



Are single children more likely to be overweight or obese than those with siblings? The influence of China's one-child policy on childhood obesity



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ABSTRACT

China's one-child policy (1979–2015) has affected Chinese parenting practices and children's health behaviors and also may have contributed to increased childhood obesity. However, very limited research has investigated the association between one-child policy and childhood obesity. We examined characteristics of single-child families and the influence of one-child policy (indicated by single-child status) on children's weight status and related health behaviors.

Data from children aged 6–18 years old in the 2011 ($n = 1580$) and 2000 ($n = 2317$) China Health and Nutrition Survey were cross-sectionally analyzed with multilevel models. From 2000 to 2011, the rates about doubled for being a single-child (30.1% to 57.0%) and being overweight or obese (OWB, 6.6% to 16.5%) along with urbanization (27.5% to 37.1%). Single-child families had higher levels of parental education, household income and urban residence than families with \geq two children ($p < 0.05$). Compared to the children with siblings, single children were more likely to be OWB; the association became stronger over time (OR = 4.5 (1.7–12.4) in 2011 and 1.7 (1.0–2.8) in 2000). Also, single children had less recreational screen time, but similar physical activity levels; however single urban children were more likely to have excess total energy intake (OR = 5.70 (1.58–20.60)) than those with siblings.

Being single-child is about four times more likely to be overweight/obesity than those having siblings, and the association became stronger over time in China. China's one-child policy might have contributed to its rising childhood obesity rates. Obesity intervention programs may need to account for the influence of the one-child policy in China.

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1. Introduction

Obesity rates have risen rapidly in China in the past three decades (Wang et al., 2007; Sun et al., 2014), while what factors have contributed to the increasing are still not well understood. At the same time, China experienced two parallel transitions in demographics and nutrition. About 40 years "one-child-per-couple" family planning policy (one-child policy) between 1979 and 2015 contributed to the reduced fertility rate and family size. The fertility rate in China dropped from

2.7 children in 1981 to 1.7 children in 2013 over about the same period. Today, China is hosting the world's largest singleton population under age 35 (The World Bank, 2016). Meanwhile, the continuous economic booming and improved living standards have led to rapid shifts in nutrition (Zhai et al., 2014). Higher income levels, particularly in urban areas, are associated with consumption of a diet higher in fat and protein but lower in coarse grains. Eating away from home and snacking became popular than before.

Given such context, questions have been raised about the association between the one-child policy, the increasing prevalence of childhood obesity and non-communicable diseases over the last several decades (Cheng, 2013; Ni, 2000; Bloomberg, 2012). Studies have shown the focus of the attention and resources from the parents and grandparents of the single child may have led to over-feeding and high-fat diets and reduced housework and other physical activity by the children (Jing, 2000; Yang, 2007). We suspect that the one-child policy might have contributed to the rising epidemic of childhood obesity in China. Recent nationwide data in China showed the prevalence of

Abbreviations: AHA, American Heart Association; AAP, American Academy of Pediatrics; CHNS, China Health and Nutrition Survey; DRI, Dietary Reference Intakes; IOTF, International Obesity Task Force; MVPA, moderate-to-vigorous physical activity; OWB, overweight/obesity; PA, physical activity; SES, socio-economic status; SSB, sugar-sweetened beverage; WHO, World Health Organization.

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childhood overweight and obesity had a striking increase in the last three decades (3% in 1985, 6% in 1995, 15% in 2005 and 19.2% in 2010; aged 7–18 years, Chinese National Surveys on Students' Constitution and Health data (Sun et al., 2014)), which is sharper than in other developed countries (23.0% in 1988–94, 30.0% in 2005–6, 31.8% in 2009–10 in the US for aged 2–19 years (National Center for Health Statistics, 2015); 25.0% in 1995, 33.0% in 2005, 30% in 2010 in the UK for aged 2–15 years (Cancer Research UK, 2016)).

However, very limited research has examined the association between single-child status and childhood obesity in China and no significant relationship was found in the studies (Yang, 2007; Hesketh et al., 2003). To our knowledge, no other new studies examining this issue have been published, although both the one-child rate and prevalence of childhood obesity have continued to increase in China in the last ten years steadily.

This study examined the characteristics of single-child families and the associations among being single-child in a household, overweight/obesity, eating behaviors and physical activity in China using nationwide survey data. Our findings will help provide insights into the influence of China's one-child policy on obesity.

2. Materials and methods

2.1. Study design and study sample

The China Health and Nutrition Survey (CHNS) is an ongoing prospective multi-cohort survey that applies a multistage, random clustering sampling design to obtain information from about 4400 households with a total of 26,000 individuals in nine Chinese provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong) since 1989. Although the CHNS is not designed to be nationally representative, it covers areas that account for approximately 45% of China's total population varying substantially in geography, economic development, public resources and health indicators. The questionnaire was designed to examine various socioeconomic factors affecting people's health and nutritional status. In 2011, the survey newly included three megacities (Shanghai, Beijing, and Chongqing) in addition to the nine provinces (CHNS Data Collection, 2016). We used the most recent 2011 survey data to cross-sectionally examine the association between being an only child and the risk of childhood obesity to capitalize on its inclusion of three new megacities and larger sample size. Our examination of the 10-year secular trends was based on two sets of cross-sectional analysis using 2011 and 2000 survey data.

We limited our study population to 6–18-year-old children ($n = 2395$) since other children were not asked of the health behavior questionnaires. For purposes of stratified analysis, younger children were defined as 6–11 years old (primary school age), and older children were defined as 12–18 years old (junior middle/senior high school age). Children without information about age, sex, weight, height and number of sibling(s) were excluded from data analysis (total subject $n = 1580$).

2.2. Assessment and measures

2.2.1. Sibling status

Children aged 6–18 in 2011 were classified either as a single-child in a household or a child with siblings after checking the matched household ID and parent ID in the CHNS dataset (CHNS Data Collection, 2016).

2.2.2. Child weight status

Child weight and height were measured to the nearest 0.1 kg and 0.1 cm in light, indoor clothing without shoes using a weight scale (Floor Weight Scale No. 877; SECA, UK) and measuring tape (Mechanical Measuring Tape No. 206; SECA) by trained and certified staff during a detailed physical examination. Child BMI was calculated by child weight and height and then transformed to a BMI Z-score according to the sex- and age-specific World Health Organization (WHO) reference growth

charts (WHO, 2006). Child weight status was classified as overweight, obese, normal weight and underweight based on the International Obesity Task Force (IOTF) sex-age-specific BMI cut-offs (corresponding to BMI 18.5, 25 and 30 kg/m² at age 18 respectively) (Cole et al., 2000).

2.2.3. Child dietary intake

Children's food consumption data were collected using the 24-hour recall and same-day interview conducted by trained nutritionists over three consecutive days. The three days were randomly allocated from Monday to Sunday and were almost equally balanced across the seven days of the week. Total energy intake (kcal) and fat consumption (g) were calculated from food consumption data (CHNS Data Collection, 2016).

Total energy intake: It was compared to the sex-age- and physical activity (PA)-specific recommendation for the daily amount of energy intake based on Chinese Dietary Reference Intakes (DRI) (Chinese DRIs Handbook, 2013). We used the DRI cut-offs corresponding to the moderate level of PA.

Percent of energy from fat: It was drawn by the calculation, % of energy from fat = [fat (grams) * 9 kcal/gram] / total energy (kcal).

We set 30% as the cutoff point of an appropriate percent of energy from fat according to the Acceptable Macronutrient Distribution Range (AMDR) for daily fat intake for the Chinese people (Chinese DRIs Handbook, 2013).

Sugar-sweetened beverage (SSB) consumption: Participants were asked to report the frequency of soft drink and sugared fruit drinks consumption (almost every day, 3–4 times per week, once or twice per week, once or twice per month, no more than once per month, or not at all). Based on the American Heart Association (AHA) recommendation of no more than 450 cal (36 oz) per week from SSBs consumption (based on a 2000-cal-per-day diet) for adolescents (American Heart Association, 2014), we defined three or more times per week as over consumption.

2.2.4. Child physical activity (PA)

Children answered the CHNS questionnaires about their daily activities:

Moderate- to- vigorous PA (MVPA) time: CHNS collected children's time spent on six specific PA before or after school or on weekends: 1) martial arts (e.g., kungfu); 2) gymnastics, dancing, acrobatics; 3) track and field (running, etc.), swimming; 4) soccer, basketball, tennis; 5) badminton, volleyball; 6) others (ping pong, Tai Chi, etc.). All six activities were defined as moderate- to-vigorous physical activities (MVPA) (Harvard School of Public Health, 2016). Following the WHO recommendation, we defined appropriate daily MVPA as ≥ 60 min/day (Global Recommendations on Physical Activity for Health, 2010).

Recreational screen time: We defined recreational screen time as combined hours for watching TV, videos, DVDs and (online) movies, and doing video/computer games, internet surfing, and online chatting. CHNS asked how much time the child spent on these activities before or after school and over the weekend. We combined their weekday and weekend time spent to calculate the average daily number of hours for these activities. We set ≤ 2 h of daily recreational screen time as an appropriate sedentary behavior based on the American Academy of Pediatrics (AAP) recommendation that parents limit children's total screen time to < 2 h per day (Strasburger, 2010).

2.2.5. Parental and household characteristics

To consider the effects of family and household socio-economic status (SES) on childhood obesity, we used information about maternal and paternal weight status (overweight or obese, not overweight or obese), highest parental education (high school or below, college or other advanced degrees), household income per capita (tertiles), and residency (rural, urban). Maternal and paternal weight status were

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