

ORIGINAL ARTICLE

## Risk factors for overweight in 2- to 6-year-old children in Beijing, China

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### Abstract

**Objective.** To assess the prevalence of overweight among Chinese preschool children and to explore risk factors of childhood obesity focusing on parental characteristics, feeding practice and lifestyle. **Methods.** Data on 930 families with 2- to 6-year-old children in five kindergartens were obtained in a cross sectional study. Families were randomly selected from two of all six urban districts in Beijing, China. Information on parental characteristics, dietary habits, lifestyle habits, and feeding practice was collected by parental self-report questionnaires. The children's stature and weight were measured in light clothing and without shoes. Overweight and obesity were defined according to international cut-off values, as proposed by the International Obesity Task Force. Multivariate regression analysis was used to explore risk factors of child overweight. **Results.** The overall prevalence of overweight and obesity was 10.7% and 4.2%, respectively, and increased with age. The prevalence of child overweight was 14.1% and 7.5% in obese and non-obese families, respectively. Significant associations were observed between child and parent characteristics for overweight, frequency of eating in restaurant, television hours, and hours of physical activity. Child overweight was associated with parental overweight (Odds Ratio [OR] 2.43, 95% CI 0.78, 6.59), low maternal education level (OR 2.22, 95% CI 1.39, 3.55), food restriction (OR 2.68, 95% CI 1.64, 4.29), and television watching >2h/d (OR 1.56, 95% CI 1.17, 2.09), after adjusting for sex, age, family income and kindergarten (for cluster study design). **Conclusions.** Overweight prevalence among Chinese preschool children in Beijing is comparable to some European countries. Prevention strategies should include identified lifestyle risk factors.

**Key words:** Children, overweight, obesity, prevalence, risk factors

### Introduction

A high prevalence of childhood overweight and obesity is reported worldwide (1–3). China has joined the world epidemic of obesity (4,5) with a reported overweight prevalence of 27.7% among boys and 14.1% among girls in urban areas (6). Childhood obesity predicts obesity in adulthood (7) and is associated with an increased risk for later cardiovascular disease (8); it may also have a profound negative effect on the psychological health of children (9). Effective prevention strategies against childhood obesity are needed because

therapeutic interventions are expensive and tend to have poor long-term results (10).

Obesity is a multi-factorial condition influenced by both genetic and environmental factors. The family eating environment includes parents' feeding practices and their own dietary habits. Additionally, their opinion and attitude regarding their own weight might play an important role. Thus, parental influences can be transmitted directly through the food served, and indirectly, through conveying behavioural models and social norms to children (11,12). Variations in parental feeding style may influence the child's weight status.

Most research on risk factors for childhood obesity originates from a Western cultural context, in which a sedentary lifestyle, soft drink and fast food consumption have been implicated and are considered as important contributing factors to the obesity epidemic (13). Since the opening up of China in 1980 and subsequent changes in the economy and lifestyles, obesity has become a public health problem. The cultural structure in China is quite different from that in westernised countries and it is possible that additional culture-bound risk factors play a role in the development of obesity. However, there are few studies on childhood obesity with such a specific focus (14). An improved knowledge is needed of factors influencing children's obesity and lifestyles in China in order to develop effective, culturally sensitive obesity prevention strategies (15).

The aim of our study was to assess the prevalence of overweight among preschool children in Beijing and to explore common lifestyle risk factors of childhood obesity in families.

## **Material and methods**

### *Study population*

Study children were selected from kindergartens in Beijing, China. There are six urban districts in Beijing. In each district, there are 40–80 kindergartens of which 10–20 are large kindergartens with more than 150 children. Almost all children aged 3–6 years attend local kindergartens in urban areas. In this study, five large kindergartens were randomly selected in two urban districts in Beijing. All children from these kindergartens were invited to participate. Parents provided written consent for their own and their children's participation before data collection. In March–April 2004, the numbered parental questionnaires were distributed. Parents were asked to complete the questionnaire at home. If a family had two children in the kindergarten, they only completed the questionnaire for the older child. The potential number of participating families was 1045. Questionnaires were given to 1045 parents and 930 parents returned completed questionnaires (response rate = 89.1%).

### *Measurements*

The items included in the questionnaire were derived from a literature review regarding risk factors for obesity (12, 16, 17). To assess comprehensibility, reliability and validity of the questionnaires prior to the start of the study, interviews were initially performed in our outpatient clinic with 40 parents from kindergartens other than those included in the

study. Parents were asked to fill out questionnaires for each family. Each parent's weight and height was measured after completion of the questionnaire. A number of questions were subsequently modified to increase practicability, reliability and validity according to this pretest. The final version of the questionnaire was then tested and retested with another 20 families not included in the study sample. The second test (interview) was conducted by telephone two weeks later. The reliability of items was measured using Cronbach's  $\alpha$  ( $\alpha=0.73$  for dietary items and  $\alpha=0.81$  for activity items). There was no significant difference in weight and height between the values of parents' self-report and direct measurement.

Participating families were asked about the following: parental height, weight and educational level; family dietary habits, frequency of food consumption over the previous 3 months, feeding style; amount of parental and child's vigorous physical activity excluding physical activity in kindergarten for children, and amount of parental and child's TV consumption and usage of computer games.

Children's weight and height data were collected from regular physical examinations in kindergartens by trained researchers. Anthropometric measurements were performed without shoes and in light clothing. Each measurement was performed twice and the average was used for the analysis. Height was measured to the nearest 0.1 cm with the SZG-180 stadiometers (Shanghai Zhengda Weigher Company, Shanghai, China). Weight was measured to the nearest 0.1 kg with the lever scale RGT-120 (Wuxi Weigher Factory, Wuxi, China).

Overweight and obesity were defined according to the sex- and age-specific body mass index (BMI; kg/m<sup>2</sup>) cut-off points, proposed by the International Obesity Task Force (18). Parental overweight was defined as BMI  $\geq 25$  kg/m<sup>2</sup>, according to recommendations for adults (18). The study was approved by the Ethics Committee of the Chinese National Center for Women's and Children's Health.

### *Statistical analysis*

The significance level was set at  $p=0.05$ . Differences in the prevalence of overweight and obesity between age groups were tested by the Cochran-Armitage trend test. The prevalence of overweight was calculated with confidence limits based on the binomial distribution. Nineteen potential risk factors were considered a priori in this study: parental overweight; low parental education; snack limitation by parents; high frequency of eating in restaurants for parents; child's soft-drink consumption, parents often encouraging child to eat more; reward with

food by parents; child's consumption of Western fast food  $\geq 1$  time/week; child's TV viewing  $\geq 2$  h/d, child's playing computer games  $\geq 1$  h/d; snacks in front of TV for child or mother, and physical activity time  $< 1$  h/d for parents or child. Variables with significant associations with the children's overweight in the bivariate analyses ( $p < 0.05$ ; Fisher's exact test for categorical variables and independent t-test for continuous variables) were analyzed in the logistic regression model adjusting for sex, age and family income. Clustering was considered with kindergartens as respective clusters. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated for each factor. Variables are reported as mean  $\pm$  standard deviation (SD) unless otherwise stated.

All calculations were carried out using the statistical software packages SPSS (version 10.0, SPSS Inc., Chicago, USA) and SAS 9.1 (SAS Institute Inc., Cary, NC, USA).

## Results

### Sample characteristics

No statistically significant differences in average age and BMI could be observed between children whose parents completed the questionnaire, and children of non-responders.

The mean age of the subjects was 4.6 years old  $\pm$  1.1 year, with an age range of 2–6 years old. The proportion sex was balanced, with  $n = 518$  (55.7%) boys and  $n = 412$  (44.3%) girls. Overall overweight and obesity prevalence was 10.7% (95% CI 8.7%–12.8%) and 4.2% (95% CI 3.0%–5.7%). There was no significant difference in prevalence of overweight and obesity between boys and girls (10.0% vs. 11.4% and 4.4% vs. 3.9%). The prevalence of overweight and obesity increased with increasing age (Table I).

### Family characteristics and child overweight

Significantly more children from overweight families (either the father or the mother were overweight)

were overweight. The prevalence of child overweight was 14.1% in overweight families, and 7.7% in non-overweight families with a corresponding unadjusted odds ratio of 1.98 (95% CI 1.29–3.04). Other significant associations between child and parental characteristics could be observed for BMI, frequency of eating out, television hours, and physical activity hours (Table II).

### Risk factors for child overweight

Six out of 19 possible risk factors were found to be associated with childhood overweight from bivariate analyses. Family income was not associated with child's overweight ( $p = 0.56$ ). In addition to parental overweight, low maternal education (high school having not been completed), high TV viewing, and mothers' restriction of snacks for the child, were associated with overweight. The mother's encouragement of eating for the child was a protective factor for child overweight (overweight vs. normal weight: 60.6% vs. 72.7%,  $p = 0.01$ ). After adjustment for sex, age, family income, and specific kindergarten (to adjust for cluster design) as potential confounders, the multivariate analysis yielded parental overweight; mother's overweight; low maternal education, children's TV viewing more than 2 hours/day, and mother's restriction of snacks for children as significant risk factors for a child being overweight (Table III).

Physical activity time and the time spent playing computer games were not found to be associated with child overweight in the logistic regression model. However, significantly more time was spent on television watching and playing computer games than that for physical activity in both overweight children ( $2.5 \pm 1.0$  h/day vs.  $0.8 \pm 0.6$  h/day,  $p < 0.001$  by one-sample t-test) and in normal weight children ( $2.1 \pm 0.9$  h/day vs.  $0.7 \pm 0.5$  h/day,  $p < 0.001$  by one-sample t-test).

## Discussion

In this study, the combined prevalence of overweight and obesity in 2- to 6-year-old children living in

Table I. Prevalence of overweight and obesity by age group and sex.

Age groups	Boys (%)		Girls (%)		Both boys and girls (%)	
	Overweight**	Obesity**	Overweight**	Obesity**	Overweight**	Obesity**
2- y (n = 322)	1.2	0.0	8.6	4.0	4.7	1.9
4- y (n = 260)	9.7	4.8	9.6	1.7	9.6	3.5
5-6 y (n = 348)	17.8	7.9	15.8	5.5	17.0	6.9
Overall (n = 930)	10.0	4.4	11.4	3.9	10.7	4.2

\*\*  $p < 0.001$  for differences between age groupings, Cochran-Armitage trend test.

Table II. Correlations between parents and child for body mass index (BMI), eating out, activity hours and television (TV) hours<sup>a</sup>.

Parent's variable	Child's variable			
	BMI	Frequency of dinner in restaurant	TV viewing hours (daily)	Physical activity hours (daily)
<b>BMI</b>				
Father	0.080 (0.015)*	-0.117 (0.000)**	0.057 (0.081)	-0.039 (0.233)
Mother	0.128 (0.000)**	0.094 (0.004)**	0.040 (0.223)	0.041 (0.211)
<b>Frequency of eating dinner in restaurant</b>				
Father	0.063 (0.056)	0.452 (0.001)**	0.075 (0.022)*	-0.024 (0.468)
Mother	0.028 (0.395)	0.625 (0.001)**	0.091 (0.006)**	-0.032 (0.333)
<b>TV viewing hours (daily)</b>				
Father	0.030 (0.363)	0.022 (0.500)	0.237 (0.000)**	0.054 (0.098)
Mother	0.015 (0.639)	0.017 (0.607)	0.210 (0.000)**	0.033 (0.314)
<b>Physical activity hours (daily)</b>				
Father	-0.026 (0.423)	0.040 (0.223)	0.006 (0.850)	0.156 (0.001)**
Mother	0.019 (0.566)	0.037 (0.259)	0.028 (0.397)	0.146 (0.001)**

<sup>a</sup> Data are presented as correlation coefficients (p values).  
 \* Significant difference at P < 0.05. \*\* Significant difference at P < 0.01.

Beijing, China, was 14.9%, similar to that seen in several European industrialized countries (19). An increased prevalence of overweight with increasing age was also observed. However, there was no difference in the prevalence of overweight between boys and girls.

Maternal overweight and parental overweight (i.e., mother or father overweight) were independently associated with childhood overweight. Parental overweight may increase the risk of overweight through genetic mechanisms or by shared familial characteristics in the environment, such as food preferences

and various lifestyle factors (20). Mothers, as the usual primary caregivers, provide their young children with meals and have more control over their lifestyle compared to fathers. The stronger association between the weight status of mothers and their children, compared to that of fathers and their children (father's overweight was not found as a risk factor in logistic regression analysis in this study) might suggest an additional environmental influence in addition to the underlying genetic predisposition.

The results of this study also indicate a strong association between parents' and children's eating

Table III. Potential risk factors of child overweight from multivariate analysis.

Risk factor (risk factor exposure)	Unadjusted proportion (%) of overweight if risk factor was present		Unadjusted attributable fraction of risk factor (%)	Adjusted p-value <sup>a</sup>	Adjusted odds ratio (95%CI) <sup>a</sup>
	yes	no			
Parental overweight <sup>b</sup>	14.1%	7.5%	6.6	0.001	2.43 (1.78, 5.69)
Maternal overweight	16.2%	9.8%	6.4	0.038	1.20 (1.07, 1.33)
Low maternal education <sup>c</sup>	16.8%	9.0%	7.8	<0.001	2.22 (1.39, 3.55)
Child's TV viewing more than 2 h/d	16.6%	9.3%	7.4	0.012	1.56 (1.17, 2.09)
Mother's encouragement of child to eat more often	5.9%	22.6%	16.7	<0.001	0.22 (0.14, 0.34)
Mother's restriction of snacks for child	12.9%	5.2%	7.7	<0.001	2.68 (1.64, 4.29)

a: adjusted for children's age, gender, family income and kindergarten in the regression model for each of the factors; b: mother or father overweight; c: high school not completed.

habits, television watching and physical activity. Associations between parental and child dietary intake and lifestyle have been found in several studies (21,22) but have not been previously studied in China. Young children's eating behavior and physical activity habits are mainly influenced by their family dietary environment and lifestyle. Family environmental factors, such as mother's supply (encouragement to eat often) or restriction of food, may work synergistically with genetic factors to produce intergenerational similarities in eating, activity and overweight. The results from the present study indicate that in addition to simply educating parents about healthy dietary behavior for their children, the parent's own dietary habits may also need to be addressed. This might be a major target for health education on childhood obesity in China. Parents should be encouraged to recognize that their own eating behavior and lifestyle are an important influence on their children.

Dietary intake has a major influence on childhood obesity (23). Parental control of food intake can be regarded as protective, but in this study a possible reverse causation was observed, with overweight children being more likely to have mothers who restricted snacks and who did not encourage their children to eat often. Restriction and control over food intake is a common way to encourage good eating habits and prevent childhood obesity. Restriction may actually promote the desire to obtain the restricted foods and may increase consumption of those foods in the absence of parental restriction, even in the absence of hunger (24). For children with a tendency to over-eat, parents may restrict their children's unhealthy food intake. However, children whose parents report greater attempts to restrict their child's food intake tend to eat more of both the healthy and unhealthy foods (25). Such studies indicate that restricting access to unhealthy foods is not an effective means of reducing intake of foods. An inverse association between meal frequency and childhood obesity has been reported in a large European study, possibly reflecting an altered hormone metabolism with frequent meals (26). Provision of education to parents about the potential negative consequences of food restriction and the positive consequences of increasing the meal frequency may be an important aspect of health promotion to prevent childhood obesity.

High levels of television watching have been associated with childhood overweight and obesity in cross-sectional studies in China (27). In the current study there was also a link with inactive lifestyle (high levels of television watching and playing computer games) and overweight. The average time spent watching television or playing

computer games was far more than that for organized physical exercise, both in overweight children and in normal weight children. The risks associated with sedentary behavior may operate through several mechanisms, including a reduction of time spent in higher-intensity activities, a lowered metabolic rate, and more frequent snacking (28).

Low maternal education was associated with childhood overweight in our study. Many studies have demonstrated that children of less well educated mothers are more likely to be overweight than children of more highly educated mothers (29,30). Mothers are usually the main caregivers for young children. Additionally mothers with higher educational level tend to have better nutrition knowledge (31). Mothers' actual child feeding practices, their own dietary habits and knowledge, as well as the beliefs and attitudes of healthy nutrition seem to have a powerful influence on developing healthy eating habits in young children. In studies from westernized countries, a lower maternal education level is associated with a more frequent consumption of soft drinks by children, while higher maternal education is associated with children's more frequent consumption of fruit and vegetables, verbal praise, negotiation and restraint from negative modeling (32). The findings of the current study suggest that it may be particularly important to target less well-educated mothers for health promotion intervention.

Although some studies report an association between high family income and childhood overweight and obesity in developing and threshold countries, family income was not associated with childhood overweight in our study. The study took place in the capital Beijing, one of the most developed cities in China. It may be that cities such as Beijing are almost comparable to cities from Western industrialized countries, whereas rural areas in China might still be more similar to threshold countries. Unfortunately, we lack data on children from rural areas as a comparison.

Several methodological limitations should be noted. Data on lifestyle and sociodemographic factors were from parents' self-report and therefore subject to possible comprehension, memory and recording errors, as well as social desirability. However, the questionnaires were completed voluntarily and anonymously, so that the respondents were less likely to answer in a socially desirable way, and the questionnaire pretest showed a good reliability.

This study identified parental overweight, lower maternal education level, parental restriction of food intake, and more time watching TV as risk factors for overweight in Chinese children aged 2- to 6-years-old. Education about maintaining a healthy weight could be introduced much earlier in families with

high-risk children. Such an approach could help protect children from unfavorable environmental factors, predisposing them to weight gain and obesity, which is difficult to reverse once established. Future research should include prospective studies on mother's encouragement to eat and identify effective intervention strategies for children at risk of overweight.

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