Nutritional challenges for children in China (transition societies)

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Per Capita GDP in Major Cities in China 1997–2016

Data from: National Bureau of Statistics of China
Problems in Transitional Countries

1. Malnutrition
2. Stunting growth & micronutrient deficiency
3. Childhood overweight/obesity
4. NCDs

What & How to do in transitional countries?
Globalization has played a major role in changes of dietary patterns and lifestyle. A traditional low-fat diet is replaced by a Westernized fat-rich diet. Energy intake does not equal energy expenditure, leading to varying degrees of malnutrition in "left-behind" or "floating" children.
• Premature infants in China
  Birth weight change
  EUGR in premature infants of hospitalization

• Growth faltering in Children
  Prevalence in urban and rural area
  Disease related in children of hospitalization

• Overweight and obesity in Children

• Food allergy
Global Epidemiologic Data for Premature Infants

• 15 million premature infants yearly from WHO reported and over 10% total number of newborns. Top 2 for China.

Top 10 countries for number of premature infants

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Rank</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>India</td>
<td>6</td>
<td>USA</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>7</td>
<td>Bangladesh</td>
</tr>
<tr>
<td>3</td>
<td>Nigeria</td>
<td>8</td>
<td>Philippines</td>
</tr>
<tr>
<td>4</td>
<td>Pakistan</td>
<td>9</td>
<td>Congo</td>
</tr>
<tr>
<td>5</td>
<td>Indonesia</td>
<td>10</td>
<td>Brazil</td>
</tr>
</tbody>
</table>

Epidemiologic Data from China for Premature infants

- 7.8% in 2005 report from Neonates Working Group of Chinese Society of Pediatrics
- 1.0-1.2 million in China yearly
- 1.2-1.4 million in China Recent 2 years
Number of Premature Going Up

- Up with multiple births increasing
- 6 times premature infant incidence for twins and multi births
- High incidence in Teenage pregnancy
- Smoking mothers induce low birth weight

Data from: National Center for Health Statistics. 2003 final natality data.
Data prepared by March of Dimes Perinatal Data Center; 2005
Birth weight changes in a major city under rapid socioeconomic transition in China

Jian-Rong He¹ ², Wei-Dong Li¹ ², Min-Shan Lu¹ ², Yong Guo¹ ², Fan-Fan Chan¹ ², Jin-Hua Lu¹ ², Li-Fang Zhang¹ ², Song-Ying Shen¹ ², Xiao-Yan Xia¹ ², Ping Wang², Wei-Jian Mo², Kin Bong Hubert Lam³ ⁴, Jane E. Hirst⁴, Hui-Min Xia¹ & Xiu Qiu¹ ²

Objectives

• **Estimates of trends in birth weight may be useful in evaluating population health.**

Babies with birth weights outside the normal range have higher risks of mortality and morbidity in the perinatal period and later in life.

• **To determine whether temporal changes in birth weight have occurred amongst 2.3 million neonates born in Guangzhou, China, during 2001–2015.**

SGA(birth weight <10th centile) , LGA( birth weight >90th centile)

• **To investigate the socioeconomic determinants of any changes.**

Maternal age, education, residence location, maternal care.
Risk of SGA/LGA

**SGA**
- **During perinatal period**
  - respiratory complications
  - hypoglycemia
  - necrotizing enterocolitis
- **In childhood**
  - neurological impairment
- **In adulthood**
  - cardiovascular disease
  - type 2 diabetes mellitus

**LGA**
- **During perinatal period**
  - birth trauma
  - cesarean section
  - postpartum hemorrhage
- **In adulthood**
  - obesity
  - metabolic syndrome
  - type 2 diabetes mellitus
Results

- After adjustment for gestational length, the decline in birth weight was 0.37 grams/year from 2001 to 2015.
- The incidence of both SGA and LGA significantly decreased during the study period.
- A narrowing of disparities in SGA and LGA incidence across different maternal educational levels and residence location.
Conclusion

- Mean birth weight decreased slightly in Guangzhou during 2001-2015
- A substantial improvement in key fetal growth indicators (SGA and LGA) in Guangzhou during 2001–2015
- There has been an increase in the proportion of neonates born in the healthy birth weight range in Guangzhou during 2001–2015
Hospitalized Premature less than Fetus growth in weight gain

### Percentage of EUGR in premature infants

<table>
<thead>
<tr>
<th></th>
<th>Shanghai (n=1196)</th>
<th>China (n=974)</th>
<th>USA (n=24371)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt less than 10(^{th})% at discharge</td>
<td>49.7%</td>
<td>60%</td>
<td>28%</td>
</tr>
<tr>
<td>Length less than 10(^{th})% at discharge</td>
<td>—</td>
<td>59%</td>
<td>34%</td>
</tr>
<tr>
<td>Head circumference less than 10(^{th})%</td>
<td>23.1%</td>
<td>30%</td>
<td>16%</td>
</tr>
</tbody>
</table>
Faltering Growth Definition for Children

- Growth less than 3% or 5%
- Growth down two percentage line (from 75% down to 25%)
- Chinese Criteria
- Common Sense – “No single measurement can predict only”

<table>
<thead>
<tr>
<th>Types</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>underweight (&lt;-2SD weight-for-age)</td>
<td>≤ -2SD ~ -3SD</td>
</tr>
<tr>
<td>stunting (-2SD height-for-age)</td>
<td>≤ -2SD ~ -3SD</td>
</tr>
<tr>
<td>wasting (&lt;-2SD weight-for-height)</td>
<td>≤ -2SD ~ -3SD</td>
</tr>
</tbody>
</table>

Growth Faltering in Middle/Low Income Countries

- Children growth data from 54 Middle/Low income countries
UNICEF reported in 2009

《Nutritional status in children and mothers》

• Although China make great progress in reducing the prevalence of malnutrition, still 12.70 million children were suffered growth faltering under 5 years old.
• Top 2 on the world in total number of Chinese children growth faltering.
Growth faltering between urban and rural area in China

Rural area (11.7%) : Urban(2.2%) = 5.3 times
Prevalence of Growth Faltering in Different Area in China

Occurrence of Growth faltering (%)

- East coastal: 4.9%
- Middle area: 11.8%
- West area: 13.9%
Yearly income < RMB 2300 (national low income county)

- Guangxi: Leye
  719 students from 6 schools

- Yunnan: Xundian
  864 students from 3 schools

Investigators: W Cai, XH Shen,
KF Yang, Linxi Qian
Nutritional Status of Elementary School Students in South-Western Area
Nutritional Status of Elementary School Students in South-Western Area

Malnutrition rate of 6-14 year-old children in Guangxi and Yunnan (%)

| 年龄 | 评价人数 | 男 | | | | 女 | | | | | 合计 | | | |
|-----|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|     |          | 营养不良 | 低重 | 常重 | 超重 | 肥胖 | 评价人数 | 营养不良 | 低重 | 常重 | 超重 | 肥胖 | 评价人数 | 营养不良 | 低重 | 常重 | 超重 | 肥胖 |
| 6~  | 74       | 0.0 | 60.8 | 35.1 | 2.7  | 1.4  | 63         | 12.7 | 57.1 | 30.2 | 0.0  | 0.0  | 137         | 5.8 | 59.1 | 32.8 | 1.5  | 0.0  |
| 7~  | 106      | 3.8 | 52.8 | 40.6 | 1.9  | 0.9  | 122        | 2.5  | 50.8 | 43.4 | 0.8  | 2.5  | 228         | 3.1 | 51.8 | 42.1 | 1.3  | 1.8  |
| 8~  | 141      | 2.8 | 44.7 | 48.2 | 1.4  | 2.8  | 122        | 3.3  | 47.5 | 46.7 | 0.8  | 1.6  | 263         | 3.0 | 46.0 | 47.5 | 1.1  | 2.3  |
| 9~  | 129      | 2.3 | 43.4 | 49.6 | 0.8  | 3.9  | 117        | 1.7  | 43.6 | 47.0 | 4.3  | 3.4  | 246         | 2.0 | 43.5 | 48.4 | 2.4  | 3.7  |
| 10~ | 141      | 3.5 | 36.9 | 51.1 | 3.5  | 5.0  | 138        | 4.3  | 39.9 | 55.1 | 0.7  | 0.0  | 279         | 3.9 | 38.4 | 53.0 | 2.2  | 2.5  |
| 11~ | 166      | 3.0 | 63.3 | 32.5 | 0.0  | 1.2  | 166        | 4.8  | 29.5 | 60.2 | 4.8  | 0.6  | 332         | 3.9 | 46.4 | 46.4 | 2.4  | 0.9  |
| 12~ | 203      | 3.9 | 64.5 | 27.1 | 2.5  | 2.0  | 169        | 8.3  | 67.5 | 22.5 | 0.6  | 1.2  | 372         | 5.9 | 65.9 | 25.0 | 1.6  | 1.6  |
| 13~ | 60       | 10.0 | 88.3 | 1.7  | 0.0  | 0.0  | 52         | 7.7  | 44.2 | 38.5 | 5.8  | 3.8  | 112         | 8.9 | 67.9 | 18.8 | 2.7  | 1.8  |
| 14~ | 15       | 26.7 | 60.0 | 13.3 | 0.0  | 0.0  | 8          | 0.0  | 37.5 | 37.5 | 25.0 | 0.0  | 23          | 17.4 | 52.2 | 12.7 | 8.7  | 0.0  |
| 总计 | 1035     | 3.8 | 55.1 | 37.2 | 1.6  | 2.3  | 957        | 5.1  | 47.1 | 44.0 | 2.3  | 1.5  | 1992        | 4.4 | 51.3 | 40.5 | 2.0  | 1.9  |

Compare with national students results in 2005
Malnutrition 7.88%, underweight 45.53%
Anemia prevalence of 6-14 year-old children in Guangxi and Yunnan (%) compared with national and rural results in 2002.

Prevalence for boy:
- South-western area: 20.5%
- Nationwide 2002: 20.1%
- Rural area 2002: 20.9%

Prevalence for girl:
- South-western area: 20.5%
- Nationwide 2002: 20.9%
- Rural area 2002: 20.9%
Prevalence of Stunting in Different Age Children in China

Stunting less than 12m 6.1%, 12m to 24m going up 12.9%, then down to 8% at 36m and up again to 13.1% at 60m
Growth Faltering in Hospitalized Children in Shanghai

(3 hospitals in Shanghai: n=2274, 1~175m)

Prevalence of Growth Faltering in Hospitalized Children

Pawellek et al, 2008
### Disease Related Children Growth Faltering

<table>
<thead>
<tr>
<th>GI</th>
<th>Surgery or Stress</th>
<th>Heart or Lung</th>
<th>Tumor</th>
<th>Nerve System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>Peri-op</td>
<td>CHD</td>
<td>Leukemia</td>
<td>Cerebral palsy</td>
</tr>
<tr>
<td>GERD</td>
<td>Trauma</td>
<td>RD</td>
<td>Solid tumor</td>
<td></td>
</tr>
<tr>
<td>Acute Pancreatitis</td>
<td>Burn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What's the Problem in China for Overweight or Obese Children
### Chronic Diseases Going Up in Different Country in Children

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Number</th>
<th>Age</th>
<th>CD</th>
<th>Prevalence(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1988-1994</td>
<td>2450</td>
<td>12-18</td>
<td>Fatty Liver</td>
<td>3.0</td>
</tr>
<tr>
<td>Italy</td>
<td>2004</td>
<td>3923</td>
<td>6-11</td>
<td>Hypertension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Boy : 9.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Girl : 13.9</td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>2003-2004</td>
<td>4811</td>
<td>6-18</td>
<td>HDL ↓ TG ↑</td>
<td>28.0% 20.1%</td>
</tr>
<tr>
<td>USA</td>
<td>1988-1994</td>
<td>2430</td>
<td>12-19</td>
<td>Metabolic Syndrome</td>
<td>4.2</td>
</tr>
</tbody>
</table>
Epidemic Obesity and Diabetes Threatens Asia
— REUTERS

China: Affluence Brings Diabetes
— NYT

India, More Wealth and More Diabetes
— IHT

How Asia Got Fat?
— TIME Asia
Prevalence in Big Cities of China

- 6-8 years old in Beijing in 2004 (n=10221)
  - Overweight: 12.5%; Obesity: 15.4%

- School children from Shanghai survey in 2005
  - Obesity: 11.5% in 7-22 years old
    - Up 3.1% compared in 2000
  - Boys in Downtown 15.1%
    - 3.1% higher than national lever of the same age group
  - Girls in Downtown 9.2%
    - 4.19% higher than national lever of the same age group
Prevalence of Obesity in Past 30 Years in Shanghai

prevalence of obesity

- 80s: 2.0%
- 90s: 8.0%
- Latest: 11.5%
Food Allergy in Infants & Toddlers

- Food allergy is more common in infants and toddlers than in adults
  - Affects up to 6-8% of children
- Cow’s milk proteins (CMPs) are one of the most common food allergens in infancy and early childhood
  - Majority of children acquire tolerance to cow’s milk by age 5
  - Those with peak CM-IgE >50 kIU/L likely to retain cow’s milk allergy until teenage years

According to the **Centers for Disease Control**, pediatric food allergies increased from 3.1% in 1998 to 5.1% in 2011.

According to the **National Institute of Allergy and Infectious Diseases (NIAID)**, CMPs is the most prevalent food allergy in infants and children 0-2 years of age.

Jackson et al 2013
Boyce et al 2010
**Common Food Allergens in Infants**

**HealthNuts Study, n=2,848 infants at 12 months**

<table>
<thead>
<tr>
<th>Allergen</th>
<th>+IgE</th>
<th>Oral Food Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow's milk</td>
<td>5.6%</td>
<td>Not performed</td>
</tr>
<tr>
<td>Egg white</td>
<td>16.5%</td>
<td>8.9%*</td>
</tr>
<tr>
<td>Peanut</td>
<td>8.9%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Sesame</td>
<td>2.5%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Shellfish</td>
<td>0.9%</td>
<td>Not performed</td>
</tr>
</tbody>
</table>

*raw egg; 80% tolerated baked egg

Nutrition and Food Allergies

Most common allergenic foods:

- Shellfish: 37.8%
- Hen's egg: 14.5%
- Peanut: 8.5%
- Dairy product: 10.8%
- Combined fruits: 8.5%
- Manioc and pequi:
Lactose Intolerance

- Inability to digest lactose, a sugar found in milk and to a lesser extent dairy products, causing side effects
- Congenital lactase deficiency prevents babies from drinking even human milk; extremely rare!
- Lactose-intolerant individuals have insufficient levels of lactase, an enzyme that catalyzes the hydrolysis of lactose into glucose and galactose, in their digestive system
Is Time for ACTION
Double Burden
Low Income Maintain Area

- Every mountain area student gets 4 yuan RMB per day for nutritional supplement
- Cover 32 millions students
- Financial support from central government
Recent progress of NIPRCES in China

○ Nutrition Improvement Program for Rural Compulsory Education Students (NIPRCES)

✓ School feeding mode has become the dominant catering mode in NIPRCES-covered schools

✓ 95% of schools used the school feeding mode

✓ 52% of the schools manifested that the amount of energy, protein, fat, and two trace elements in school meals met the national recommendation
Recent Progress of NIPRCES in China

- A study of 1,920,000 students who benefited from NIPRCES found that the physical status of students from impoverished areas has significantly improved.

Data from: Report of China Development Research Foundation: progress in nutrition improvement of rural students in poverty-stricken areas
Recent Progress of NIPRCES in China

- Data shows that malnutrition rate decreased from 18.5% in 2012 to 15.4% in 2016.

Data from: Report of China Development Research Foundation: progress in nutrition improvement of rural students in poverty-stricken areas
Obesity in Cities

School based intervention for obesity

Grade 1-2

Grade 3-5

Parents education

High School

Middle School
NST program in Children’s Hospital of China

Hangzhou, Nanjing, Beijing, Suzhou, Chongqing, Zhongshan
Key Challenges in China

- Education in medical staff in whole country
- Make popular for NST in the hospital
- Make a suitable policy or regulation (RD system)
- Do high quality research
- Join international academic activity
- More contribution in the international lever
  - Organize international meetings
  - Peer-review international journal editorial board
  - Publish more scientific papers
Acknowledgement

- Faculty from department of clinical nutrition, Xinhua hospital, School of Medicine, Shanghai Jiao Tong University
- Faculty from department of clinical nutrition, Renji hospital, School of Medicine, Shanghai Jiao Tong University
- Faculty from Division of Pediatric GI and Nutrition, Xinhua hospital, School of Medicine, Shanghai Jiao Tong University
- Faculty from Shanghai Key Lab of Pediatric GI and Nutrition
- Faculty from department of nutrition, School of Medicine, Shanghai Jiao Tong University
Acknowledgement
Thank You