



Secular growth trends among children in Beijing (1955–2010)



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ABSTRACT

Objectives: To analyze the growth trends of children in Beijing from 1955 to 2010.

Methods: Data for the period 1955–1975 were derived from published records. Data for the period 1985–2010 were derived from the Chinese National Survey on Students' Constitution and Health (CNSSCH). Since 1985, the overall sampling and measurement methods have been consistent. The mean, the standard deviation, and the variance (ANOVA) of height, weight, and BMI by age and sex of students aged 7–17 were calculated and analyzed.

Results: Between 1955 and 2010, the average height and weight of children in Beijing has increased. The average increments per decade for boys and girls were 2.45 cm and 2.03 cm in height and 2.68 kg and 1.68 kg in weight, respectively. The largest height increase per decade occurred between 1975 and 1985: 4.51 cm and 3.23 cm for boys and girls, respectively. The largest height increase for the entire 55-year period under study occurred among boys at age 13 (17.85 cm) and among girls at age 11 (15.90 cm.)

Conclusions: During the period 1955–2010, growth trends among children in Beijing were positive. The health and nutritional status of these children improved significantly. Since 2007, might be related to government intervention, childhood obesity has been curbed.

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1. Introduction

Childhood is the foundation and the formative phase of human development. A healthy start is of critical importance, as it can have lifelong implications. The health and well-being of a given nation's children reflect both its state of socioeconomic development and the quality of its healthcare system (Sawyer et al., 2012). The physical growth of children can be used as an indicator of their nutritional status and living standards (Eaton et al., 2012; Tanner, 1992). Many governments therefore regularly

collect and analyze anthropometric data pertinent to this issue (Cardoso and Caninas, 2010; Krawczynski et al., 2003; Kutesa et al., 2013; Leitao et al., 2013; Marques-Vidal et al., 2008; Schousboe et al., 2003; Zheng et al., 2013).

Since the 1840s, the growth rate has increased and the average age at which the onset of puberty occurs has dropped significantly: a phenomenon that the British pediatric endocrinologist J. M. Tanner (1920–2010) termed “the secular trend” (Marshall and Tanner, 1968; Tanner, 1973). The secular trend, an important biological phenomenon, and one influenced by socioeconomic development, has been observed in both developed and developing countries since the 19th century (Ayatollahi et al., 2006; Gyenis and Joubert, 2004; Komlos and Lauderdale, 2007; Leitao et al., 2013; Loesch et al., 2000; Zheng et al., 2013). The secular trend in growth displays a similar pattern

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worldwide, although its timing and speed vary (Morgan, 2000).

Secular trends in growth plateau, as a rule, after about 80 to 180 years (6 to 8 generations) (Cole, 2003; Hauspie et al., 1996). Studies in recent decades suggest that in many developed countries secular height trends have plateaued, whereas average weight has continued to increase (Bielecki et al., 2012; Cardoso and Caninas, 2010; Cardoso and Padez, 2008; Komlos and Lauderdale, 2007; Smpokos et al., 2011). For instance, the average height of children in the United States increased significantly from 1900 to 1920 and has plateaued since the 1980s (Komlos and Lauderdale, 2007; McDowell et al., 2009). The fact that similar trends have occurred in developing countries helps to explain the current escalating global epidemic of overweight and obesity (Jaruratanasirikul et al., 1997; Sungthong et al., 1999; Thang and Popkin, 2003; Thanakappan, 2001; Zhang and Huang, 1988).

Obesity increases the risk of cardiovascular diseases, which are the leading cause of death globally (Boyne et al., 2014; Samaras and Elrick, 2002). Childhood obesity is one of the most serious global public-health challenges. It often persists into adulthood and is associated with numerous chronic illnesses, placing long-term social and economic burdens on societies. The ever-earlier onset of menarche is associated with an increase in early sexual activity, the incidence of breast cancer, and even alcohol and drug abuse (Boyne et al., 2014; Downing and Bellis, 2009; Galvao et al., 2014; Leung et al., 2008). Such medical conditions, the causes of which are largely due to secular changes, outweigh the benefits of an upward growth trend.

Since the 1950s, there have been several studies of the secular growth trends of children in China, analyzing the differences between girls and boys and between urban and rural areas and comparing various geographical locations and ethnicities (Chen and Ji, 2013; Ji and Chen, 2008; Ji et al., 2013; Morgan, 2000). Over the past half century, rapid economic development and improved living standards have enabled and sustained positive secular trends in both height and BMI among Chinese children (Ministry of Education et al., 2002; Song et al., 2013; Ying-Xiu and Shu-Rong, 2012).

However China's significant regional, east-west, socio-economic disparities cannot be overlooked, since they have a direct impact on children's physical growth (Morgan, 2000) (<http://data.stats.gov.cn/workspace/index?m=csnd>). Averaging data nationwide will not accurately reflect regional development; for instance, the extent of childhood obesity in cities with a relatively high GDP, such as Beijing, will be masked if BMI figures are analyzed at the national level. A study that focuses exclusively on the secular changes in the physical growth of Beijing's children can establish benchmarks and provide reference points for research regarding other regions of China and even of other developing countries. Moreover, since Beijing's economical level, nutritional status, and chronic-disease patterns bear similarities to those of developed countries, they are often the basis of comparative studies. While there have been studies of secular growth trends among Chinese children during the period

1950–2005 (Ji and Chen, 2008; Morgan, 2000), the data for Beijing during this period have not been analyzed independently. Drawing on published records for the period 1955–1975 and data obtained from public surveys for the period 1955–2010, we formed an uninterrupted 55-year-long dataset that enables us to explore the growth trends specific to Beijing's children. In addition, we provide an unprecedented report on the recent decline – a consequence of the Chinese government's anti-obesity campaign – in childhood obesity.

The purpose of this research is to determine the current growth curve of schoolchildren in Beijing and describe the long-term secular change corresponding to socioeconomic development during the years 1955–2010.

2. Methods

2.1. Data sources

Data for the period 1955–1975 were derived from published records collected by the Beijing Center for Disease Control and Prevention (formerly known as the Beijing Municipal Health and Epidemic Prevention Station), though the original data were not available (Ministry of Education et al., 1987). Data for the period 1985–2010 were obtained from the Chinese National Survey on Students' Constitution and Health (CNSSCH). The CNSSCH has been conducted every five years since 1985. This initiative was launched by the Ministry of Education, the Ministry of Health, the Ministry of Science and Technology, the State Ethnic Affairs Commission, the State General Administration of Sport, and the Ministry of Finance of China. The project was approved by the Medical Research Ethics Committee of the Peking University Health Science Center (IRB00001052-13082).

The students surveyed during the period 1955–1975 were from families residing in Dongcheng District, Xicheng District, Chongwen District, and Xuanwu District. The students surveyed during the period 1985–2010 were from primary schools and secondary schools of Dongcheng District, Xuanwu District, and Haidian District.

The sampling method used in the study was that of stratified multistage sampling. The children in the sample were attending randomly selected primary and secondary schools in districts that varied in terms of GDP: Haidian District (high GDP), Dongcheng District (middle GDP) and Xuanwu District (low GDP). There were no differences in the sample sizes of these three areas in each of the two surveys. The subjects were primary- and secondary-school students between the ages of 7 and 17. Since 1985 the sample has been drawn from a set of target schools. Sampling methods and quality control of in regard to the collection, handling, and analysis of the samples have been consistent.

2.2. Measurements and data analysis

The first step was a physical examination, to determine whether a given subject qualified for inclusion in the sample. Exclusion criteria included acute illness, chronic illness, and physical handicap. Since 1985, height and weight were measured in accordance with standardized

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