Environmental Factors Leading to Pediatric Obesity in the Developing World

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A recent report of World Health Organization indicated that there is a global epidemic of obesity, affecting both developed and developing countries (1). Though there is much published information from developed countries about obesity and about its causes and its consequences for health, information from developing countries is limited, especially for childhood obesity. Onis and Blossner (2) and Martorell et al. (3) analyzed the prevalence of overweight and obesity in children in developing countries and concluded that—although undernutrition remained a major public health problem—obesity among children did not seem to be of great importance in such countries. However, further surveys from developing countries (1,4–6) have indicated that the prevalence of overweight and obesity in childhood and adolescence has been increasing rapidly in the past two decades and has now reached epidemic proportions. It appears that obesity has, in fact, become a public health problem in some developing countries, and intervention strategies should be put in place to try to limit its incidence.

As there is a lack of effective measures for treating obesity, the most effective and economical strategy is to prevent obesity at an early stage of life. Contributing factors to the onset and development of obesity should be identified so that an effective preventive strategy can be developed. Although genetic factors play an important role in determining individual susceptibility to obesity (7), genetics cannot explain the current obesity epidemic, as our genes have not changed substantially during the past two decades. This suggests that the primary cause of the rapid increase in obesity lies in environmental and social factors (8).

The study described in this chapter was designed to explore the environmental factors concerned with childhood obesity in China and to provide scientific information that will help in developing effective intervention strategies. These data may also serve as reference data for other developing countries.
SUBJECTS AND METHODS

Subjects

The investigation was carried out in 1999 and involved 9,356 children (4,570 boys and 4,786 girls) aged 4 to 17 years. They were selected from four eastern cities of China (Guangzhou, Shanghai, Jinan, and Haerbin) using a stratified multistage cluster random sampling method. Three kinds of questionnaire were designed to obtain information from preschool children, elementary students, junior students, and their respective parents. The questionnaires were interview administered for children aged 4 to 8 years, and self-administered for students older than 8 years and for all the parents.

The weight and height of the children were measured by trained interviewers following a standardized procedure. Overweight and obesity were defined as weight-for-height exceeded 110% and 120%, respectively, of the WHO reference for children aged 4 to 6.9 years, and of Chinese standards for children aged 7 to 17 years.

In the analysis of the prevalence of overweight and obesity, the following variables were considered: sex, age, age group (preschool, elementary, and junior school students), domicile region (northeast, east, mid-south), domicile situation (urban or suburban), domiciliary monthly per capita income in renminbi yuan (RMB) (distributed in three categories: low income, less than RMB 293.20; middle income, RMB 293.20 to 722.90; high income, over RMB 722.90) (9), educational level of the parents, breakfast frequency (0 to 1 per week, 2 to 4 per week, 5 to 7 per week), television viewing time (less than 1 hour per day, 1 to 2 hours per day, 2 to 3 hours per day, more than 3 hours per day), fast food consumption (never, 1 to 2 times per month, 3 to 4 times per month), and desired body size.

The hypothesis of no association between groups of children and the demographic characteristics of the groups was tested using the chi distribution. Logistic regression models were developed using the SAS 6.12 program to identify factors characterizing obesity, after adjustment for possible confounding and interactive effects. Factors examined were sex, age group, domicile region, domicile situation, income, educational level of parents, breakfast frequency, fast food consumption, television viewing hours, and desired body size. Odds ratios (OR) and their 95% confidence intervals (CI) were calculated. All p values were two-sided. A p value of < 0.05 was accepted as statistically significant.

RESULTS

The prevalence of overweight and obesity among children and adolescents according to age and sex are presented in Table 1. The overall prevalences of overweight and obesity were 12.1% and 11.9%, respectively. Overweight and obesity were more prevalent in boys than in girls (13.2% versus 11.0%; 14.8% versus 9.3%). The peak prevalence of obesity was 19.3% in boys 12 years of age and 13.1% in girls 13 years of age.

The prevalence of obesity in relation to the demographic characteristics of the subjects is given in Table 2. Boys were about 1.6 times more liable to obesity than girls (OR, 1.567; 95% CI, 1.345 to 1.827). The prevalence of obesity was 13.6% in the
TABLE 1. Prevalence (%) of overweight and obesity (weight-for-height) according to age and sex

<table>
<thead>
<tr>
<th>Age</th>
<th>M</th>
<th>F</th>
<th>T</th>
<th>N</th>
<th>M</th>
<th>F</th>
<th>T</th>
<th>M</th>
<th>F</th>
<th>T</th>
<th>M</th>
<th>F</th>
<th>T</th>
<th>M</th>
<th>F</th>
<th>T</th>
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</thead>
<tbody>
<tr>
<td>4-</td>
<td>334</td>
<td>337</td>
<td>671</td>
<td>11.1</td>
<td>9.2</td>
<td>10.1</td>
<td>20.1</td>
<td>19.0</td>
<td>19.5</td>
<td>31.2</td>
<td>28.2</td>
<td>29.6</td>
<td></td>
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<tr>
<td>5-</td>
<td>362</td>
<td>370</td>
<td>732</td>
<td>10.5</td>
<td>11.1</td>
<td>10.8</td>
<td>18.0</td>
<td>18.9</td>
<td>18.4</td>
<td>28.5</td>
<td>30.0</td>
<td>29.2</td>
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<tr>
<td>6-</td>
<td>365</td>
<td>344</td>
<td>709</td>
<td>11.5</td>
<td>9.6</td>
<td>10.6</td>
<td>16.2</td>
<td>12.8</td>
<td>14.5</td>
<td>27.7</td>
<td>22.4</td>
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<tr>
<td>7-</td>
<td>323</td>
<td>300</td>
<td>623</td>
<td>16.1</td>
<td>7.7</td>
<td>12.0</td>
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<td>11.7</td>
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<td>18.4</td>
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<tr>
<td>8-</td>
<td>332</td>
<td>325</td>
<td>657</td>
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<td>10.1</td>
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<td>11.4</td>
<td>28.7</td>
<td>14.1</td>
<td>21.5</td>
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<td>9-</td>
<td>381</td>
<td>367</td>
<td>748</td>
<td>17.9</td>
<td>10.6</td>
<td>14.3</td>
<td>11.3</td>
<td>10.1</td>
<td>10.7</td>
<td>29.2</td>
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<td>25.0</td>
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<td>776</td>
<td>14.4</td>
<td>11.8</td>
<td>13.0</td>
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<td>10.6</td>
<td>12.8</td>
<td>29.6</td>
<td>22.4</td>
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<tr>
<td>11-</td>
<td>396</td>
<td>400</td>
<td>796</td>
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<td>12-</td>
<td>400</td>
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<td>866</td>
<td>19.3</td>
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<tr>
<td>13-</td>
<td>391</td>
<td>374</td>
<td>765</td>
<td>17.1</td>
<td>13.1</td>
<td>15.2</td>
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<td>10.2</td>
<td>10.7</td>
<td>28.4</td>
<td>23.3</td>
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<td>392</td>
<td>484</td>
<td>876</td>
<td>11.2</td>
<td>7.2</td>
<td>9.0</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>17.6</td>
<td>13.6</td>
<td>15.4</td>
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<td>15-</td>
<td>376</td>
<td>424</td>
<td>800</td>
<td>13.6</td>
<td>5.0</td>
<td>9.0</td>
<td>11.2</td>
<td>9.2</td>
<td>10.1</td>
<td>24.8</td>
<td>14.2</td>
<td>19.1</td>
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<tr>
<td>16-</td>
<td>149</td>
<td>188</td>
<td>337</td>
<td>18.1</td>
<td>3.7</td>
<td>10.1</td>
<td>11.4</td>
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<td>8.0</td>
<td>29.5</td>
<td>9.0</td>
<td>18.1</td>
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</tr>
<tr>
<td>Total</td>
<td>4570</td>
<td>4786</td>
<td>9356</td>
<td>14.8</td>
<td>9.3</td>
<td>11.9</td>
<td>13.2</td>
<td>11.0</td>
<td>12.1</td>
<td>28.0</td>
<td>20.3</td>
<td>24.0</td>
<td></td>
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</tr>
</tbody>
</table>

Abbreviations: F, female; M, male; N, number of subjects; OW + O, overweight and obesity; T, total.
Note: Obesity is defined as weight-for-height exceeding 120% of the WHO reference for children aged 4-6.9 years and exceeding 120% of Chinese standard for children aged 7-17 years.

elementary school students, which was significantly higher than that in preschool children or junior students. The prevalence of obesity was greatest in northeast China, least in mid-south China, and intermediate in east China. Obesity was more prevalent in urban than in suburban areas, with odds ratios ranging between 0.982 and 1.282. There were significantly more obese children in high-income families than in low-income families. In relation to food consumption, the risk of obesity was related to the frequency of breakfast eating, in that children who often skipped breakfast were more likely to be obese than their counterparts who ate breakfast daily; and children who often consumed fast food were more likely to be obese than those who consumed fast food less often. With regard to television viewing, obese children watched more television daily than their nonobese counterparts: the prevalence of obesity increased by about 1.5% for each additional hour of television viewed.

By chi testing with no adjustment for other variables, obesity in children tended to be greater in those with better educated parents. The prevalence of obesity was 13.8% in children claiming to prefer a larger body size; this was significantly higher than in those who preferred a normal or small body size. Children with parents preferring a larger body size were also more likely to be obese.

DISCUSSION

Prevalence and Trends of Obesity in Developing Countries

Onis and Blossner (2) analyzed 160 nationally representative cross-sectional surveys from 94 countries and found that the global prevalence of overweight in preschool children was 3.3% (defined as a weight-for-height > 2 SD above the NCHS/WHO reference median). The percentage of overweight children was highest in Latin America and the Caribbean (4.4%), followed by Africa (3.9%), and Asia (2.9%). The
TABLE 2. Prevalence of obesity with odds ratios (OR) and 95% confidence intervals (CI)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Obesity (%)</th>
<th>OR (CI) crude</th>
<th>OR (CI) adjusted</th>
</tr>
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<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4,786</td>
<td>9.3</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Male</td>
<td>4,570</td>
<td>14.8</td>
<td>1.696 (1.495–1.925)</td>
<td>1.567 (1.345–1.827)</td>
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<tr>
<td><strong>Age group</strong></td>
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<td></td>
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</tr>
<tr>
<td>Preschool</td>
<td>2,329</td>
<td>10.7</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Elementary</td>
<td>4,474</td>
<td>13.6</td>
<td>1.322 (1.131–1.546)</td>
<td>1.358 (1.138–1.620)</td>
</tr>
<tr>
<td>Junior</td>
<td>2,553</td>
<td>10.2</td>
<td>0.951 (0.792–1.143)</td>
<td>0.988 (0.803–1.215)</td>
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<tr>
<td><strong>Domicile region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-south</td>
<td>2,390</td>
<td>10.2</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>East China</td>
<td>4,638</td>
<td>12.2</td>
<td>1.228 (1.048–1.440)</td>
<td>1.347 (1.143–1.588)</td>
</tr>
<tr>
<td>Northeast</td>
<td>2,328</td>
<td>13.2</td>
<td>1.347 (1.127–1.610)</td>
<td>1.415 (1.172–1.708)</td>
</tr>
<tr>
<td><strong>Domicile situation</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburb</td>
<td>4,115</td>
<td>11.0</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Urban</td>
<td>5,241</td>
<td>12.7</td>
<td>1.178 (1.037–1.337)</td>
<td>1.122 (0.982–1.282)</td>
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<tr>
<td><strong>Income</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2,883</td>
<td>11.6</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Middle</td>
<td>5,180</td>
<td>11.9</td>
<td>1.032 (0.896–1.189)</td>
<td>1.069 (0.919–1.243)</td>
</tr>
<tr>
<td>High</td>
<td>1,293</td>
<td>12.8</td>
<td>1.124 (0.921–1.371)</td>
<td>1.207 (0.967–1.507)</td>
</tr>
<tr>
<td><strong>Educational level of parents</strong></td>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>207</td>
<td>9.2</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Mediate</td>
<td>6,266</td>
<td>11.7</td>
<td>1.305 (0.810–2.102)</td>
<td>1.365 (0.839–2.221)</td>
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<tr>
<td>High</td>
<td>2,883</td>
<td>12.8</td>
<td>1.448 (0.894–2.344)</td>
<td>1.502 (0.908–2.482)</td>
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<tr>
<td><strong>Breakfast frequency</strong></td>
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</tr>
<tr>
<td>5–7/day</td>
<td>8,726</td>
<td>11.8</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>2–4/week</td>
<td>490</td>
<td>13.5</td>
<td>1.170 (0.895–1.528)</td>
<td>1.230 (0.936–1.615)</td>
</tr>
<tr>
<td>0–1/week</td>
<td>140</td>
<td>18.6</td>
<td>1.714 (1.119–2.623)</td>
<td>1.742 (1.123–2.702)</td>
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<tr>
<td><strong>Fast food frequency</strong></td>
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<td></td>
</tr>
<tr>
<td>No</td>
<td>1,900</td>
<td>10.5</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>1–2/month</td>
<td>7139</td>
<td>12.2</td>
<td>1.184 (1.007–1.393)</td>
<td>1.180 (0.996–1.400)</td>
</tr>
<tr>
<td>3–4/month</td>
<td>311</td>
<td>13.9</td>
<td>1.370 (0.966–1.943)</td>
<td>1.277 (0.891–1.832)</td>
</tr>
<tr>
<td><strong>TV viewing time</strong></td>
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<tr>
<td>&lt;1 h/d</td>
<td>3,012</td>
<td>10.9</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>1–2 h/d</td>
<td>4,255</td>
<td>11.8</td>
<td>1.089 (0.941–1.260)</td>
<td>1.102 (0.949–1.279)</td>
</tr>
<tr>
<td>2–3 h/d</td>
<td>1,427</td>
<td>13.2</td>
<td>1.233 (1.019–1.490)</td>
<td>1.253 (1.031–1.523)</td>
</tr>
<tr>
<td>&gt;3 h/d</td>
<td>56</td>
<td>15.1</td>
<td>1.444 (1.119–1.865)</td>
<td>1.398 (1.075–1.819)</td>
</tr>
<tr>
<td><strong>Desired body size by children</strong></td>
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</tr>
<tr>
<td>Small</td>
<td>1,381</td>
<td>10.6</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Normal</td>
<td>4,029</td>
<td>10.6</td>
<td>0.988 (0.818–1.217)</td>
<td>1.076 (0.869–1.337)</td>
</tr>
<tr>
<td>Large</td>
<td>3,946</td>
<td>13.8</td>
<td>1.358 (1.120–1.648)</td>
<td>1.083 (0.870–1.349)</td>
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<tr>
<td><strong>Desired body size by parents</strong></td>
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<td></td>
<td></td>
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<td>9.9</td>
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<td>1.000</td>
</tr>
<tr>
<td>Normal</td>
<td>4,880</td>
<td>10.4</td>
<td>1.054 (0.790–1.406)</td>
<td>1.051 (0.782–1.410)</td>
</tr>
<tr>
<td>Large</td>
<td>3,901</td>
<td>14.2</td>
<td>1.501 (1.127–1.999)</td>
<td>1.198 (0.880–1.632)</td>
</tr>
</tbody>
</table>

Note: Obesity defined as weight-for-height exceeding 120% of the WHO reference for children aged 4–6.9 years and exceeding 120% of Chinese standard for children aged 7–17 years.

*p < 0.1 (logistic regression analysis).

* p < 0.05.
percentage of overweight children in different countries ranged from 0.1% in Sri Lanka to 14.4% in Uzbekistan. It was concluded that obesity did not appear to be a public health problem among preschool children in Asia. However, although undernutrition remains a major problem in developing countries, it is now apparent that obesity is becoming prevalent in some of these countries, especially in urban areas that are undergoing a rapid transition in their economies and lifestyles. The prevalence of obesity in preschool children and schoolchildren has increased at an alarming rate in those countries in the past two decades. For example, the prevalence of obesity among Singaporean preschool children increased from 2.6% in 1988 to 6.8% in 1991, and among schoolchildren from 5.4% in 1980 to 8.8% in 1985 and to 13.2% in 1990 (5). A similar trend is present in other developing countries (2), including China (4,10). The prevalence of obesity among children aged 0 to 7 years increased from 0.91% in 1986 to 2.0% in 1996 (4), whereas among schoolchildren it increased by two- to threefold between 1985 and 1995 (10). This increasing trend is observed in both urban and rural areas of China (11). Our results show that the prevalence of obesity among children in urban China has reached the level found in developed countries (12). The total number of children aged 0 to 17 years in China is 361.7 million, accounting for 29.0% of the total population. If the increasing trend to obesity persists, very large numbers of children will be affected. The economic cost of controlling this problem will be tremendous, considering that obese children are much more likely than normal-weight children to become obese adults, and thus may be at increased risk of obesity-related morbidity and mortality. Action should be taken immediately to control this emerging public health problem.

**Domicile Region**

Dietz and Gortmaker (13) found regional variations in childhood obesity in American children. They showed that the prevalence of obesity was greatest in the northeast of the country, followed in descending order by the midwest, the south, and the west. Ding et al. (14) also showed regional variation in the prevalence of obesity in Chinese children. Neutzling et al. (6) also found such variation in Brazilian adolescents. In our study we found that the prevalence of obesity was greater in northeast China than in south China, whereas in east China the prevalence was intermediate. These findings are in agreement with those of Ding. It is of interest that the increasing prevalence of obesity between 1986 and 1996 was greatest in south China (17.5%), followed by central China (12.2%), and north China (1.4%) (4). Differences in economic development may play a role in this trend.

**Socioeconomic Status**

The relation between the prevalence of obesity and socioeconomic status has been reviewed by Sobal and Stunkard (15). They concluded that obesity was negatively correlated with socioeconomic status in developed countries but positively correlated in developing countries.
Neutzling et al. (6) found that Brazilian adolescents in a high-income group were two to three times more liable to overweight and obesity than their lower-income counterparts. This confirmed previous findings in Brazil (16) and in China (17). In our study we found a similar relation between the prevalence of obesity and income levels.

Martorell et al. (3) showed that in developing countries overweight was more common in children of mothers with higher educational achievement. We also found that children of well-educated parents tended to be more obese than their counterparts with poorly educated parents.

There is an urban—rural divide, with urban children showing significantly higher rates of obesity than their rural counterparts (3). The results of our study showed that children living in urban areas were more likely to be obese than their counterparts in suburban areas. A possible explanation is that parents with a higher income and better education, living in urban areas, are more likely to be “westernized,” thus increasing the risk of obesity.

**Eating Practices**

**Breakfast**

The relation between obesity and breakfast eating has been identified in studies conducted in both developed and developing countries. A positive association between skipping breakfast and being overweight was found in American children (18). The same correlation has been shown in Chinese children (19,20). Our results in the present study indicated that breakfast skippers were more likely to be obese than their counterparts who had breakfast daily, with an odds ratio of 1.7. The underlying mechanism is unclear. Children who skip breakfast may eat more in the day, or be less active, or make poor food choices over the rest of the day and thus increase the risk of obesity in the long term (21). On the other hand, children who are already overweight may tend to skip breakfast in an attempt to lose weight (18).

**Fast Food Consumption**

A positive association between fast food consumption and obesity has been identified in American adults (22), but there is limited information on children. “Western” fast food is very popular in big cities in China, and there has been a dramatic increase in the numbers of restaurants selling these types of food in the past decade. More than 20% of preschool children and schoolchildren in cities consume fast foods at least once a month (23). Fast foods are high in fat and energy and low in fiber. Frequent consumption of fast foods will increase the intake of fat and total energy, which increases the risk of developing obesity.

**Television Viewing**

Significant associations between the time spent watching television and the prevalence of obesity have been observed among American children and adolescents.
Youngsters who watch more television daily are significantly more obese than their counterparts who watch less television (24). There is a dose–response relation between the obesity, superobesity, and time spent watching television, with an increase in obesity prevalence of 2% for each additional hour of television viewed (25). A similar relation between the prevalence of obesity and television watching has been observed in Chinese children (19) and was reconfirmed in our present study.

The number of television sets owned per 100 households increased from 17.2 in 1985 to 89.8 in 1995, and to 111.6 in 1999 in China (9). More than half of the urban children in China watch television for more than 1 hour daily. Urban children spend increasing amounts of time playing with computers and video games, and there has been a rapid expansion in retail sales of computer electronics in China.

Possible explanations for the relation between television viewing and obesity are that TV viewing is inversely associated with time spent in physical activity and that commercials on TV influence children’s food choices and eating practices.

**Dietary Factors and Physical Activity Pattern**

Obesity is a result of an energy imbalance, where energy intake exceeds energy expenditure over a long period of time. Many studies have focused on dietary factors or physical activity alone, but the results have been inconsistent (26–29). It is now clear that obesity is not simply a result of overeating or of a lack of physical activity; nevertheless, high-fat and energy-dense diets and a sedentary lifestyle are the two characteristics most strongly associated with the increased prevalence of obesity worldwide (1).

Dietary patterns have changed rapidly in China over the past two decades. Fat intake in both rural and urban children increased dramatically between 1989 and 1993 (14). Although the physical activity pattern of Chinese children has not been investigated, adults in urban China were more likely to be sedentary 1991 than in 1989 (30).

The interaction of dietary factors and physical activity on the development of childhood obesity has not been documented in developing countries because of the lack of sophisticated population-based instruments for measuring physical activity patterns. Research in this area should be strengthened in the future.

**Social Factors**

In addition to the genetic and environmental factors, the influence of social factors on the development of obesity should not be neglected. In parallel with the transformations that are occurring in economic development and lifestyle, changes in social structure, social norms and perceptions, and attitudes to health and body image will unavoidably take place. This may have a profound influence on the trend to obesity.

Throughout most of human history, an increase in weight and girth has been viewed as a sign of health and prosperity. In Chinese culture this is still the case for young children in urban areas and for both children and adults in rural areas. Our study found that children and their parents preferred a large body size for boys and a
small body size for girls. The prevalence of obesity in children who preferred a large body size was significantly increased. Children of parents who preferred a large body size were also more likely to be obese. Perceptions of body size may affect eating behavior and the management of body weight, which in turn will influence the development of obesity. The underlying mechanism of these phenomena needs to be explored in the future.

SUGGESTIONS

The following are some suggestions for reducing obesity in children:

1. **Identify factors influencing the trend to obesity in developing countries.** There is limited information from developing countries on factors contributing to the development of childhood obesity. The influence of current changes in dietary patterns, lifestyle, social structure, and culture on the increasing trend to obesity should be analyzed. Recommendations can then be made for developing public health policies and programs for preventing and managing obesity nationwide.

2. **Develop a national prevention strategy.** As undernutrition is still the major public health problem in developing countries, obesity has not received enough attention in most of these countries, although its prevalence has increased dramatically in the past two decades. It is clear that obesity is difficult to cure once it is established; the most effective and economical strategy is to prevent it. National public policy should be developed to face this new challenge in public health. The strategy should be targeted at reducing the prevalence of obesity in the population as a whole. A framework of health promotion in schools should be adopted to foster a healthy lifestyle in children.

REFERENCES


DISCUSSION

Dr. Ismail: In your summary, you said that television viewing was related to obesity in China, but from the bar graph you showed, this did not seem to have much influence on boys, though it had a rather big effect on girls. Could you comment on that?

Dr. Ma: You are right, there were sex differences in obesity prevalence for girls and boys, and their TV viewing times were different. I don’t have any explanation for this phenomenon at present—these are just the preliminary results of my study and I don’t know the underlying mechanism.

Dr. Dietz: It’s fascinating to see the parallels with obesity in the United States and elsewhere. Does your recognition, and Dr. Chen’s, of obesity as a public health problem make this a priority public health concern for China? If not, what institutional changes would have to occur to make it a public health problem?

Dr. Ma: In the scientific arena we believe that obesity in urban China has now definitely become a health concern. We know that obese children are more likely to become obese adults,
and that the prevalence of obesity in children has reached epidemic levels, so if we don’t take action now the problem will get out of hand. We also know that obesity is related to certain chronic diseases, and that the direct and indirect costs of obesity amount to a substantial proportion of national health care. For these reasons, we believe that in urban China obesity should be regarded as a public health priority.

Dr. Dietz: I agree, but what I was asking was how do you know when you have made it a priority? For example, in the United States, the CDC recognizes obesity as a priority public health problem, the surgeon general of the United States has recognized obesity as a priority problem, but Congress has not. So what I am asking is whether it is sufficient for the Chinese Academy of Preventive Medicine to recognize this as a problem, or how will you know that you have succeeded in making it a priority?

Dr. Ma: I think that question should be answered by Madam Chen, as she represents the Chinese Obesity Task Force.

Dr. Chen: Your question is of critical importance, because obesity has not yet been established in China as a public health concern. Even among the medical fraternity it is not taken very seriously. We therefore organized a working group on obesity in China to collect scientific evidence that would convince the policy makers about the cost and future danger of obesity in children and adults. Obesity is a big problem in China, the prevalence of overweight being about 30% in adults. The policy makers need to be informed about the economic costs this will entail in the future. The current priority is to collect evidence. At present, we don’t have good data on physical activity and the factors associated with obesity in children. We are considering the possibility of international collaboration to investigate the current situation and make informed predictions of future economic and health implications of obesity in China.

Dr. Shen: I also have a comment about this issue. I absolutely agree with Dr. Chen’s view that we need evidence to convince the government. Everybody in this room believes that obesity has become a serious problem. However, it is another matter to convince government officials, who need the evidence to be presented in understandable form. In the next 5 or 10 years, epidemiologic studies will be of critical importance. Furthermore they should not be limited to the east coast of China but should be done nationwide. If all the Chinese delegates in this room, who come from different parts of China, can work together to undertake a nationwide epidemiologic study, that would be of the greatest value.

Dr. Bar-Or: Following up this question, let’s suppose we are now 10 years older and you have the evidence. How do you think the Chinese authorities will implement the recommendations? As a Canadian, the scene I’m familiar with is that it’s very hard to convince the Canadian government that something should be done, and even if we do manage to convince them, they often do not have a very clear idea of what to do about it. So what would you think would happen in the Chinese scenario when the evidence is provided?

Dr. Ma: We can only provide the evidence and hope we can persuade the government to develop an obesity intervention policy. The Scientific Committee can continue to press for obesity intervention as well. The involvement of the mass media is also very important. Many people are aware that obesity is a public health concern, and sometimes if the push comes at grass roots level this may be an effective way of persuading the government to take action.

Dr. Shen: I can give you an example of the government’s response to another problem. My research area is mainly related to the prevention of lead poisoning in Chinese children. I started working on this problem 12 years ago. Before that time, although lead poisoning was considered a problem in the United States and Western Europe, this was not the case in China. However, about 12 years ago I discovered that the blood lead level of children in Shanghai was
extremely high—much higher than in children in the United States. I therefore decided to do a nationwide epidemiologic study and found the prevalence of lead poisoning to be very high by the standards provided by the US CDC. I also found that the high lead level was extremely harmful to children's development, reducing the IQ and causing behavior problems. And after 3 to 5 years of work on this problem, I found that the principal source of lead in China is leaded gasoline. In a pilot study I proved that removal of lead from gasoline resulted in a reduction in the blood lead level. I presented these data to the Ministry of Public Health and the Mayor of Shanghai, and they were very supportive, providing me with a very large grant for a large-scale study. About 5 years later, that is 3 years ago, the government decided on the basis of my data that leaded gasoline should be phased out in the whole of China. This is a success story about how the government responds to scientific research. I believe that if we can provide sufficient evidence about obesity, the government will respond appropriately.

Dr. Sung: I'm interested in the different prevalences of obesity in the four cities you investigated. Obesity appears to be most common in the northeast of China, which is less well off economically than the other regions you studied. What is the reason for that? Do you use one growth chart for the whole country? I have the impression that people in the north are of a larger build than in the south. If you use the same growth chart for both regions, this may give the impression of more obesity in the north.

Dr. Ma: Well, as you know, the dietary pattern in China varies according to region. For example, in the south of China rice is the staple, whereas in the north it is wheat. I carried out analyses between 1982 and 1992 but found no difference in average energy intakes in the different regions. Maybe genetic factors play a role. People in the northern part of China are usually taller than in the south. Regarding growth charts, we use a Chinese standard for weight for height, based on the Chinese Physical Fitness and Health Survey conducted in 1985. We use the same weight-for-height standard in the whole country. There are some arguments about the validity of this standard, but if we were to use different standards in different regions it would be very hard to make comparisons.

Dr. Buenaluz: You had a chart showing increased energy consumption from fat in Chinese children. How were these data obtained? Did you do a dietary survey?

Dr. Ma: Yes, this result was based on a dietary survey. We obtained data on food intakes of all the individuals in the household and then calculated the individual dietary intakes.

Dr. Buenaluz: My concern is that when we have conducted dietary surveys in this way we find that sometimes the family does not want to reveal their actual consumption.

Dr. Chen: Consumption was assessed by weighing and by diary records, so we feel the assessments were quite accurate. The observations were summed for each household member, and the housewife also made an assessment of the proportions consumed by individual family members. We think that the fat measurements were probably more accurate than the other nutrients, because all the oils were weighed by the interviewers.

Dr. Huang: I'm interested in your finding that obesity is more common in boys than in girls in China. How do you explain that phenomenon?

Dr. Ma: That is an interesting question. One possible explanation may be a genetic effect. There could also be sociocultural influences. For example, most parents and indeed children think that a desirable body size for boys is large and for girls is small. People think that if you are a boy you should eat more food and look stronger. Also, boys like movie action stars, and there are many role models on TV commercials.

Dr. Dulloo: When dietary fat increases, one needs to consider the type of fat. In Malaysia it's palm oil; in Thailand it's coconut oil. What kind of oil do you use in China? That would be relevant to the effect on plasma fatty acids.
Dr. Ma: We use mainly vegetable oils such as soy oil and corn oil.
Dr. Dulloo: Is it polyunsaturated? ω-6? Is it like palm oil, which is very different in its fatty acid composition? These aspects can affect energy balance.
Dr. Ma: The soy oil and corn oil are similar to what is used in other countries such as the United States. In some parts of China animal fats are popular, particularly pig fat.
Dr. Dulloo: This would need to be quantified in the future.
Dr. Ma: Yes, a lot needs to be done, especially in relation to the correlations between physical activity patterns, diet, and the development of obesity. This was just a preliminary study. There have been very few studies focusing on the factors contributing to obesity. We need to do more in the future.