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Diet-related determinants of childhood obesity in urban settings: a comparison between Shanghai and New York



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ABSTRACT

Over the past three decades, both Shanghai and New York City (NYC), have experienced dramatic rises in childhood obesity rates. Given the role that obesity plays in the aetiology of chronic diseases such as diabetes and heart disease, the elevated rates are a major concern. Despite differences in governance systems and cultures, Shanghai and NYC have experienced rapid industrialization, a growing population and a rise in income inequality. The prevalence of childhood obesity in Shanghai and NYC is greater than their respective national rate. However, the trajectory and development of this epidemic has differed between the cities. The distribution of obesity by race and ethnicity, socio-economic status, sex, and age differs markedly between the two cities. To reduce prevalence and inequities within this complex epidemic requires an understanding of the dynamic changes in living conditions among social groups in each city and the behaviours that are influenced by such changes. By comparing changes in the influences on dietary behaviours, such as food distribution, pricing, gender values, and media and marketing, this highlights opportunities for Shanghai, NYC, and other world cities with high or rising rates of childhood obesity to inform future program and policy initiatives. It reiterates the importance of a comprehensive and multilevel approach that includes action at the individual, family, community, municipal, national, and global levels.

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Introduction

Over the past three decades, both Shanghai and New York City (NYC), the commercial capitals of their respective nations,^{1,2} have experienced dramatic rises in childhood obesity rates. Given the role that obesity plays in the aetiology of chronic

diseases such as diabetes and heart disease, the elevated rates are a major concern. Furthermore, as the world's population continues to expand in urban environments, this epidemic could impose growing burdens on cities' governments and healthcare systems. In both developed and emerging nations, 'world cities', urban centres that play a key role in the global economy,³ face rising rates of diet-related diseases, creating

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both the opportunity and necessity of accelerating interurban learning.

New York City experienced its rapid industrialization and population boom in the early 1900s, while Shanghai is still in the midst of its growth. While globalization and industrialization have contributed to both Shanghai and NYC's prosperity, differences in the pace and trajectory of economic growth have influenced each city's development of childhood obesity. In addition, the cities' differing governance structures, histories, and cultures have also shaped the epidemic's development.

Since Shanghai and NYC illustrate two different types of world cities in high and middle income nations, a comparison of the aetiology of childhood obesity may assist in developing more effective strategies to reduce its prevalence in the growing portion of the world's population residing in big cities. Assessing the similarities and differences in how certain social and behavioural determinants of childhood obesity play out in these two cities may also enable public health officials to identify which programs and policies can be universally applied in urban settings and which may require tailoring to the history, culture, and politics of a particular city. This review focuses on diet-related influences on childhood obesity; equally worthy of analysis but beyond the scope of this paper are physical activity influences in the two cities, considered elsewhere.^{4–6}

Childhood obesity in Shanghai and New York

As shown in Table 1, the two cities share some demographic characteristics. Both have a significant proportion of their population born outside the city, both have a relatively small average household size, and both are densely populated. However, the two cities differ in ethnic/racial heterogeneity – almost all of Shanghai's population is of Han Chinese descent, while in NYC more than half the population belongs to non-European ethnic/racial groups. While both cities are the most populous of their nation, Shanghai has a total area that is approximately eight times greater and a population nearly three times larger than NYC.

Prevalence and trends

The prevalence of childhood obesity in both Shanghai and NYC is greater than their respective national rates. However, the trajectory and development of this epidemic has differed between the cities. In Shanghai, childhood obesity and overweight emerged in 1985 and increased exponentially over the following 15 years.⁷ Currently 18% of its youth (defined as ages 6–18 years) are either obese or overweight,⁸ nearly double the national rate of 11%.⁹ In the US, increases in childhood obesity were first recorded in the 1960s, twenty-five years earlier.¹⁰ While the rates in NYC have decreased by about 5% since 2006, they continue to remain high at nearly 21%.¹¹ Combined overweight and obesity rates are 38% among NYC children (grades K–12 years)¹² compared to the national prevalence of 33% (age 6–19 years).¹³

Socio-economic status. In Shanghai, childhood obesity is more prevalent in higher income families^{9,14} and in children living in school areas of high socio-economic status (SES).¹⁵ However, the economic and political transition appears to have narrowed

such differences⁹ as obesity prevalence in lower SES areas of Chinese cities tripled over the last ten years.¹⁶ Unlike Shanghai, NYC's childhood obesity rate is higher in low SES communities and among youth receiving free school lunches than among their respective counter-parts.¹¹ Inequalities in childhood obesity prevalence continue to widen in NYC, as recent declines have been greatest in higher SES children.¹¹ The largest disparity has been observed in children ages 5–6 years as a 16.7% decrease (from 16.8% to 14.0%) has been reported in low school neighbourhood poverty areas compared to a non-significant decrease of 2.7% (from 22.2% to 21.6%) in very high poverty areas, between 2006 and 2011.¹¹

Race and ethnicity. Although Shanghai's population is approximately 98% Han Chinese,¹⁷ rapid industrialization continues, bringing to Shanghai a growing population of rural-to-urban migrants, many of whom are from one of the 55 ethnic minority groups residing in China.¹⁸ As this migrant population expands, obesity and overweight appears to be rising among certain minority Chinese children.^{16,19}

Unlike Shanghai, NYC is considered a 'melting pot' of diverse ethnic, racial, and linguistic backgrounds. More than 50% of its population has their origins in various non-European racial/ethnic groups, predominately Hispanic/Latino (29%) and Black/African-American (26%).²⁰ Black (21%) and Hispanic (26%) children have disproportionately higher rates of childhood obesity in NYC.¹¹ While obesity rates have declined overall in this city since 2006, the prevalence dropped less among Black (–1.9%) and Hispanic (–3.4%) children compared to white children (–12.5%).¹¹

Age. The prevalence of childhood obesity in Shanghai is highest among younger children, with rates of about 10% and 6% for boys and girls (ages 7–12 years), respectively, which is nearly triple the rates than older children.⁷ Meanwhile in NYC, the childhood obesity rate is slightly higher among older children (ages 11–14 years) at 21.1% compared to about 18% for younger children.¹¹

Sex. Clear sex differences exist in Shanghai as the prevalence of combined overweight and obesity for boys (23%) is nearly double the rate for girls (12%).⁷ In NYC, the obesity rate is about 4% higher among boys compared to girls.

Table 2 summarizes childhood obesity prevalence and trends for both cities.

Historical, political, and cultural differences between the cities have had an impact on the development of childhood obesity in various ways. To reduce inequalities within this complex epidemic requires an understanding of the dynamic changes in living conditions among social groups in each city and the behaviours that are influenced by such changes. The following section highlights obesity-related dietary changes in both cities and relevant historical, political, and cultural experiences that may explain the observed changes. City-level data are presented when possible; otherwise national data are used and noted.

Changes in dietary behaviours

Shanghai

China has experienced major changes in dietary patterns resulting in a shift towards increased consumption of energy-

Table 1 – Demographic profile of Shanghai and New York.

	Shanghai	New York
Total area	2448 mi ² (6341 km ²)	302 mi ² (782 km ²)
Central city	112 mi ² (289 km ²)	23 mi ² (60 km ²)
Population		
Total 2010 (increase from 2000)	23,019,148 (37.5%)	8,008,278 (2.1%)
Central city (%)	6,986,300 (30.4%)	1,537,195 (22.0%)
0–14 years	8.6%	20.4%
15–64 years	81.3%	67.9%
65 years+	10.1%	11.8%
Female	48.5%	52.6%
Population density	9,446 people/mi ² (3631 people/km ²)	27,021 people/mi ² (10,383 people/km ²)
Central city	62,791 people/mi ² (24,137 people/km ²)	69,468 people/mi ² (26,703 people/km ²)
Legal status		
Foreign-born 2008 (increase from 2000)	–	36.4% (36%)
Migrant 2010 (increase from 2000) ^a	36.4% (19.4%)	–
Race/ethnicity		
White	–	44.7%
Black/African American	–	26.6%
Hispanic/Latino	–	27.0%
Asian/Pacific Islander	–	9.8%
Other Race	–	13.4%
Han	98.0%	–
Chinese Ethnic Minority	1.2%	–
Education^b		
Middle-school graduates enrolled in vocational/high school (2008)	97%	
Graduated high school (2012)		71%
Economic		
Persons per household	2.49	2.59
Population below poverty line	1.9% ^c (2009)	20.9% ^d
People living below poverty line	363,000 ^e (2009)	1,700,000
Gross domestic product	US \$297 Billion	US \$1.28 Trillion ^e
Extreme wealth^f		
Number of millionaires	166,000	389,000 (Manhattan only)
Number of billionaires	23	70

All data show demographics as of 2010, unless otherwise noted.

^a Migrant (non-permanent) residents defined as residents that lived in Shanghai for six months or longer and lack official Shanghai registration (Shanghai Hukou status).

^b China has a 9-year compulsory education program, which appears comparable up to US middle school. Graduation rates for Shanghai were not available so the percent of middle-school graduates, who entered vocational or high school, is presented.

^c Shanghai Statistical yearbook, 2009, defined as total number of people (and %) receiving Minimum Living Standards Assurance.

^d U.S. Census Bureau benefits.

^e Bureau of Economic Analysis, US Department of Commerce.

^f WealthInsight, 2013.

dense foods high in fat and low in carbohydrates,^{21,22} so that Chinese children's diets now resemble that of American children's in the mid-1990s.²¹ Furthermore, snacking behaviours have doubled from 2004 to 2009, with approximately 50% of children reporting consuming a snack over a three-day period, indicating another major shift towards more Westernized behaviours.²³ In addition, skipping breakfast and consuming meals away from home have been documented in Chinese youth, and in particular, migrant adolescents.^{24,25} These changes are most marked in cities, where the transition to Western-style food environments has proceeded most rapidly.

Economic change and food pricing. Economic growth in China has resulted in an expanding urban middle class and increased disposable income,^{26,27} often spent on energy-dense food.^{28,29} As noted, this economic and political transition appears to have narrowed SES differences in childhood

obesity. Such shifts may be explained by the accessibility of street foods high in fat, particularly for low SES migrant children.²⁴ In addition, a globalized food system has made higher fat foods, such as animal products and edible oils, more affordable and accessible for lower SES groups.^{27,30} This may explain some of the increases in dietary fat consumption, particularly among urban, low-income households.^{21,27,31} Contrary to Western countries like the US, vegetable consumption is associated with childhood overweight in China, perhaps because vegetables are often cooked with affordable but energy-dense oils.³²

Fast food. Global fast food companies such as KFC™ and McDonald's® continue to expand across China, particularly in urban areas like Shanghai.^{33–35} However, the total reach of such chains in the broader population is still limited as fast foods are largely consumed by youth of middle and high SES groups.^{29,36} Local food chains have responded to this gap in

Table 2 – Summary of childhood obesity prevalence in Shanghai and New York.

Shanghai	New York
Prevalence	
Both cities have combined CO and OW rates higher than their national averages.	
CO emerged in Shanghai in 1985 and continues to rise-rate is nearly two times higher than national average.	CO was first documented in US in 1960's and remains high. Prevalence in NYC has decreased slightly between 2006 and 2011.
Socio-economic status	
SES levels play a major role in CO risk in both cities.	
CO prevalence is greatest among middle and high SES families, but economic transition has narrowed differences.	CO prevalence is greatest among low SES groups.
Race and ethnicity	
Both cities exhibit a growing minority and immigrant/migrant population that is at risk for CO.	
A growing migrant and minority population is at risk for CO.	Black and Hispanic youth are at greatest risk for CO.
Age	
CO prevalence in younger children is nearly triple the rate for older children.	CO prevalence is slightly higher in older children compared to younger ones.
Sex	
Combined CO and OW rate for boys is nearly double than girls.	Sex differences exist across specific ethnic groups.
Diet	
Globalization and agricultural production/food distribution advances have resulted in diets higher in animal foods, edible oils and snacking. National and global fast food companies have increased outlet density and marketing in urban areas.	US youth have increased intake of CHO's and simple sugars, mainly from SSB.
Abbreviations: CHO's = Carbohydrates; CO = Childhood Obesity; NYC = New York City; OW = Overweight; SES = Socio-economic Status; SSB = Sugar-sweetened Beverages.	

the market by adopting Western fast food models³⁷ and making energy-dense, nutrient-poor food more accessible and affordable to urban youth across all SES groups, including low-income populations.²⁷

Food distribution. Food distribution chains have evolved significantly in cities like Shanghai, in response to food safety concerns, which may paradoxically promote poorer dietary choices. Government-led conversion of 'wet markets' (open public markets) into supermarkets has been carried out in cities across China as wet markets are considered unclean, unsafe, and inefficient in generating tax revenue.²³ As a result, China is experiencing the world's fastest growth in supermarkets.³¹ While this shift leads to more control and access to safer foods,³⁸ it also increases access and availability of affordable prepackaged, processed, energy-dense foods.³⁹ Unaware consumers seeking safer food may be inadvertently consuming higher levels of sodium and fat as traditionally consumption of these nutrients came from salt and oil being added during the cooking and eating process.^{40–44}

Double burden. Malnutrition is gradually being reduced as China continues to evolve.²⁸ However, the country still struggles with a 'double burden' of malnutrition and obesity, similar to the food insecurity and obesity paradox observed in the US, where low income individuals often depend on less expensive, non-nutritious, energy-dense foods.⁴⁵ Thus, efforts to reduce malnutrition in China may be contributing to childhood obesity as the rates are rising in lower SES youth.

The Little Emperor. A shift in workforce has occurred in China, in response to the country's growing economy.⁴⁶ In many families, both parents have entered the workforce so grandparents have become the primary caretakers of children in three-generation families. Many grandparents grew up in poverty and recall experiences of the Great Famine in the 1960s, which resulted in millions of lives lost.⁴⁷ They may thus compensate for their personal experiences by encouraging their grandchildren to consume larger portions.⁴⁸ In addition, they are more likely to hold traditional beliefs that heavy young children are a sign of good nutritional status and of wealth and prosperity.⁴⁹ Furthermore, China's one-child policy, a population control measure originally implemented in the late 1970s, has resulted in a 4:2:1 ratio of grandparents, parents, and (grand) child, where a majority of the disposable income and attention are focused on the single child. This has produced what's been coined the 'Little Emperor's Syndrome', which has led to rewarding of the single child through over-indulgence of food.⁵⁰

Gender values. Traditional gender values in China favour heavier boys,⁵¹ which may explain the childhood obesity differences between males and females in Shanghai. Studies suggest that Chinese parents are more likely to misperceive overweight sons as being strong and healthy, while parents are more sensitive to daughters' weight issues such that girls with slender statures are perceived more favourably in society,⁵² the latter likely stemming from Western culture and

Table 3 – Program and policy recommendations to reduce adverse dietary influences on childhood obesity in Shanghai and New York.

	Shanghai	New York
Engage families in obesity prevention	Develop intergenerational programs to assist parents and grandparents to encourage healthier food choices	Assist single-parent households to encourage healthier food choices
Continue improvements in school food	Expand school food programs to all schools	Improve quality and appeal of school food and make school lunch free for all children
Develop comprehensive school- and community based nutrition education	In both cities, coordinate school and community programs that provide children and parents with consistent, accessible knowledge and skills to make healthier food choices; engage families in dialogue on gender and cultural beliefs that put children at risk of obesity	Use zoning, subsidies, and tax incentives to encourage healthy retail outlets and discourage additional unhealthy outlets in low-income areas
Encourage retail food environments that make healthier food more available and obesogenic products less available	Use powers of municipal government to encourage healthier food retail outlets and to limit density of unhealthy food outlets	
Reduce marketing of high fat, sugar, and salt foods to children	In both cities, use powers of municipal government and encourage national government to establish and monitor restrictions on marketing unhealthy food to children	
Integrate food security and obesity prevention programs	Develop municipal and national standards for nutrient content of food assistance programs	Integrate nutrition standards into existing food benefit programs such as SNAP and WIC; provide nutrition education within food assistance programs
Reduce social isolation and stigmatization of ethnic groups and low SES populations	Ensure full access to educational, health and other services for ethnic minority and migrant children	Reduce residential and educational ethnic/racial and SES segregation
Reduce child poverty and income inequality	In both cities, develop income, tax, wage, and housing laws that enable families to move out of poverty and provide safety nets during times of economic crisis	

advertising.⁵³ These traditional gender values may be adopted by the youth themselves as research has shown that healthy or underweight Chinese girls (ages 14–18 years) are two times more likely to misclassify themselves as overweight than girls from the US,⁵⁴ whereas normal weight or overweight Chinese boys (ages 11–15 years) are more likely than Chinese girls to misclassify themselves as underweight.⁵⁵

New York

In the US, youth consume about one-fifth of all calories from sugar-sweetened beverages and fast food.³⁶ While energy intake from solid fats and added sugars appears to have plateaued among children and adolescents, levels still exceed recommendations by 18–28%.⁵⁶ Sugar-sweetened beverages are the number one source of carbohydrate, total sugars, and added sugars^{57,58} and account for nearly 9% of total energy intake in youth.⁵⁸ While beverage consumption trends have varied between racial groups over the last two decades, consumption of fruit drinks and sugar-sweetened beverages increased the greatest among Black and Hispanic children between 1989 and 2008,⁵⁹ which parallels the increase in childhood obesity. More than four out of five NYC children (ages 6–12 years)⁶⁰ and 50% of high school students consume one or more serving of sugar-sweetened beverage per day.⁶¹ In addition, snacking accounts for up to 27% of children's daily caloric intake, largely due to an increased proportion of snacking calories from candy, salty snacks, fruit juice, and fruit drinks over the past three decades.⁶²

Deserts and swamps. Food deserts (areas characterized by poor access to healthy and affordable food) are more prominent in neighbourhoods with the highest proportions of Black residents and the lowest median household incomes, while predominately white, middle and upper-income areas provide better access to healthy food.^{63,64} These low-income areas are also more likely to be food 'swamps' (areas with greater availability of energy-dense foods) as small grocery stores (commonly known as bodegas) with limited healthy options and fast food establishments have a greater presence.⁶³

Obesity paradox. In NYC, as in Shanghai, health officials struggle to find the right balance between strengthening programs to reduce food insecurity (e.g., Supplemental Nutrition Assistance Program (SNAP), the largest federal nutrition assistance program,⁶⁴ and the federal School Breakfast and Lunch Programs) without increasing overweight. The available evidence is mixed as some studies suggest an association between SNAP participation and obesity^{37,65–68} while others find no association.⁶⁹ One study found that child SNAP participants are below national recommendations for whole grains, fruits, vegetables, fish, and potassium and exceed recommended limits for processed meat, sugar-sweetened beverages, saturated fat, and sodium.⁷⁰ In addition, the SNAP program seems to cover the majority of sugar-sweetened beverage purchases among participant households including children.^{64,71}

Adolescent autonomy. The modest difference in childhood obesity observed between the age groups could be partially due to older children and adolescents having greater autonomy in food purchase and consumption behaviours,^{72,73}

which may result in the purchasing of more energy-dense foods outside the school environment. Additionally, perceived time constraints and convenience often influence adolescent food preferences,^{74,75} leading to nutrient-poor food choices. However, the risk for childhood obesity and overweight between age groups also differs by ethnicity as the prevalence in young Chinese-American children (19.2%) is nearly double that of their adolescent counterparts (10.4%).⁷⁶ These age differences in Chinese-American youth resemble those observed in Shanghai,⁷ which may suggest the traditional values around younger children may still exist in Chinese families who have immigrated to NYC. In addition, the traditional Chinese gender values for males may also continue in families even after immigration to Western countries, like the US, as obesity rates are similar for Chinese-American boys in NYC compared to those in Shanghai.⁷

Culture. As highlighted above, culture (in the form of traditional gender values) may contribute to disparities in childhood obesity. However, weight and body image development can be influenced in a cultural and ethnic context, regardless of gender. While such data specifically related to immigrant NYC Chinese youth do not appear to exist, research has shown that Latina mothers in NYC tend to prefer a plumper figure for their children, irrespective of the child's gender as a larger figure represents health, fitness, beauty, and wealth.⁷⁷ Similarly, African-American caregivers of overweight and obese children tend to underestimate their child's body size and have limited concerns about weight-related health outcomes.⁷⁸

Super-size portions. The dietary patterns of increased solid fats and added sugars observed in US youth could be partially explained by increased portion sizes of popular energy-dense, nutrient-poor foods. For example, McDonald's fountain drink sizes in the US have increased from seven ounces in 1955 to 32 ounces in 2007, a 457% increase.⁷⁹ Additional examples of increased portion sizes over the years include burgers, French fries and Mexican fast foods, which have also been important contributors to youth's total daily energy intake.⁸⁰ To further incentivize consumption of such foods, portion pricing is used across fast food outlets where larger portions of nutrient-poor foods and sugar-sweetened beverages are priced disproportionately cheaper.⁸¹ Adolescents appear to be more susceptible to increased portion sizing, as are Black and Hispanic youth and youth from a household with a lower level of education.⁸⁰

Media and marketing. Because of their spending power, purchasing influence, and potential as future adult consumers, youth have been a major focus of food and beverage marketing.⁸² They spend more time (approximately 7.5 hours per day) in front of multiple forms of media than any other activity, aside from sleeping,⁸³ increasing the opportunity of exposure to advertisements. Food advertising, which predominantly promotes unhealthy foods and drinks,⁸⁴ has been shown to influence children's food purchase requests, nutritional quality of their food selections, and their health.^{85,86} Children may be uniquely vulnerable to marketing of poor nutritional quality foods as they lack decision-making skills and maturity to make appropriate choices.⁸⁷

Implications and conclusion

This review summarizes the similar and unique social and behavioural diet-related determinants of childhood obesity for the cities of Shanghai and NYC. While the cities share certain determinants such as an expanding minority and immigrant population that may be at greater risk for childhood obesity, distinct differences exist across other determinants like SES, sex, and age. Unique cultural values, historical events and policies appear to have played a role in shaping the dietary patterns and childhood obesity rates for each city and country.

While the available data limit the ability to make direct comparisons between the cities, the review of the current evidence highlights opportunities for Shanghai, NYC, and other world cities with high or rising rates of childhood obesity to inform future program and policy initiatives. Following the recommendations of several recent reviews of approaches to reducing childhood obesity,^{88–90} such guidance suggests the importance of a comprehensive and multilevel approach that includes action at the individual, family, community, municipal, national, and global levels. Summary of the complex social and behavioural determinants of childhood obesity in Shanghai and NYC reinforce the call for equally complex and multilevel responses.

To reduce the prevalence of childhood obesity and to shrink the inequalities in obesity rates among various sub-populations, Shanghai and NYC face similar challenges since common factors have driven increasing prevalence and inequitable distribution. [Table 3](#) identifies possible strategies in each city for dietary influences. The implementation of such strategies requires further analysis of existing responses to childhood obesity in the two cities and their governance processes.

In China, a comprehensive school-based obesity prevention intervention that included both nutrition education and physical activity was recently tested in several cities, including Shanghai, and found to be cost-effective.⁹¹ Other efforts have focused on increasing labelling of supermarket food products,⁹² using the Healthy Cities model to create health promotion programs to address common risk factors for non-communicable diseases,⁹³ and promoting breastfeeding rather than infant formula use.

In NYC, a recent report from the intersectoral Mayor's Task Force on Childhood Obesity summarizes recent and planned initiatives to encourage further reductions in childhood obesity.⁹⁴ Among its recommendations are the expansion of nutrition and wellness programs in city schools, initiatives to further reduce sugar-sweetened beverage consumption, and expansion of mass media nutrition education campaigns.

Shanghai and NYC have strong municipal governments committed to taking action to protect the health of their city's children and families. But health officials in both cities face challenges in implementing comprehensive, sustainable programs that reach all sectors of the population. These include an often-siloed rather than intersectoral approach to solving problems, competition for scarce municipal resources needed to address other urban social and health problems, and resistance from small food businesses and multinational

food companies challenged with balancing the higher costs of using healthier ingredients with sustaining revenue streams. More broadly, both cities face global forces that increase income inequality, a fundamental cause of childhood obesity, and that limit the ability of municipal governments to work directly with an increasingly concentrated global food industry.

In the years to come, the success of health officials in Shanghai, NYC, and other world cities around the globe in reducing childhood obesity will depend on their skills in negotiating this complex terrain.

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