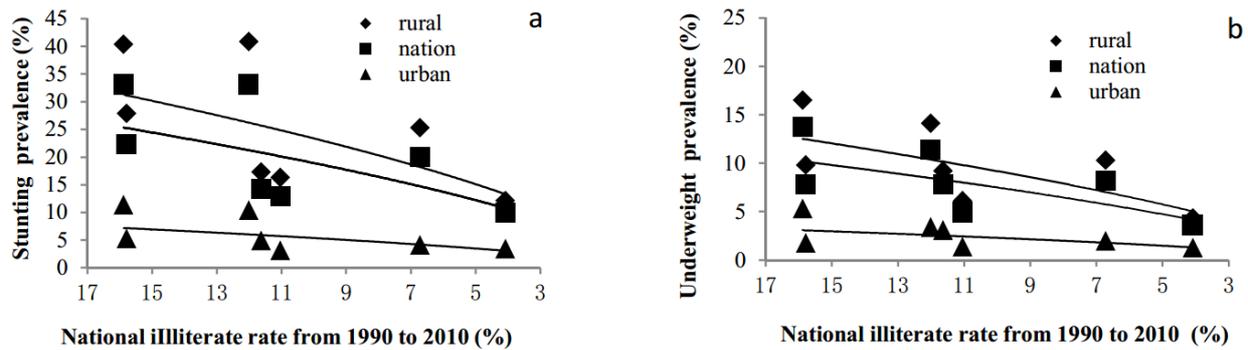
## RESULTS

### Socioeconomic development and malnutrition of children younger than 5 years

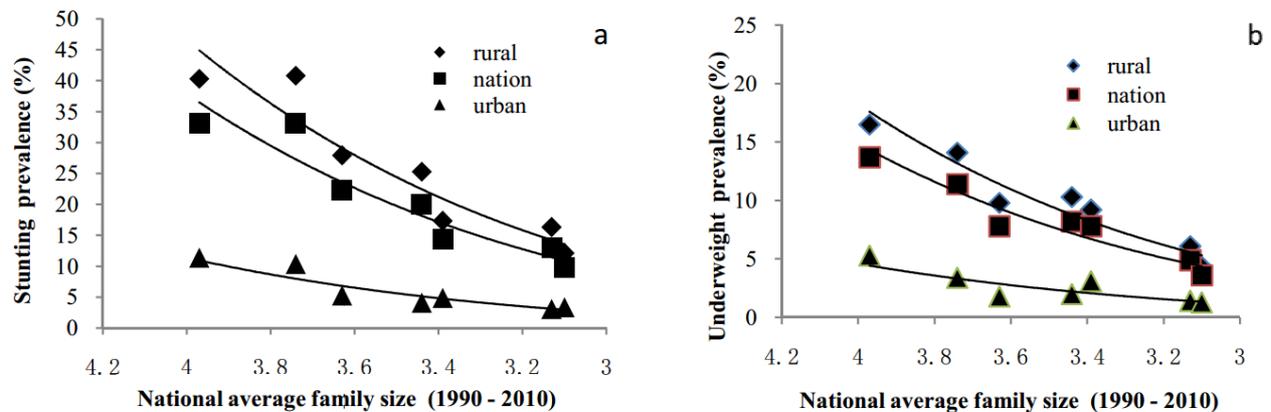
The trends in the relationship between socioeconomic development and improvements in the nutrition of children younger than 5 years are shown in Figures 1-3 and Table 1. Over the last 20 years GDP per capita in China has increased from about 1644 CNY in 1990 to 30,015



**Figure 1.** Association between GDP/person expressed by Chinese Yuan (CNY) and the prevalence of malnutrition (stunting in Figure 1a and underweight in Figure 1b) in children under 5 years in China, 1990-2010. CNY, Chinese Yuan, 100 CNY was equal to about 16.3 United States Dollar at the end of 2013. The eight surveying time-points from left to right side were respectively in 1990, 1992, 1995, 1998, 2000, 2002, 2005 and 2010 from the report of National Bureau of Statistics of China. The data on malnutrition prevalence were from China Food and Nutrition Surveillance System at the same year as the report of National Bureau of Statistics of China.



**Figure 2.** Association between illiteracy rate and the prevalence of malnutrition (stunting in figure 2a and underweight in figure 2b) in children under 5 years in China, 1990-2010. The seven surveying time-points from left to right side were respectively in 1990, 1995, 1998, 2000, 2002, 2005 and 2010 from the report of National Bureau of Statistics of China. The data on malnutrition prevalence were from China Food and Nutrition Surveillance System at the same year as the report of National Bureau of Statistics of China.



**Figure 3.** Association between average family size and the prevalence of malnutrition (stunting figure 3a and underweight figure 3b) in children under 5 years in China, 1990-2010. Average family size was expressed as person per household. The seven surveying time-points from left to right side were respectively in 1990, 1995, 1998, 2000, 2002, 2005 and 2010 from the report of National Bureau of Statistics of China. The data on malnutrition prevalence were from China Food and Nutrition Surveillance System at the same year as the report of National Bureau of Statistics of China.

CNY in 2010 (Figure 1). During such period, for urban residents, average disposable income per capita increased from 1510 CNY to 19109 CNY, average per capita consumption expenditure increased from 1279 CNY to 13471 CNY, and Engel coefficient decreased from 54.2% to 35.7%; for rural residents the absolute gains were lower, but still stable increase from 686 CNY to 5919 CNY, and from 585 CNY to 4382 CNY for average per capita consumption expenditure, and Engel coefficient decreased from 58.8% to 41.1% (Table 1). Education and cultural services consumption per person in urban areas increased from 112 CNY in 1990 to 1628 CNY in 2010, and in rural areas from 15.3 CNY in 1990 to 367 CNY in 2010. The illiteracy rate decreased from 15.9% in 1990 to 4.1% in 2010 (Figure 2), and average family size was reduced from 3.97 in 1990 to 3.10 in 2010 (Figure 3). Over the same period, the prevalence of stunting and being underweight in children younger than 5 years also significantly decreased (Table 1). In percentage terms, stunting decreased from 33.1% (11.4% and 40.3% in urban and rural) in 1990 to 9.9% (3.4% and 12.1% in urban and rural) in 2010, and the percentage of children who were underweight dropped from 13.7% (5.3% and 16.5% in urban and rural) in 1990 to 3.6% (1.3% and 4.3% in urban and

rural) in 2010.

#### ***Socioeconomic development and anaemic prevalence of children younger than 5 years***

The prevalence of anaemia did not obviously improve from 1992 to 2000 (Table 1); the percentage of anaemia in urban areas in 1992 was 13.1% and had been reduced to 12.9% by 2000, while in rural areas the corresponding figures were 17.6% and 25.8%, respectively. By 2010 there had been little change in the incidence of anaemia in urban areas (12.6%), but the incidence in rural areas had significantly decreased (to 12.6%), reversing the previous trend.

#### ***The association between the prevalence of malnutrition and anaemia and socioeconomic development***

The association between the prevalence of malnutrition and anaemia in children under 5 years and socioeconomic development is shown in Table 2. GDP was negatively associated with the prevalence of stunting and underweight and a significance was obtained for both national and rural areas. A very significant positive correlation was observed between Engel coefficient, family size and the prevalence of stunting and underweight, while a sig-

**Table 1.** The trends of the prevalence of malnutrition and anaemia in children under 5 years with socioeconomic development 1990 to 2010<sup>†</sup>

| Indicators                                       | 1990 | 1992 | 1995 | 1998 | 2000 | 2002 | 2005   | 2010   |
|--|------|------|------|------|------|------|--------|--------|
| Stunting (%)                                     |      |      |      |      |      |      |        |        |
| Urban  | 11.4 | 9.2  | 10.4 | 5.3  | 4.1  | 4.9  | 3.1    | 3.4    |
| Rural  | 40.3 | 39.7 | 40.8 | 27.9 | 25.3 | 17.3 | 16.3   | 12.1   |
| Underweight (%)                                  |      |      |      |      |      |      |        |        |
| Urban  | 5.3  | 6.5  | 3.4  | 1.8  | 2.0  | 3.1  | 1.4    | 1.3    |
| Rural  | 16.5 | 19.4 | 14.1 | 9.8  | 10.3 | 9.2  | 6.1    | 4.3    |
| Anaemia (%)                                      | --   | 16.5 | --   | 17.6 | 22.6 | 18.8 | 19.3   | 12.6   |
| GDP per capita <sup>‡</sup>                      | 1644 | 2311 | 5046 | 6796 | 7858 | 9398 | 14,185 | 30,015 |
| Average disposable income per capita             |      |      |      |      |      |      |        |        |
| Urban  | 1510 | 2027 | 4283 | 5425 | 6280 | 7703 | 10493  | 19109  |
| Rural  | 686  | 784  | 1578 | 2162 | 2253 | 2476 | 3255   | 5919   |
| Average per capita consumption expenditure (CNY) |      |      |      |      |      |      |        |        |
| Urban  | 1279 | 1672 | 3538 | 4332 | 4998 | 6030 | 7943   | 13471  |
| Rural  | 585  | 659  | 1310 | 1590 | 1670 | 1834 | 2555   | 4382   |
| Engel coefficient (%) <sup>§</sup>               |      |      |      |      |      |      |        |        |
| Urban  | 54.2 | 53.0 | 51.0 | 44.7 | 39.4 | 37.7 | 36.7   | 35.7   |
| Rural  | 58.8 | 57.6 | 58.6 | 53.4 | 49.1 | 46.2 | 45.5   | 41.1   |
| ECRSC (CNY)                                      |      |      |      |      |      |      |        |        |
| Urban  | 112  | 147  | 331  | 499  | 670  | 902  | 1098   | 1628   |
| Rural  | 15.3 | 18.4 | 102  | 159  | 187  | 210  | 296    | 367    |
| Food consumption (CNY)                           |      |      |      |      |      |      |        |        |
| Urban  | 694  | 884  | 1772 | 1927 | 1971 | 2272 | 2914   | 4805   |
| Rural  | 339  | 374  | 768  | 850  | 821  | 848  | 1162   | 1801   |
| Illiterate rate (%)                              | 15.9 | --   | 12.0 | 15.8 | 6.7  | 11.6 | 11.0   | 4.1    |
| Family size                                      | 3.97 | --   | 3.74 | 3.63 | 3.44 | 3.39 | 3.13   | 3.10   |
| Urban  | 3.50 | 3.37 | 3.23 | 3.16 | 3.13 | 3.04 | 2.96   | 2.88   |
| Rural  | 4.80 | 4.67 | 4.48 | 4.30 | 4.20 | 4.13 | 4.08   | 3.95   |

<sup>†</sup>The data was expressed as mean.

<sup>‡</sup>GDP per capita was expressed in Chinese Yuan (CNY).

<sup>§</sup>Engel coefficient (%) refers to the total food expenditure/total household or personal consumption expenditures × 100%, which is mainly explained as food expenditure proportion of total consumption with the change in income.

"--": no National data available for this year.

ECRSC: Education, Cultural and Recreation Services Consumption per person.

**Table 2.** The association analysis of the prevalence of malnutrition and anaemia in children under 5 years with socioeconomic development 1990 to 2010

| Indicator                         | Stunting prevalence (%) |          |           | Underweight prevalence (%) |         |           | Anaemia (%) |
|-----------------------------------|-------------------------|----------|-----------|----------------------------|---------|-----------|-------------|
|                                   | National                | Urban    | Rural     | National                   | Urban   | Rural     |             |
| GDP per capital <sup>†</sup>      | -0.811*                 | -0.692   | -0.816*   | -0.819*                    | -0.676  | -0.833*   | -0.614      |
| Engel coefficient                 |                         |          |           |                            |         |           |             |
| Urban                             | --                      | 0.959*** | --        | --                         | 0.839** | --        | -0.058      |
| Rural                             | --                      | --       | 0.988***  | --                         | --      | 0.911**   | 0.219       |
| Illiteracy                        | 0.626                   | 0.594    | 0.623     | 0.653                      | 0.586   | 0.653     | 0.219       |
| Family size                       |                         |          |           |                            |         |           |             |
| Urban                             | --                      | 0.959*** | --        | --                         | 0.839** | --        | 0.436       |
| Rural                             | --                      | --       | 0.988***  | --                         | --      | 0.911**   | 0.231       |
| ECRSC (CNY)                       |                         |          |           |                            |         |           |             |
| Urban                             | --                      | -0.833*  | --        | --                         | -0.770* | --        | -0.400      |
| Rural                             | --                      | --       | -0.944*** | --                         | --      | -0.973*** | -0.270      |
| Food consumption per person (CNY) |                         |          |           |                            |         |           |             |
| Urban                             | --                      | -0.746*  | --        | --                         | -0.768* | --        | -0.542      |
| Rural                             | --                      | --       | -0.831*   | --                         | --      | -0.903**  | -0.516      |

<sup>†</sup>GDP per capital was expressed in Chinese Yuan (CNY).

ECRSC: Education, Cultural and Recreation Services Consumption per person.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . "--" no data.

nificant negative correlation was shown between education, cultural and recreation services consumption per person, food consumption per person and the prevalence of stunting an underweight, but there was no correlation between illiteracy and the prevalence of stunting and underweight. However, none of the socioeconomic indica-

tors listed in Table 2 was significantly associated with anaemia prevalence.

The Spearman rank-order correlations between GDP per capita, percentage of illiteracy, average family size and malnutrition in children younger than 5 years at the national level are given in Table 3 and these analyses do

**Table 3.** Spearman rank-order correlations between socioeconomic factors and the prevalence of malnutrition in children younger than 5 years at the national level

| Prevalence of malnutrition | GDP per capita <sup>†</sup> (CNY) | Illiterate rate (%) | Average family size (person) |
|----------------------------|-----------------------------------|---------------------|------------------------------|
| Stunting                   | -0.93**                           | 0.79                | 0.96***                      |
| Underweight                | -0.93**                           | 0.69                | 0.94**                       |
| Anaemia                    | -0.03                             | -0.00               | 0.30                         |

<sup>†</sup>GDP per capita was expressed in Chinese Yuan (CNY).

\*\* $p < 0.01$ , \*\*\* $p = 0.001$ .

**Table 4.** Spearman rank-order correlations between socioeconomic factors and the prevalence of malnutrition in children younger than 5 years in urban and rural areas

| Prevalence of malnutrition | ADI      | ACE      | Engel C | ECRSC    | Food C   | Family S |
|----------------------------|----------|----------|---------|----------|----------|----------|
| Urban                      |          |          |         |          |          |          |
| Stunting                   | -0.93*** | -0.93*** | 0.93*** | -0.93*** | -0.93*** | 0.93***  |
| Underweight                | -0.88**  | -0.88**  | 0.88**  | -0.88**  | -0.88**  | 0.88**   |
| Rural                      |          |          |         |          |          |          |
| Urban                      | -0.93*** | -0.93*** | 0.98*** | -0.93*** | -0.86**  | 0.93***  |
| Underweight                | -0.95*** | -0.95*** | 0.90**  | -0.95*** | -0.95*** | 0.95***  |

ADI: Average Disposable Income per capita; ACE: Average Consumption Expenditure per capita; Engel C: Engel Coefficient; ECRSC: Education, Cultural and Recreation Services Consumption per person; Food C: food consumption; Family S: family size.

\*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

not adjust for the other confounding effects. The prevalence of stunting and underweight was found to have a negative association with GDP per capita ( $p < 0.01$ ) and a strong positive association with average family size ( $p < 0.01$  or  $0.001$ ), and a weak positive association with education levels and the illiteracy rate ( $p > 0.05$ ). However, there appears to be no distinct correlation between socioeconomic factors and the prevalence of anaemia ( $p > 0.05$ ).

The Spearman rank-order correlation analysis (data were not shown here) among the socioeconomic variables showed that the illiteracy rate and average family size were negatively associated with GDP per capita ( $N=7$ ,  $R=-0.86$  and  $-0.99$ ,  $p < 0.05$  or less), and the illiteracy rate was positively associated with average family size ( $N=7$ ,  $R=0.86$ ,  $p < 0.05$ ); significantly positive associations were found between food consumption and education, cultural services and recreation consumption and average family size ( $N=8$ ,  $R=0.93$  and  $1.00$ ,  $p < 0.05$ ), and there was a negative association between cultural and recreation consumption and average family size ( $N=8$ ,  $R=-1.00$ ,  $p < 0.05$ ) in urban and rural areas.

Spearman rank-order correlation between socioeconomic factors and the prevalence of malnutrition in children younger than 5 years in urban and rural areas is shown in Table 4. Significantly negative relationships were noticed between the average disposable income per capita, average consumption expenditure per capita, education, cultural and recreation services consumption per person and malnutrition (stunting and underweight) in urban and rural areas respectively, however, significantly positive associations were observed between Engel coefficient, family size and malnutrition in urban and rural areas respectively.

## DISCUSSION

In the present study we analysed the relationship between socioeconomic development and malnutrition in children

younger than 5 years in China during 1990 to 2010, which indicated that socioeconomic growth played an important role in reducing the prevalence of malnutrition in children.

The variability in child growth environments across nations is due much more to social, demographic, economic factors and socioeconomic inequality than to genetics,<sup>13,29-33</sup> For example, the study of birth cohorts on nutritional status and economic development in 28 sub-Saharan African countries found that economic growth had a significant influence on final adult height,<sup>34</sup> and the Great Famine lasting three years which occurred in the early 1960s in China had resulted in higher prevalence of severe protein-energy malnutrition in children.<sup>35</sup> Macroeconomic growth is generally considered to be related to the nutrition status in developing countries.<sup>36-38</sup> The increases in income for all population groups, especially among low-income groups, enable them to access and to consume nutrition-promoting foods, and the increase of investment in public programs such as educational and cultural services are also of benefit to nutritional improvements. This study analysed the malnutrition trends of younger children and their relation to socioeconomic development and to systematically address the socioeconomic factors which would affect children's nutritional outcomes.

In China, a substantial decline in malnutrition rates in children under 5 years has been achieved in the past two decades, and the percentages of stunting and underweight have been reduced from 33.1% and 13.7% in 1990 to 9.9% and 3.6% in 2010, respectively.<sup>15,23</sup> This tremendous decline could be related to socioeconomic determinants (Figures 1-3). First, China has recorded rapid economic growth in the past two decades, and accompanied with significant increases in GDP per capita<sup>19,20,39</sup> and the average disposable income per capita in urban and rural residents.<sup>15</sup> The present study indicated the important role of economic growth in reducing the prevalence of under-

weight and stunting in children. During the early stages of economic development from 1990 to 2003, the impact of economic growth on improvements in child nutrition was fast and marked, when GDP per capita was less than 1000 USD (Figure 1). Nevertheless, by 2010 the contributory benefit from economic development to the improvement of malnutrition prevalence in younger children was no stronger than those of increases in educational levels (Figure 2), and reduction in family size (Figure 3) resulting from China's family planning policy. These results indicate that a plateau effect of economic development on nutritional improvement of children does exist.<sup>6</sup> Second, food supplies have been improved in both urban and rural areas with economic development and average per capita food expenditure has increased about 6 times. Third, the implementation of national family planning policy has significantly reduced the average family size from 3.97 to 3.10 which mean that the family has fewer children to bring up.<sup>40,41</sup> Our analysis showed that a strong positive correlation existed between family size and child malnutrition (Table 2-4) which indicated that the observed decline in family size was a definite contributor to the nutritional improvements and in combating malnutrition deficiencies in children. Finally, China established a free nine-year compulsory education system in 1984, which enabled all children to attend primary and middle schools.<sup>1,21,39-44</sup> The significant increase in consumption per person of education and cultural services and the national investment in these have decreased illiteracy from 15.9% to 4.1% (Table 1). In addition, more and more child-bearing women with more years of schooling have entered the labour market, contributing to increasing incomes, the increase of average disposable income per capita and the improvement of their living conditions. However, compared with economic growth and family size, the educational effects attributed to nutritional improvements in children appear to be relatively weak. Nevertheless, international experience has shown that educational interventions in relation to national nutritional status are not useless. This is especially true when the effects of economic growth and family size reductions on the improvement of the nutritional status of children have reached a plateau. Malnutrition in children is an interaction outcome of various factors resulting from unfavourable socioeconomic circumstances.<sup>1,3,15</sup> In recent years, the role of the family as an important influence on the nutritional status of children has been emphasized.<sup>45</sup> Using an Spearman rank-order correlation analysis to explore changing trends on the prevalence of malnutrition, positive relationships were obtained between GDP per capita and average family size and measures of stunting or underweight ( $p < 0.001$ ), while no association was observed between the rate of illiteracy and measures of stunting or underweight (Table 3). This result indicates that both GDP per capita and average family size are the main determinants of child nutritional status in urban and rural areas (Table 4), which are closely related to the average disposable income per capita, average consumption expenditure and Engel coefficient.

However, economic growth and reductions in family size cannot solve all nutritional problems. The present study found that anaemia prevalence did not vary be-

tween urban and rural areas.<sup>6,15</sup> Spearman rank-order correlation coefficient analysis showed that there was no obvious correlation between socioeconomic factors and anaemia prevalence at the national level (Table 1 and Table 3). While anaemia prevalence has fluctuated during the past two decades, improvements were very limited during this period, and up to 12.6% of the population still suffered from anaemia in 2010<sup>23,24</sup> because the prevalence and severity of anaemia in younger children is influenced by complex and multidimensional factors such as socioeconomic, individual healthy and nutritional status, biological, environmental, and cultural characteristics.<sup>46-48</sup>

It has been documented that the implementation of poverty alleviation and development policies in rural areas in China has resulted in a great decline in rural poverty and an increase in personal income. This has in turn made more low-income people eligible for government support and assistance, and has contributed to the added expenditure on food that ensures nutritional improvement and combating of anaemia in children.<sup>15,49</sup> However, to solve the general nutrition problems in younger children, especially micronutrient deficiencies in poor areas, national nutritional intervention strategies should be considered as being as important as economic development, a national family planning policy to control population growth, and improving education levels (especially of child-bearing women).<sup>49-51</sup> At the same time, providing complementary food supplements to ensure the nutritional improvement of children living in poor areas and implementing national food-based fortification for the key nutritional problems are as important as poverty alleviation and steady increases in household income.<sup>49</sup>

The current study has certain limitations. The study cited data from cross-sectional representative surveys and so it cannot draw conclusions about causality. The nature of national representative data from different government departments also means that missing data occurred, other confounding factors may be available and these data are obtained from publications or reports without the variability of these data, and this inevitably affected the uncertainty to the present study.

In conclusion, this study estimated the trends in socioeconomic development and malnutrition improvement in younger children and provided information about the impact of socioeconomic factors on the nutritional status of younger children. The plateau effect of economic development on nutritional improvement of children does exist and economic development cannot solve all nutritional problems. Comprehensive national socioeconomic developmental strategies should be considered to solve these problems.

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#### AUTHOR DISCLOSURES

All authors read and approved the final manuscript and there are no conflicts of interest. Shi-an Yin and Zhenyu Yang designed the study; Lifang Wu, Zhenyu Yang, Mei Zhu and Huiyu Gao collected, checked, treated and analysed data; Lifang Wu and Shi-an Yin wrote the paper; Shi-an Yin had primary responsibility for the final content.

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## Original Article

# The relationship between socioeconomic development and malnutrition in children younger than 5 years in China during the period 1990 to 2010

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## 中国社会经济发展与5岁以下儿童营养不良的关系-1990~2010

**背景与目的：**超过30年的中国社会经济持续发展明显改善了人们的生存环境，显著降低了5岁以下儿童营养不良率。本研究的目的是为了阐明社会经济发展在改善营养不良中的作用以及确定幼儿营养改善干预中优先考虑的政策。**方法与研究设计：**我们收集了全国调查的社会经济发展、教育、文化和娱乐设施、食物消费、平均家庭人口以及营养不良率的数据。**结果：**从1990到2010年，人均国民生产总值（GDP）从1644元增加到30015元；城乡人均可支配收入和食品消费均显著增加，人均教育消费支出从112元增加到1628元，用于其它文化消费支出从15.3元增加到367元；文盲率由15.9%降低到4.1%；平均家庭人口由3.97降低到3.10；生长迟缓和低体重患病率分别从33.1%和13.7%下降到9.9%和3.6%。然而，贫血的患病率从1992年到2000年期间没有明显下降。调整了混杂因素后，人均GDP、平均家庭人口与生长迟缓和低体重率呈显著负相关。然而，文盲率与生长迟缓和低体重率间没有相关性，并且人均GDP、文盲率和平均家庭人口与贫血率间也没有相关性。**结论：**我们的研究结果表明，社会经济发展并不能完全解决儿童的营养问题，应考虑全面的国家发展战略以解决营养不良问题。

**关键词：**社会经济发展、儿童、营养不良、贫血、中国