Childhood Obesity in China

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ABSTRACT

In the context of globalization, economic reforms, and urbanization, China is experiencing a nutrition transition, a trend referring to shifts in dietary and physical activity patterns. In recent decades, the prevalence of childhood obesity increased dramatically and became a public health concern. Childhood obesity has multiple drivers, and the increasing rate reflects the changing food system, economic growth, and changes to dietary and physical activity patterns. Moreover, it becomes more complex when considering the disparities between urban and rural regions of China. Despite rural children have a lower prevalence in obesity than their urban counterparts, they are experiencing a higher rate of increase indicating a potential explosion. Effective interventions should be comprehensive, addressing both dietary and physical activity patterns and health education in both rural and urban areas. Furthermore, a whole-system intervention approach is suggested, which needs efforts of schools, communities, and families.
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Chapter One: the Global Obesity Epidemic

Obesity Epidemic

The world is getting fatter. A few decades ago, malnutrition was the primary global nutrition problem that the world was concerned about. However, in recent decades, along with the increase of population, the world has been experiencing a rapid upsurge in overnutrition and obesity. As such, the global obesity rate has more than doubled since the 1980s (WHO, 2016). Across the world, both in developed nations and developing countries among adults and children, the number of overweight and obese people is growing dramatically. In 2014, over 1.9 billion people worldwide were overweight, of which more than 600 million were obese (WHO, 2016). Moreover, 65% of the global population are living in the countries where overweight and obesity kills more people than underweight (WHO, 2017). In many low-and-middle-income countries, while people are still fighting with malnutrition and infectious diseases, they are facing the double burden of also battling non-communicable diseases related to overweight and obesity, such as diabetes and heart diseases (Shetty, 2013).

Understanding how to tackle the global problem of obesity begins with understanding how best to define and measure obesity. For adults, the WHO defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health (WHO, 2016)." Body mass index (BMI), which is the value of one's weight in kilograms divided by the square of height in meters (kg/m²), is widely used to classify overweight and obesity (WHO, 2016). The normal range of BMI is from 18 to 24.9 kg/m². Overweight is classified as a BMI equal or higher than 25 kg/m², while obesity is defined as greater than or equal to 30 kg/m² (WHO, 1998).
For children, different measures are used to capture childhood overweight and obesity because of normal growth patterns that occur during childhood and due to differences between age and sex. Two major definitions are widely used in the research.

The first one is the World Health Organization (WHO) criteria. According to the WHO, children under five years old who have a weight-for-height more than two standard deviations above WHO Child Growth Standards median are classified as overweight, and children above three standard deviations are classified as obese (Salehiniya et al., 2012). For children aged 5-19, overweight is defined as a BMI that greater than one standard deviation of the WHO reference median, while obesity is greater than two standard deviations (Lakshman et al., 2012).

The second criterion is based on the International Obesity Task Force (IOTF) cut-offs. Based on the large data sets from six countries including Brazil, Britain, Hong Kong, the Netherland, Singapore and the USA, IOTF proposed a series of sex-age-specific BMI cut offs for children. These BMI cut off values are linked with adult BMI cut off values, which are established based on the risk of health consequences (Wang & Wang, 2002).

Controversy on the definition and measurement of overweight and obesity arose in recent years (Popkin, 2002). It is found that BMI is not sensitive to measure obesity for many sub-populations in the world. For instance, an Asian adult is likely to have a greater adverse metabolic effect than a Caucasian adult who has the same BMI (Popkin, 2002). And it is common among Asian populations that an individual whose BMI is in the "normal" range has a disproportionately large waist circumference (Zhang et al., 2016). Thus, in some studies, waist-to-height ratio and waist circumstance are also used to measure obesity (Ashwell et al., 2012; Li...
et al., 2013). Furthermore, different countries use different measurements to define childhood obesity. The United Kingdom uses the same threshold as WHO, while many countries including the United States define childhood obesity as a BMI above the 95th percentile for age and sex, and overweight is defined as a BMI above 85th percentile (Lakshman et al., 2012) based on expected growth using growth curves.

Using these metrics to determine obesity, there were 114 countries in 2014 with high rates of obesity, where more than half of the adult population are overweight or obese (WHO, 2017). Across the global, 39% of adults aged over 18 are overweight (38% of men and 40% of women) while around 13% of the adults are obese (11% of men and 15% of women). In 1980, only 22 percent of men and 24 percent of women were overweight, and 3.7 percent of men and 7.1 percent of women were obese. As such, there has been a rapid increase in the global prevalence of overweight and obesity over the past three decades. Once obesity was considered as a disease of well-developed countries; however, obesity is becoming a burden in many developing countries. Moreover, some low-and-middle-income countries have seen a higher rate of obesity prevalence than high-income countries (Popkin & Gordon-Larsen, 2004).

Similarly, the childhood obesity rate is increasing at the same time, albeit with a faster speed (Lakshman et al., 2012). Figure 1.2 shows that from 1980 to 2013, the prevalence of overweight and obesity increased in both developed and developing countries (Ng et al., 2014). In developed countries, the prevalence of overweight and obesity increased from 16.9% for boys and 16.2% for girls to 23.8% and 22.6%, respectively. In developing countries, the prevalence was 8.1% for boys and 8.4 for girls in 1980, and increased to 12.9% to 13.4% (Figure 1.2). Globally, the prevalence of overweight and obesity among children aged under 5 grew from 4.2% in 1990 to 6.7% in 2010, and it was estimated that the prevalence will reach 9.1% (or 60
4 million) in 2020 (De Onis et al., 2010). Strikingly, the increasing rate of overweight and obesity in low-and-middle income countries is 30% higher than high-income countries (WHO, 2016).

Figure 1.2 Age-standardized prevalence of overweight and obesity, ages 2–19 years, by sex, 1980–2013
Source: Ng et al., 2014

Health Consequences

Overweight and obesity place burdens on healthcare and economic system. Research reported that obesity was estimated to attribute to 0.7 to 2.8% of the healthcare expenditure worldwide (Withrow & Alter, 2011). Moreover, overweight and obese individuals spend 30% more on healthcare than their normal-weight counterparts (Withrow & Alter, 2011). The burden on economics reflects the numerous health consequences caused by overweight and obesity.
Overweight and obesity are the main risk factors for many nutrition-related non-communicable diseases (NCD) (WHO, 2016), and it is tightly associated with high levels of degenerative and chronical diseases such as hypertension, diabetes, and some cancers (Popkin, 2002). In 2012, 481,000 (about 3.6%) of all new cancer cases were attributable to high BMI (Arnold et al., 2012). Another study indicated that about 20% of cancers are the result of overweight and obesity (Wolin et al., 2010). BMI-related diseases such as cardiovascular diseases (including heart disease and stroke) become the global main causes of death (WHO, 2017). In 2006-2015, death from non-communicable diseases increased 27% in Africa, while 17% in the U.S. and 4% in Europe (WHO Chronic Disease Report, 2015). WHO predicted that in the next 10 years, developing countries would experience increasing mortality from cardiovascular disease, cancer, respiratory disease and diabetes. The obesity epidemic has now shifted to the developing countries, which results in them facing the double burden of malnutrition and overweight.

Similar health consequences from obesity are seen for children. Overweight and obese children are more likely to be obese in adulthood, and have a higher risk of premature death and disability (Wabisch, 2000). The result of the U.S. Longitudinal Studies of Adolescent Health Study shows that around 40 percent of obese adolescents became severely obese (BMI > 40kg/m²) by 30 years old while the number of their normal-weight counterpart was less than 5 percent (Lakshman et al., 2012).

There are negative health consequences of obesity during childhood. A positive relationship was found between childhood obesity and the increased risks of high blood pressure, dyslipidemia, insulin resistance, metabolic syndrome, type 2 diabetes mellitus, and cancer (He et al., 2011; Lakshman et al., 2012, WHO, 2016). A study conducted in the United States found
that obese children were twice as likely to have diabetes than their normal-weight counterparts (Lee et al., 2006). Children who are above 84th percentile in BMI have a 50% higher risk in developing urothelial and colorectal cancer in their adulthood compared with the children who are normal weight (Levi et al., 2011). Moreover, obese children are more likely to suffer psychological and social pressure, which is linked to the depression, low self-esteem and self-image, and poor academic performance (Yu et al., 2010). A study conducted in China showed that the prevalence of depression was 35% higher among obese children than their normal-weight counterparts (Wang et al., 2007).

The negative physical and mental health consequences caused by the obesity have lifelong impacts on children. Interventions are urgently needed to address childhood obesity. As the nutrition transition happens everywhere and obesity is dominating the globe, understanding the trends and determinants is crucial to determine the next steps.

**Nutrition Transition**

Obesity is a multi-factorial disease. The changed global food system allows people to have more access to processed and energy-dense food, and a westernized diet which is high in fat and sugar is sweeping the world (Schlosser, 2012). As such, we are living in an obesogenic environment. At an individual level, weight gain is caused by energy intake being larger than energy expenditure (Catenacci et al., 2009). The rising rates of obesity are likely a result of this imbalance. This has been termed the nutrition transition in order understand the worldwide increasing prevalence in obesity. Along with the shifts in dietary intake and energy expenditure, there are two other transitions related to the nutrition transition that are worth noting. One is the demographic transition, which refers to the trend of reducing fertility and mortality; the other is epidemiological transition, referring to the shift from the pattern of high
prevalence of infectious diseases caused by malnutrition, famine, and poor sanitation to the pattern of high prevalence of non-communicable diseases related to the urban, modern and western lifestyle (Popkin & Gordon-Larsen, 2004; Catenacci et al., 2009).

The Nutrition Transition refers to the shifts in people's dietary and physical activity patterns (Popkin & Gordon-Larsen, 2004). Unlike the dietary pattern we used to have which relied heavily on cereals, vegetables, and unprocessed food, the current dietary pattern is high in fat, sugar, salt, and refined food (Popkin & Gordon-Larsen, 2004). The change of the food system contributes to the shift of dietary patterns. Because of industrialization of food and agriculture, we have a higher food productivity, and processed food takes up a huge part of our diet. It not only feeds the increasing population but also changes our dietary pattern (Roberts, 2008). Processed food helps people save time to cook and to eat, makes people feel sanitary because of the standardized and uniformed production, and most importantly, it is less expensive. However, it contains higher amount of fat, added sugar, and salt, which can cause cardiovascular diseases and overweight (Popkin et al., 2012).

Barry Popkin, who first proposed the concept of nutrition transition in 1993, summarized four major trends in worldwide diet shifts. First, consumption of edible oil is increasing. For instance, from 1990-1996, the global consumption of vegetable oil and fats increased from 60 to 71 million metric tons (Popkin & Gorden-Larsen, 2004). And the global vegetable oil production achieved a fourth-fold increase in 1975-2007 (Figure 1.1). Second, intake of animal-source products increased. Animal-source product consumption is positively related to socioeconomic status. China has achieved remarkable economic and income growth since the 1950s. The consumption of animal-source products increased along with the economic growth. Per capita annual consumption of animal foods in 1952 was 11kg and increased to 38kg
in 1992 (Du et al., 2002). The increasing consumption of protein and fat resulted in increasing energy intake.

![World vegetable oil production](source)

Figure 1.1 World vegetable oil production
Source of the data: www.fas.usda.gov/psdonline

Third, people have heavily relied on processed food (Popkin et al., 2012). Processed food is energy-dense but nutrient-poor, and can easily lead to overeating (Monterio, 2010). People prefer processed food because the use of additives, unified shapes, and quality make it palatable and easily-to-eat (Moneteiro, 2010). As such, snacking, as a main form of processed food consumption, is becoming a part of dietary patterns worldwide. For instance, in the U.S., prevalence of snacking increased in all age groups from 1977-78 to 2003-06, and the contribution of snacking to total energy intake increased from 17% to 24% (Piernas & Popkin, 2010). Snacking is also prevalent in low-and-middle income countries; Figure 1.2 shows that the per capita retail sales of snacks increased dramatically. Processed food is a big source of added sugar, fat, salt, and energy, thus increasing consumption of processed food is a risk factor of overweight and obesity (Moneteiro et al., 2013).
The increasing energy intake is not solely related to the food we eat, but also with what we drink (Popkin, 2009). The fourth trend is the rising consumption of caloric sweetener. In recent decades, instead of adding sugar, people started to use caloric sweetener such as corn syrup in beverages. In 2000, people consumed 306 calories from caloric beverages per day, which is 33% more than the consumption in 1962 (Popkin & Gorden-Larsen, 2004). Sugar-sweetened beverage (SSB) is popular among the world, especially for children. And it is the primary source of added sugar in children's diet. In Mexico, 17.5% and 19% of the daily energy intake of children aged 1-19 and adults aged 20 and over respectively come from caloric sweeteners.
sweetened beverage (Stem, 2014). The dietary pattern that is high in sugar results in the increasing prevalence of overweight and obesity. As caloric sweeteners contribute a large share of energy intake, many studies confirmed the positive relationship between the consumption of SSB and obesity (Olsen & Heitmann, 2009; Grimes et al., 2013; Fowler et al., 2008).

Another facet of the nutrition transition is the shift in physical activity pattern. A sedentary lifestyle which decreases the level of physical activity is likely the result of the development of technology. Previously, the agricultural world dominated, and agriculture demanded large expenditure of energy. Currently, we have shifted more towards a sedentary lifestyle. In 1991-2006, the largest reduction in energy expenditure was seen in an increase in sedentary time among Chinese men. In the United States, the average time that children spend watching television or playing video games is 3 hours, and they spend another 3 hours on movies and pre-recorded music (Popkin & Gordon-Larsen, 2004). Moreover, automobiles and public transportation reduce the opportunity for people to move around. For instance, in China, only 17% of households owned motorized vehicles in 1991 (Bell et al., 2002). But in 2013, 70% household owned one car, while 22% have two cars (Statista, 2013).
Figure 1.2 Shift In MET Hours per Week by Activity Among Chinese Men (18-55 Years Old).
Chapter Two: Trends and Prevalence

National Trends and Prevalence

Since the 1980s, the global obesity epidemic has spread to China. The image of traditional Chinese people that are lean and slim has changed; currently one-fifth of the global one billion overweight or obese population are Chinese (Wu, 2006). According to a study which analyzed obesity trends of 188 countries during 1980-2013, China had 62 million individuals with obesity in 2013, which was 9% of the world's total (Ng et al, 2014). The latest study published in the Lancet reports that China has the greatest number of obese people in the world, with 43.2 million obese men and 46.4 million obese women (Figure 2.1; Di Cesare et la., 2016). Although China does not have a high prevalence of overweight and obesity compared with other developed and developing countries, China has experienced the most rapid growth in obesity in the world. For adults aged 20 and over, China saw the tenth biggest change in overweight and obesity prevalence (Ng et al, 2014. Moreover, during the past 40 years, the prevalence of overweight in a Chinese man has a nearly five-fold increase rising from 8.2% to 38.7%, while the prevalence of overweight in the female has a three-fold increase from 10.4% to 33.1%.
Meanwhile, the burden of the obesity epidemic has also been on the rise among children in China. Several decades ago, the primary nutritional problem of Chinese children was malnutrition. In 1987, the prevalence of stunting children aged under 5 was 38.7%. During the past thirty years, the prevalence of stunting decreased dramatically to 9.4% ("Prevalence of stunting," 2016). Although this decrease has been helpful for improving child health, childhood overweight and obesity is now the major concern of children nutritional health. Many studies have shown that the prevalence of overweight and obesity among children in China is increasing at a fast rate. Among 188 countries globally, China had the fourth-greatest rise in childhood overweight and obesity rate from 1980 to 2013, increasing from 5.5% to 18.8% (Ng et al., 2014). The Chinese Center for Disease Control and Prevention (CCDC) reported that in 2012, more than 120 million children in China were overweight or obese ("Obesity is a growing concern," 2012).

To understand the changes over time in childhood obesity trends, there are two main national surveys that are widely used. One is the Chinese National Survey on Students'
Constitution and Health (CNSSCH), which is conducted every five years since 1985 by the Ministry of Education, the Ministry of Health, the Ministry of Science and Technology, the State of National Affairs, and the State Sports General Administration of People's Republic of China (Song et al., 2013). The other one is the China Health and Nutrition Survey (CHNS), which covers twelve provinces and is conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health at the CCDC (Zhang et al., 2015). Both surveys show that the prevalence of childhood obesity in China is increasing over the past few decades.

According to the CNSSCH, the standardized prevalence of obesity in Chinese urban boys and girls increased from 0.2% in 1985 to 8.1% in 2010 (Song et al., 2013). It is consistent with the results of CHNS. The result of the CHNS shows that the prevalence of childhood obesity was 3.8%, 5.1%, 7.9%, and 8.3% in 1991, 2000, 2004, and 2006, respectively (Popkin et al., 2010). Other studies also support the argument that China is experiencing a dramatic increase in childhood obesity. Shanghai CDC reported that the childhood obesity prevalence increased from 3.8% in 1991 to 13.5% in 2009 (Lu et al., 2013). A meta-analysis reviewing 41 studies found that the prevalence of overweight and obesity increased from 1.8% and 0.4% in 1981-1985 to 13.1% and 7.5% in 2006-2010 (Yu et al., 2012).

The increasing prevalence is seen in all age groups. From 1996 to 2010, the rates of overweight in toddlers had a four-fold increase, while it was 2.4, 2.1, 1.3, and 2.2 times higher than 1996 for infancy, pre-school children, school children, and adolescents respectively (Yu et al., 2012). Although childhood obesity is increasing in China, the trends in overweight and obesity prevalence among children vary by sex, age, and area subpopulations (Sun et al., 2014).
Gender Disparity

Many studies have observed a gender disparity in the childhood obesity trends and prevalence. Boys are considered more likely to be overweight and obese than girls (Li et al., 2015; Yu et al., 2012). The result of CNSSCH (Figure 2.2) shows that the prevalence of childhood overweight of boys and girls were 0.2% and 0.1% in 1985, and was 11% and 5.2% in 2010 (Song et al., 2013), which is significantly greater than the prevalence seen among girls. In addition, Song and colleagues (2013) found that the gender disparity is expanding over time. The comparative meta-analysis of 41 studies shows that the prevalence of obesity among boys was 15.4% in 2006-2010 while 10.7% of girls were obese (Yu et al., 2012).

Figure 2.2 Standardized prevalence of obesity in Chinese urban boys and girls, 1985-2010
Source: Song et al., 2013

The gender disparity was also found in the studies focus on specific provinces or cities. In Shandong Province, 22.6% of boys were overweight or obese while 12.9% of girls were
obese (Zhang & Yang, 2013). In Jintan city, 23.7% of the boys and 20% of the girls were overweight or obese in 2007 (Sun et al., 2015). Moreover, the gender disparity is also seen among different age groups. For the children aged 7-12, the prevalence of overweight and obesity among children is 39.3% for boys and 28.1% for girls, while among adolescence aged 13-18, it is 26.5% for boys and 14.7% for girls (Zhang et al., 2016).

**Rural-urban Disparity**

The prevalence of obesity also varies across rural areas and urban. Overweight and obesity are tightly associated with socioeconomic status (SES), but the association varies based on the study. In some western studies, people with lower SES are more likely to be obese than those with high SES (Cai et al., 2012; 2013). But in China, as is the case in many developing countries, higher socioeconomic status is the risk factor for overweight and obesity (Cai et al., 2012; 2013; Yu et al., 2012). Urban areas are more developed than rural areas, and people in urban areas are likely to have higher SES than their rural counterparts. Research has found that urban areas have a higher rate of childhood obesity than rural counterparts (Sun et al., 2014; Yu et al., 2012). In 1991-1995, the rate of overweight in urban and rural areas was 5.3% and 3.7%. In 2006-2010, the prevalence of overweight in urban areas increased to 12.3% while in rural areas, the rate was 7.7% (Yu et al., 2012). The result is consistent with other Chinese studies. In Shandong Province, the childhood obesity rate in 1985 was 2.2% for urban children and 0.6% for rural children. Twenty five years later, both urban and rural areas have seen dramatic increases in obesity, but the prevalence is higher in urban areas (24%) as compared to rural areas (20.5%) (Zhang & Wang, 2013).
Despite urban areas having a higher prevalence of childhood obesity, more recent studies have shown that rural areas are experiencing an increasing rate of childhood obesity; among some rural population, childhood obesity rates even exceed urban ones (Ji & Chen, 2008). For instance, across 13 studies focused on childhood obesity in urban and rural areas, Yu and colleagues (2012) found that between 2006-2010, the rate of obesity was 8.1% for urban areas and 4.6% for the rural areas. The figures were 2.8 and 3.5 times higher than 1991-1995. Meanwhile, the annual increases were 7.1% for urban and 8.8% for rural areas. In Shandong Province, the prevalence of childhood obesity in rural areas increased more than 33 times from 1985-2010, while it had a 10-time increase in urban areas (Zhang & Wang, 2013). Even though rural areas have a lower prevalence of childhood obesity, society should pay much attention to increasing rate of obesity seen in rural areas (Zhang et al., 2016).

Since China is geographically large (Figure 2.3), people living in different areas have varying dietary patterns which may also lead to differential obesity rates. Similar to the rural-urban disparity, economic development attributes to the inland-coastal disparity. It is observed that boys and girls aged 7-18 years in north coastal big cities have much higher rates of overweight and obesity, with 32.5% and 17.6% respectively (Ji & Chen, 2008).
Other Disparities

In both urban and rural areas, boys tend to have a higher rate of overweight and obesity. A study conducted in Shandong Province points out that the prevalence of overweight was 18.81%, 13.54%, 11.94%, and 9.54% for the urban boys, rural boys, urban girls, and rural girls respectively. The obesity rate was 8.05 (urban boys), 4.78% (rural boys), 2.42% (urban girls), and 1.77% (rural girls) (Zhang & Wang, 2013). In rural Shandong areas, the prevalence of overweight and obesity in 2014 were 16.35% and 17.20% for boys and 13.91% and 9.11% for girls (Zhang et al., 2016).

In a meta-analysis of 41 studies, results demonstrated that the rate of increase in childhood obesity was the fastest in urban boys, for 26.6% for overweight and obesity in 2006-2010 (Yu et al., 2012). The result in another study has a different conclusion which the rate of
increase in obese or overweight prevalence highest among rural boys with a 9% annual increase (Sun et al., 2014).

Moreover, the interaction between gender and region indicates that boys still have higher rates of obesity as compared to girls but those living in rural areas have lower rates regardless of gender. Specifically, the prevalence increased to 36.57% (urban boys) and 19.39% (urban girls), and 29.59% (rural boys) and 18.76% (rural girls) (Zhang & Wang, 2013). Combine the gender and rural-urban disparities, urban boys are considered the subpopulation group that has the highest risk of being overweight and obese (Yu et al., 2012; Chen et al., 2011).

The dramatic increase in the prevalence of childhood overweight and obesity should alarm China to take action to prevent the further increasing trend. It is important to note the disparities as more research is needed to investigate the causes behind them.
Chapter Three: Determinants

Context of China: The Changes over the past 30 years

Since the Chinese economic reform ("改革开放"), which in Chinese literally means “reform and opening-up”), was enacted in 1978, China has experienced exceptional economic growth and social development. These changes have had significant impacts on Chinese society.

The Chinese economic reforms benefit the society immensely. To stimulate economic growth, the People's Commune System was replaced by the Household Responsibility system, and government introduced market principles to the socialist country. In 1980, the Gross Domestic Product (GDP) per-capita of China was $193.28, while in 2015, the figure boomed to $7924.65 (World Bank, 2017), with an annual rate increase of 8.1%. Currently, China is the second largest economy in the world. Facing the booming population, the government also enacted policies to develop agriculture. For example, the government removed the agriculture tax and subsidized the production of dairy cattle and edible oils (Wang et al., 2016).

Opening-up is another facet of the reforms. The Chinese government has started to encourage international trades and welcome foreign investments. The opening-up is a significant step for China to embrace the globalized world, and also important in increasing employment rates, quality of goods, and knowledge. In December 2001, China joined the World Trade Organization (WTO). In 2004, as part of the commitments as a WTO member, China reduced overall agricultural tariffs from 22% to 17%. This in turn, lowered the domestic price of agricultural products. In addition to changes in agriculture, global companies and factories, restaurants and supermarkets, and even the movies and TV shows set roots in China.
Along with the fast economic growth and globalizing society, urbanization is another remarkable change in China. In 1980, the urbanization rate was 19.6% (Yusuf & Saich, 2008). However, it increased to 56.1% in 2015, with 771 million people living in urban areas (National Bureau of Statistic of China, 2016). The great progress in urbanization also leads to larger disparities between rural areas and urban. The differences exist in income, education, health care, consumption, and employment (China Economic, 2006). Figure 3.1 shows the real rural and urban per-capita income adjusted to 2003 RMB level. While income has increased in both rural and urban areas, urban areas experienced a significantly faster rate than rural areas.

Figure 3.1. Real rural and urban per-capita income in 1978-2005

**Contextual Factors: The Obesogenic Environment in China**

Economic reforms, globalization, and urbanization bring economic growth to China and increase income to Chinese people. These changes simultaneously affect the food system including food production, processing, distribution, and retailing. For instance, urbanization attracted the labor force to migrate from rural to urban areas. In 2009, urbanized China had 38% of the population working in agriculture, while this figure was 80% in 1970.
(Carter et al., 2012). In 2009, the share of agriculture's contribution to GDP decreased to 11% from 40% in 1970s (Garnett & Wilkes, 2014). The declining workforce and increasing demands stimulates the transformation from family farms to large-farms, and the widely applied agricultural industrialization. The rising income allowed people to get rid of hunger and made it possible to consume more types of food, which in turn, stimulated food production.

Overall, during the past three decades, along with the impact of economic reforms, globalization, and urbanization, China has experienced a large increase in food production, food availability and accessibility, as well as food consumption (Garnett & Wilkes, 2014). It is notable that these changes occurred alongside the increase in the prevalence of obesity.

**Changes in Food Production.** Food production has a fundamental impact on people's diet, as it determines the food availability and food diversity. Since 1980s, both the volumes and diversity of food increased. From 1978 to 1999, the output in grains, meat, and aquatic products increased 1.7, 7.0, and 8.8 times, respectively (Beijing Official Website, 2012). The increased food production ensured food security in China.

Historically, China’s diet was dominated by grains, and staple grains were the primary agricultural products. However, the structure of agricultural output has changed in recent decades. Products with higher value such as horticultural cash crops (fruits and vegetables), aquaculture, and livestock products grew faster than grain crops (Figure 3.2). While the output of crops took half of the total agricultural output, livestock contributed around one-third of the total value (Huang et al., 2012).
These changes reflect how the agricultural structure is changing in the context of the organizational and technological changes, such as the Household Responsibility system reform and industrialization. These changes also mirror the consumption demand of the population. Research shows that the increasing per-capita income is positively associated with the increasing meat consumption, and the trend is particularly prominent in China (Tong et al., 2015). The changes in food production not only indicate the growth in agricultural output, but they also create a food environment which is gradually becoming obesogenic. People with rising incomes can afford the food they need, and the diverse food varieties they want.
Changes in Food Supply Chains. In the food system, along with the changes of food production, the food supply chain is also transforming. As more of the population migrated to the urban areas, food processing, manufacturing, and transportation adjusted with the trends. Thus, the food supply chains are lengthening and becoming more complex (Garnett & Wilkes, 2014). Just as food production, the food supply chains are industrialized as well. Moreover, food companies started to pay more attention to "value-added" products, in other words, processed food. That is, instead of selling agricultural products directly to the customers, food industry receives huge profits through adding value and processing the food, such as adding sugar (Popkin, 2008).

Meanwhile, the government plays a role in the processed food industry, as it can meet the demand of diverse food and the nutrition needs, and importantly, the processing sector creates employment (Garnett & Wilkes, 2014). Besides pursuing profits and government support, processed food is also the result of urban life, as people living in a fast pace society need food that is prepared and easy and convenient to eat.

Along with the rapid growth in economy and income, the processed food market is rising at a fast speed (Garnett & Wilkes, 2014). In 2011, the processed food market was valued at $140.4 billion, of which $28.0 billion was for diary, $19.3 billion for bakery, and $15.2 billion for dried processed food, such as dehydrated meat and fruits (Bradbury, 2012). Although China is at the early stage of processed food consumption (Popkin, 2014), the market size had a four-fold increase between 1999 and 2013 (Euromonitor, 2016). According to the CHNS, packaged food and beverages contribute to 29.6% of Chinese daily calories (Popkin, 2014). Processed food is always high in sugar, refined carbohydrates, salt, and fat. The food supply chain shifted the focus to increasing exposure to a processed food environment. For Chinese children, specifically,
28.5% of their energy intakes come from processed food (Zhou et al., 2015). Research found that processed food intake increases the risk of overweight and obesity among children aged 2-18 (Zhou et al., 2015).

**Supermarket.** The concept of the supermarket is new to Chinese food supply chains. In the past, for most of China, people tended to consume fresh food products and cook for themselves. The primary source was the traditional wet market, where people can get unprocessed food. However, the emergence of supermarkets changed the food supply chains. The large-scale supermarkets, providing more food varieties and meeting the customers' desire for the food safety, is becoming a new channel for Chinese to get food, especially processed food.

Although some research indicated that the wet market still dominates food retailing, the significant growth in supermarkets reflects that the food supply chains are gradually changing. While the annual growth of food retail sales was 10% in 2000s, the increase in the supermarket sector was three time higher, at 30% (Zhang & Pan, 2013). In the urban areas, supermarket plays a significant role in the changes seen in food retailing. In 2004, supermarkets contributed 30% to the urban food retail environment (Hu et al., 2004). Moreover, a survey conducted in the five biggest cities in China reported that people in these cities consume 79% of processed food, 60% of dairy, 50% of rice, 46% of meat, 37% of fruits, and 22% of vegetables (Reardon, undated).

In the context of globalization, many foreign supermarkets emerged in the Chinese market, such as Walmart and Carrefour. The fast growing supermarket sector is also
supported by the government. In the Twelfth Five-Year Plan on Domestic Trade Development, the Chinese government is planning to replace traditional markets with supermarkets (Garnett & Wilkes, 2014), and to let more supermarket run in the rural areas.

Supermarkets do sell fresh food products, but they are selling more processed and packaged foods. Since people have bustling lives in urban China, people are tending to purchase more foods in the supermarket instead of frequenting wet markets for small-volume purchases (Garnett & Wilkes, 2014). This indicates that people are consuming more processed produce, including frozen food and packaged food.
**Fast Food Restaurants.** In the past, Chinese people rarely ate away from home (Popkin, 2008). But from 1978 to 2008, the number of people dining outside the home increased 159 times. In this context, the fast food industry rapidly expanded in China during the past thirty years. Kentucky Fried Chicken (KFC) spent 61 years to open 4618 chain restaurants in the United States, but had 4260 locations only 30 in years in China since the first one opened in Beijing in 1987 (Wang et al., 2016). According to the China Fast-Food Market report, in 2013, there were more than two million fast food restaurants running in China, with estimated revenues of $94.2 billion contributing 20% to the total catering revenue in China. The annual increase rate of the fast food restaurant was around 13%. Western fast food restaurants are popular in China, as they are considered hygienic, modern, and representing the high socioeconomic status. Currently, McDonald's has more than 2800 chain restaurants in China, while 4260 for KFC, more than 1000 for pizza hut, and more than 500 for Burger King in over 100 cities. These western fast food restaurants introduced western diet to the Chinese people, and made it particularly popular among the young population (Cheng, 2012).

Unlike the traditional Chinese diet, the food products in fast food restaurants are high in saturated fat, calories, and sugar (Wang et al., 2016). Also, these fast food restaurants serve large portion sizes, which easily leads to energy imbalance (Popkin, 2008). Many research studies have suggested the positive relations between consumption of fast food and childhood obesity (Cheng, 2004; Wang et al., 2016). Besides western brand fast food restaurants, many domestic fast food restaurants mimic the foreign ones to provide the traditional Chinese food and westernized food products (Popkin, 2008). These Chinese-style fast food restaurants serve large portions as well, increasing consumers’ calorie intake. Compared to traditional restaurants, fast food restaurants are more convenient for people because of the consistent food quality, high level
of food safety, and the convenience. In 2013, the top Chinese-style fast food restaurants contributed 43% to the total fast food revenue (Yum.com, 2016).

In recent decades, Chinese children have been exposed to an environment full of fast food restaurants which serve energy-dense foods and large portions. Further, they are attracted by the advertising which promotes the fast food as fashion and elite-class lifestyle (Wang et al., 2016). The consumption of fast food increased significantly in all groups by sex, age, and family income, and the most rapid increase was among children aged 13-18, which increased from 17.9% to 26.3% in 2004-2009 (Xue et al., 2016).

**Technological Changes.** Technology plays a crucial role in the changing food environment. Refrigerators were owned by only one-sixth of Chinese families in 1989, but now more than half of Chinese families have one in their home. This allows them to purchase more frozen and processed foods to keep at home for a longer time. Microwaves are another example of how technology has changed how we prepare food. Advanced technology simplifies traditional Chinese cooking, and brings the modern diet to them. In the 1980s and 1990s, a term called "the new four big things (xin si da jian)" emerged. This term refers to the items that people want to have in their families. These four items were television, refrigerator, wristwatch, and washing machine. These items are the symbol of a modern life, meanwhile, they provided people a convenient life that impacted their food choices.

Besides the influence on diet, along with the economic growth, technology also affects people's physical activities and energy expenditure. The most influential technological changes are the creation of the television and the car. The television came into China in the
1950s, but was widely prevalent since the 1980s. In 1989, around two-thirds of the Chinese household owned a television. As incomes rose, more households could afford television. Television ownership increased dramatically and achieved 91% penetration in 2000 (Popkin, 2008). In 2012, the average number of televisions per household was 1.3 in urban areas and 1.1 in rural areas (National Bureau of Statistics, 2013). Along with the of television ownership, the time that Chinese people spend watching television is increasing as well. Studies have shown that television watching is a risk factor of overweight and obesity among children and adults (Hu et al., 2011). The average daily time spent on watching television for Chinese people was 160 minutes in 2013 (Statista, 2017).

While watching television reduces outdoor physical activities for Chinese people, the increasing number of the motorized vehicles such as motorcycle and private cars save more energy for the them. In the past, walking and cycling were the most prevalent way for Chinese people to commute (Bell et al., 2002). During the past three decades, automobile ownership increased significantly, such that 70% of households owned at least one motorized vehicle (Statista, 2016). Figure 3.3 shows that the rate of being obese was higher among those who owned motorized vehicle than someone who did not.
Figure 3.3 Odds of being obese or having a high waist circumference according to household vehicle ownership in 1997.
Source: Bell et al., 2002.

**Nutrition Transition in China**

Similar to what is happening in many other developing countries, nutrition transition is happening in China. In order to understand the determinants of the rapidly increasing obesity rate in China and make policy recommendations, it is helpful to examine the specific nutrition transition trends.
**Food Consumption Patterns.** A Traditional Chinese diet is based on grains, but in recent years, the consumption of grains decreased in both in urban and rural areas (Figure 3.4; Garnett & Wilkes, 2014). Meanwhile, there have been significant increases in the consumption of animal source products, edible oil and animal fats, processed foods, soy products, and fruits (Zhang et al., 2008). Research found that during the past three decades, Chinese dietary patterns shifted from a grains-and-vegetable based diet to a meat-based diet (Zhang et al., 2008).

![Figure 3.4](image.png)

Figure 3.4: Per-capita consumption (kg) of key food categories in rural and urban areas, 1985-2010. Source: Cao et al., 2013.
Animal-source Products. Studies have shown that meat consumption correspondingly increases with the rising income, and that increase is more rapid and preeminent in China than in other countries (Wu et al., 2015). The increase is seen in all kinds of meat, including pork, poultry and aquaculture products (Garnett & Wilkes, 2014). Figure 3.5 indicated that from 1989 to 2009, livestock consumption increased in all community groups (city, suburb, town, and village). In 1979-2013, China's pig livestock volume increased from 300 million to 490 million. The poultry livestock volume had a more striking six-fold growth (Wu et al., 2015). One study predicted that in next decade, the per-capita consumption of poultry will have an annual growth of 2.4% while 1.5% for the pork (Wu et al., 2015). Research also found the decline in annual growth of pork, indicating that the poultry will take more share of the meat market. Currently, China’s poultry output is the second largest in the world, with 17 million tons produced each year, attributing 18% of the global production (Garnett & Wilkes, 2014).

![Figure 3.5: Livestock consumption among Chinese adults in different community, 9 provinces, 1989-2009 (g/d)](image)

Source: China Health and Nutrition Survey.
Another type of animal-source products are dairy products. The traditional Chinese diet did not include dairy typically; however, it is now more common and has increased in recent decades (Garnett & Wilkes, 2014). For instance, milk production dramatically increased from about 1 million ton in 1980 to 36 million tons in 2010 (FAOSTAT, 2011). It had a relatively slow increase in the 1980s and 1990s, but after the year 2000, the growth was rapid (figure 3.6).

![Figure 3.6: Trends in China's cow milk production, 1980-2011 (million tons)](source: FAOSTAT)

Increasing consumption of animal-source products is associated with away-from-home dining and other catering outlets (Garnett & Wilkes, 2014). Rising income levels allow people to afford eating at restaurants and the fast life pace reduces time to spend cooking meals. The increase of particular kinds of animal-source produces is also linked with government support. For instance, the Chinese government encourages raising "grain saving" animals such as chicken, because feeding chicken is more environmentally friendly (Garnett & Wilkes, 2014). Companies producing poultry can have a 25% income tax waiver (Gale, 2013). Aside from the government support, huge demands of poultry from fast food industry is another driver of the increasing poultry output.
Among Chinese children, the livestock meat consumption rate increased from 60.9% to 87.2%, and the intake increased from 47.4g/d to 100g/d from 1991 to 2011 (Wang et al., 2013). The increasing intake of animal-source products has nutritional benefits, such as providing energy and important micronutrients such as iron. However, it also increases the risks of being overweight and having chronic disease (Garnett & Wilkes, 2014). According to Global Burden of Disease Project, it was estimated that high-in-red meat diet could be responsible for 50,000 cancer deaths globally per year (WHO, 2015). In 2011, Chinese children consumed pork 50g/d, 59.8% higher than the recommended amount (Wang et al., 2013). Thus, consumption of animal-source products, especially red meats, is a risk factor for Chinese children’s health.

**Edible oil.** During the past few decades, edible oil is more affordable because the price declined rapidly as a result of international trade. A reduced price leads to increasing consumption. From 1991-2000, the average daily edible oil intake increased from 23 to 33 grams (Ng & Popkin, 2008). Research shows that the intake of edible oil in rural China has a more significant increase than in the more affluent areas (Ng & Popkin, 2008). It is aligned with other research showing that lower-income countries have a higher increase of edible oil intakes than middle-income countries (Popkin, 2013).

The growth of edible oil is related to the increased consumption of meat, as the cooking method changed. Instead of steaming, boiling, and baking, Chinese people shift their cooking styles to deep-frying and stir-frying (Popkin, 2013).
**Snacking.** In a traditional Chinese diet, which consists of two or three meals a day, snacks played a very small role, and many Chinese people did not have a habit of snacking (Wang et al., 2012). However, recent studies found an increasing trend in snacking among Chinese people (Gorden-Larsen et al., 2014; Wang & Eldridge, 2016). From 1991-2009, the percentage of snack intake increased in all age groups, and the largest growth occurred among children (Figure 3.7, Wang et al., 2012).

![Figure 3.7](image)

**Figure 3.7** Percentage of Chinese population consuming snacks over a 3-day period, 1991–2009
Source: Want et al., 2012

Compared with children in the United States, where snacking contributes 25% to their daily energy intake, Chinese children consumed an additional 138 calories from snacks on average per day (Wang & Eldridge, 2016). The three top food sources of snacking were snacks and sweets, fruits, and milk and dairy, and fruits were the most reported snacks (Wang et al., 2012; Wang & Eldridge, 2016). Although Chinese people consume more healthy snacks which are low in calories, sugar, and fat, one study indicated that Chinese people prefer to snack in the evening (Wang et al., 2012), which is a risk factor of being overweight (Ovaskainen et al., 2006).
Sugar-sweetened Beverage. Sugar-sweetened beverage (SSB) are popular around the world, and nowadays, many children in China regularly drink SSB. Research reported that 46.1% of Chinese children consume SSB regularly (Shang et al., 2012). Moreover, children in rural areas consumed more than twice the amount of SSBs than their urban counterparts (Yu et al., 2016). Previous studies provided evidence on the positive association between SSB and obesity (Trumbo & Rivers, 2014), and the results in the research conducted in China are consistent (Shang et al., 2012; Yu et al., 2016). The prevalence of obesity among children who regularly consumed only milk was 7.6%, while it was 16.6% for those who regularly consumed sports/caloric beverages and 12.7% for those who regularly drank carbonated beverages (Shang et al., 2012).

Diet Composition Changes. As the food consumption pattern is changing, the composition of nutrient intakes is shifting as well. Research has found that overall the energy intakes have declined (Zhang et al., 2011). This result is consistent with the trends that have happened in many developed countries (Garnett & Wilkes, 2014).

From 1989-2009, the declining trends in energy intake were evident in urban, suburban, and rural areas in China, of which suburban had the fastest decline, with a decrease of 469.9 kcal per day (Zhang et al., 2011). The total daily energy intake for a Chinese adult decreased to 2251 kcal in 2002 while in 1982, it was 2491 kcal. In 2009, carbohydrates provided 53.5% of the daily energy intake of adults aged 18-49, while the fat and protein provided 31.4% and 15.1% (Zhang et al., 2011). The main source of energy is food grains, providing 57.7% of daily energy intakes. In the past, Chinese nutrient intake was carbohydrates-oriented. But currently, while carbohydrates are still the main source of energy providing 57.7% of daily
energy intake, contribution of fat and protein to overall energy intakes increases gradually (Garnett & Wilkes, 2014).

The total energy intake also declined among children. In their research, Cui and Dibley (2012) found that the from 1991 to 2009, daily energy intake of children aged 7-17 decreased form 9511kJ (2377.73kcal) to 7658.2 kJ (1914.5kcal). Figure 3.8 shows that rural and urban areas have the same trends in dietary composition. The proportion of energy from carbohydrates decreased from 61.3% to 51.3% in urban areas and from 68.3% to 58.6% in rural areas. For children aged 7-17, the intake of carbohydrates decreased from 382.5g per day to 245.1g from 1991-2009 (Cui & Didley, 2011). The proportion of energy intakes from carbohydrates decreased from 64% to 51.2%.

The dietary fat comes from animal and plant sources. Since both animal-source product consumption and vegetable oil intakes are increasing, the daily fat intake increased from
49g to 76g in 1982-2002 (Zhai, 2011). According to the CHNS, while in 1989, no more than 20% of the population in urban and 15% in rural areas were getting over 30% of daily energy from fat, in 2009, the figures were 62.1% and 45.1% respectively (Figure 3.9).

![Figure 3.9 Percent of energy from fat more than 30% among Chinese adults](source)

Source: CHNS

The same trend was seen among Chinese children. In the last three decades, children's daily energy intake of fat increased from 54.8g to 66.0g (Cui & Dibley, 2011). Thus, the proportion of energy from fat increased from 21.5% in 1991 to 30.0% in 2009. The proportion of children who had a more than 30% energy intake from fat increased from 20.1% to 49.4% in 1991-2009 (Cui & Dibley, 2012). They also found that the proportion of children who consume fat contributing more than 30% of their daily energy intakes is larger among lower-income group than the higher-income group (Cui & Dibley, 2011).

The intake of protein has not increased in recent decades, and the decrease of the intake is slight. While the total energy intakes dropped, the changes of proportion of energy intake from fat was not obvious. This applied for both the adults and children. In 1991, the intake
of protein among children was 66.2g per day, and it dropped to 58.0g in 2009, and the contribution to energy intakes changed from 11.1% to 12.1% (Cui & Dibley, 2011).

One thing that is worth noting is that in the consumption of high-quality protein, which refers to the protein from meat and soybean, took a large share (Garnett & Wilkes, 2014). However, during the past few decades, there is no significant increase in legume-derived consumption. Thus, we can assume that it reflects the increasing consumption of animal-source products (Garnett & Wilkes, 2014).

**Physical Activity Patterns**

Urbanization has been shown to have a negative impact on people's health in China (Van de Poel et al., 2012). One reason for these negative health outcome is that urbanization reduces physical activity levels. In one study which used metabolic equivalents of task (MET) to measure the level of physical activity, results showed that from 1991 to 2011, the MET hours per week fell from 382 to 264 for men and 420 to 243 for women (Ng et al., 2014). Both occupational and domestic physical activities declined. According to the CHNS, from 1989-2006, light physical activities increased 75% among adults but the amount of moderate and vigorous physical activity decreased about 50% (Figure 3.10).
Figure 3.10 Chinese Adults in the Same Occupations Use Much Less Energy: The Physical Activity Profiles of Urban Chinese Adults Aged 20-45,1989-2006
Source: Du et al., 2002

Reduction of high-intense physical activity and increased sedentary activities have also been shown among children, and this shift varies by obesity status. Among school-aged children, researchers found that overweight children spent 0.5 hours less than normal-weight children in moderate/vigorous activities, while they spent 2 hours more per week in low-intense activities, including watching television, playing video games, using a computer, reading, and studying (Li et al., 2007). In 2005, only 20.6% of urban school-aged children had more than 1 hour of physical activity per day, and 29.9% of boys and 3.7% of girls had no exercise after class (Ye, 2006). Chinese children spend more time on their homework, as 33% of urban children spent 2-3 hours a day and 16.7% of boys and 17.4% of girls spent more than 4 hours (Ye, 2005). Moreover, many students went to after-class schools for to improve school performance. Among those children, 12.1% spent 5-8 hours per week while 8.5% spent more than 9 hours (Ye, 2005).
Socio-economic Factors

The associations between obesity and socioeconomic status (SES) is well documented in previous research worldwide (Wang et al., 2002), and it is recognized that lower SES is associated with greater obesity in developed countries (Du et al., Jones-Smith et al., 2011; 2004; He et al., 2014). However, in China, the high SES group have a higher prevalence of obesity, as the changes in dietary and physical activity patterns vary from different SES status.

Childhood obesity is also associated with SES, and measured by their parents’ income (Wang et al., 2002). However, the relationship between prevalence of childhood obesity and SES status is not consistent across countries. In general, children who have access to energy-dense food are more likely to be overweight and obese, which is common in low-SES groups in developed countries and high-SES groups in developing countries (Wang and Lim, 2012). In the United States, children from low-income families have higher risks of being obese than their counterparts from high-income families (Ogden et al., 2010), while in India, the situation is reverse (Raj and Kumar, 2010). The prevalence of childhood obesity is higher among high-SES children than their counterparts with low-SES (Du et al., 2004; He et al., 2014) and high SES children experienced a greater rate of BMI change over time (Yu et al., 2012; He et al., 2014). As shown in figures 3.11 and 3.12, SES had a positive correlation with childhood obesity regardless of gender (Zhang et al., 2014). For boys, the mean values of waist circumstance (WC) of children aged 7-18 with high SES were higher than those with moderate and low SES by 1.08-2.11cm and 1.86-3.15cm, while 0.60-1.27-1.27cm and 1.20-2.24cm for girls (Zhang et al., 2014).
Many specific socioeconomic determinants have been examined to understand how SES contributes to the childhood obesity epidemic in China, including household income, parental education, parental employment, and migration status (Yu et al., 2011; He et al., 2014; Zhang et al., 2014; Liu et al., 2016).
Household income has a significant impact on childhood obesity (Zhang et al., 2014, He et al., 2014), and the changes in diet pattern vary by income. Purchasing power, which is related to income, is the most influential factor on the accessibility of obesogenic foods (Egger and Swinburn, 1997). In China, energy-dense foods, such as fast food, are more expensive than vegetables, grains, and home-made meals (He et al., 2014). In Jiangsu Province, about 10% of children from high-SES families consumed hamburgers every day while only 2.8% of children from low-SES families did (Shi et al., 2005). As Figure 3.13 shows, children from high-income families had a higher probability of snacking than their counterparts from low-and-middle income families. Moreover, low-income group consumed less edible oil and animal-source products than their high-income counterparts. From 1989 to 1997, the consumption of edible oil in low-income populations was 43.8g per day and 51.6g per day for high-income populations. Among low-income groups, the proportion eating animal-source products was 72.7% while for high-income groups, it was 97.1% (Du et al., 2004).

Figure 3.13 The Likelihood of Snacking Across All Individuals Aged 2 and Older, China 1991-2009
Changes in physical activity pattern are also influenced by income.

When the society started to urbanize and industrialize, the children from high-income families not only had the advantage of accessing energy-dense food, but also to labor-saving technology, thus reducing physical activity (Shi et al., 2006). Housework machines and transportation vehicles save a lot of energy for children, especially for those in high-income families, while children from middle-and-low income families did housework as their primary physical activities (Chen et al., 2015). Technological products such as televisions and computers discourage children's vigorous physical activities. Children from high-income families have spent more time in sedentary activities such as watching television but less time in moderate/vigorous activities compared to low-and-middle-income counterparts (Figure 3.14). It is reported that snacking increases the risks of obesity, and there is a positive relationship between screen time and energy-dense snacks (Li et al., 2015). China is expected to be the greatest market for television advertising (Popkin, 2008), and children in China have more influence on their parents' purchase decision compared to other societies (Jing, 2000). Thus, watching television has impacted not only on children’s physical activities but also their diets.
Aside from household income, other factors of socioeconomic status have been examined. But unlike household income, other factors are more controversial and need further investigation. Research has shown that maternal employment positively affected childhood obesity (Nie & Sousa-Poza, 2014; Sun et al., 2015). Another study indicated that the total intake of fat and protein is positively correlated with father's education level (He et al., 2014). However, some studies indicated that neither parental employment or education was a significant factor of childhood obesity (Li et al., 2007; Fu & George, 2015). Since the studies were conducted in different areas and subjects, more research is needed to elucidate the impact of parental factors on childhood obesity.
**Rural/Urban Disparity.** Better understanding the differences of socioeconomic status and the obesogenic environment can provide insights about regional difference in the prevalence of childhood obesity in China. Children in urban areas have a higher prevalence of overweight and obesity than rural areas (Sun et al., 2014; Yu et al., 2012). This disparity reflects the income inequality between rural areas and urban areas (Figure 3.15). Urban residents consume more of everything – animal-source products, edible oil, vegetable and fruits, soy products, alcohol, sugar, and processed food, except for grains (Zhai, 2011; He et al., 2014). For instance, in 2011, the livestock meat consumption rate was 94.7% for the urban and 84.5% for the rural areas (Zhang et al., 2013). Because of the difference of SES, urban residents can afford more energy-dense food.

![Figure 3.15 Real net incomes in rural and urban areas, 1990-2010 (in 1990 constant prices, CNY)](image-url)
The rural/urban disparity of childhood obesity is not only the result of SES differences, but also differences in the obesogenic environment between rural and urban areas. For example, urban areas have more supermarkets and fast food restaurants than rural areas (Garnett & Wilkes, 2014). Moreover, ownership rate of televisions and motorized vehicles are higher in the urban than rural areas (Fong, 2009).

Although rural areas have a relatively lower rate of childhood obesity, in recent years, the number of obese individuals living in rural areas is increasing (Du et al., 2004; Zhang et al., 2014). Research found that the rural/urban disparity can be divided into two periods (Zhang et al., 2014). The first period is from 1985 to 1995, when the prevalence in both rural and urban areas was low, but the increase rate was very high, and the rural-urban ratio was high. However, during 1995-2010, while urban areas still had a higher prevalence than rural areas, the rural-urban ratio was declining (Zhang et al., 2014).

Urban populations have the advantages in purchasing power, and they have more access to the supermarkets, fast-food restaurants, and the places they can get energy-dense food. Nonetheless, rural China is shifting towards an obesogenic environment because of rapid urbanization.

There are some other unique reasons that influence childhood obesity in rural China. First, diet and nutrition knowledge is scarce among rural people. People in rural areas regard edible oil and meat as good for health (Xinhuanet, 2016). According to Chinese Children Nutrition and Health Report (‘中国少年儿童营养与健康报告’ in Chinese), most of rural school-aged children have little nutrition knowledge, and it is common that children get snacks from stalls by exchanging with eggs (China Association of Student Nutrition and Health Promote, 2016). Only 6.77% of parents in rural areas restrict their children’s beverage intake,
and 2.75% restrict children’s meat intakes. Second, prevalent fake food also contributes to childhood obesity. Some famous brand food (especially the Western ones) are not sold in rural China. “Fake food,” which has a similar brand name, logo, and packaging to more common brands, is unique in rural China. For instance, Oreo (“奥利奥” in Chinese) ® (Figure 3.16) is a popular snack in China, but in rural areas, they are selling Oleo (奥利粤), not Oreo® (奥利奥). Just a little difference in the third Chinese character makes this cheap fake snack prevalent among rural children. In rural areas, there is not only Oleo (奥利粤) but also other fake snacks and beverages. Compared with authentic snacks, these fake snacks are cheap because most of them are produced illegally (Xinhuanet, 2016). The fake snacks and beverages contain colorants, preservative, and trans fat (Xinhuanet, 2016). However, the similar packaging and products and the cheap price attract rural children to buy them, thus, these kinds of food are more likely to harm children’s health and lead to overweight and obesity.

Figure 3.16 Left: fake Oreo (奥利粤), and right: fake Oreos (only the one held by hand is authentic 奥利奥). Source: Pictures come from the internet: http://money.163.com/17/0314/07/CFFLFPR002580SL.html
A Paradox

All the evidence suggests that dietary patterns are shifting in China to promote higher fat, higher sugar intake. However, it is paradoxical that daily energy intake did not increase in parallel. According to studies based on CHNS data, calorie intake of Chinese adults is decreasing (Zhang et al., 2009; Cui & Dibley, 2011; Zhang et al., 2012). But these results contradict with other studies showing an increasing trend of energy intake among Chinese people (Vasileska & Rechkoska, 2012; UN, 2013). Explaining these discrepancies remains complex. It is possible that inconsistent results may be due to the difficulties in measuring energy intake at a population level.

Nevertheless, studies from the CHNS data show that the energy intake is declining while obesity rate is increasing. This is important because much of previous research was based on the data from CHNS. Thus, it is necessary to explain the paradox. According to previous research, four possible reasons might help to understand it. First, the decreasing trend of energy intake represents the average energy intake among the population, but does not reflect the obese population. In one study, it was found that obese children consumed about 250 kcal per day more than non-obese children (Zhang et al., 2008). Moreover, people with high SES and living in urban areas also tend to consume more energy. Thus, children in high-SES group gain more weight and have a higher prevalence of obesity. Second, the high-fat diet pattern is associated with increasing obesity rate (Du et al., 2001). Chinese people do not eat the way they did thirty years ago, when grain provided most daily energy. The current Chinese diet is shifting to a high-fat pattern (Cui & Dibley, 2011); more than 60% of the urban population consume a diet composed of less than 60% of energy provided by carbohydrates and more than 30% of energy from fat (Du et al., 2001). The increasing consumption of animal-source products and
edible oil results a two-fold increase in fat intake (Du et al., 2001). It is well recorded that a high-fat diet is associated with obesity, as it promotes fat storage (Golay & Bobbioni, 1997). And decreasing intake of grain is also linked with many chronic diseases (Du et al., 2001). Therefore, it is possible that the diet composition might be a greater factor in the obesity epidemic among Chinese children. Third, decreasing physical activity is another reason that needs to be considered. More than 90% of households owned televisions, and 70% of households owned one car (Statista, 2016). Well-developed public transportation makes commuting easier and convenient. People spend more time indoor doing light physical activities, reducing energy expenditure and thus, leading to energy imbalance. Fourth, energy intake varies across different population groups. For instance, intake of carbohydrates decreased the most in rural areas, and the intake of fat is higher in urban than rural. Children with high SES tend to consume more energy than their counterparts with low or middle SES (Zhang et al., 2014), and boys consume more than girls (Cui & Dibley, 2011). These factors help not only to understand the disparities in prevalence by rural/urban, SES, and sex, but also to partially explain understand the paradox. The facts above remind us to investigate the relationships between the changes in dietary patterns and the concurrent increasing obesity rates. Although energy intake is declining, the increasing prevalence of childhood obesity alarms the public to inspect the current diet composition, which is high in fat, sugar, and energy-dense. And it is also helpful for the policymaker to take interventions focused on healthy diet into consideration.
Chapter Four: Intervention Programs

Global childhood obesity intervention review

In recent years, as nutrition transition is shifting to developing countries, interventions for childhood obesity are needed. Worldwide, diet and physical activity interventions, and health education are the most common approaches to deal with the problems (Gao et al., 2007).

However, none of the studies that assess the effectiveness of the interventions demonstrated convincing evidence about the most effective approach (Li et al., 2008). Considering the social context, and the socioeconomic and sociodemographic differences among individuals, it is understandable that the results vary from different studies. Examining school-based intervention studies specifically in different countries, Doak et al. (2006) asserted that physical education at schools along with reduced screen time at home significantly reduced both BMI and skin-folds. His argument is aligned with the results of Sharma (2006), who conducted assessment of interventions in the United States and the United Kingdom, showing that the most effective way to reduce childhood obesity is to restrict TV viewing, followed by increasing physical activity and changing eating behavior (Sharma, 2006). However, Summerbell et al. (2005) claimed that physical activity and dietary interventions were not enough, as psychological support and environmental change are also needed. In some studies, dietary intervention is challenged. Gibson (2006) claimed that dietary intervention was not effective for reducing childhood obesity, and for adults, the effective dietary intervention was a low-fat diet. But overall, most intervention reviews concluded that a comprehensive intervention combining physical activity, dietary intervention, education, and psychological supports is the most modifiable (Gao et al., 2007).
In the United States the prevalence of childhood obesity was 17.4%-20.4% from 2013-2014 (CDC, 2015). The US Department of Agriculture launched many projects focusing on nutrition, such as identifying nutritional needs; and providing nutrition education (USDA, 2017). The U.S. Center for Disease Control and Prevention (CDC) provided plenty of guidelines for the communities, schools, and families (CDC, 2017). In 2010, Michelle Obama, first lady of the U.S., started led a national campaign called Let’s Move to end childhood obesity epidemic. The White House made recommendations to increase the access to the healthy food, to improve food and beverage choices provided in schools, and increase children’s physical activities through encouraging the cooperation of communities and families. In Mexico, where 75% of deaths are attributable to non-communicable diseases and obesity, government tackles the childhood obesity by regulating polices on calorie beverages. As the consumption of caloric beverage increased 226% between 1996-2006 among Mexican children, this guide helps people to have a healthy hydration habit (Barquera et al., 2013). Along with the beverage policies, other efforts such as banning soft drinks in schools and using front-of-packaging label to inform nutrition facts help the society to create a healthy environment for children.

**National Intervention Policies in China**

In response to the increasing prevalence of childhood obesity over the past three decades (Popkin et al., 2010; Song et al., 2013), the Chinese government started to regard overweight as a health indicator for children in 1993. But before 2004, there were no systematic policies or interventions addressing the childhood overweight and obesity problem.
In China, the policies and interventions adopt the top-down approach, which means the government makes the policies, and most of the programs are implemented in schools. This is because most schools are government-owned and easy to manage. And just as the interventions in other countries (Gao et al., 2007), the national interventions in China also address primarily reducing unhealthy dietary habits and increasing physical activity.

To begin, in 2004, the Chinese government issued a requirement that schools screen children and adolescents for obesity using body mass index (BMI) measurements. Two years later to improve physical activity, the Minister of Education, Sports, and Communist Youth League launched Billion Students Engaging in Exercise (Sunshine Sports Program, “全国亿万学生阳光体育运动” in Chinese), which aimed to ensure 85% of Chinese students exercise at least one hour a day. In 2007, the Chinese Communist Party released the Opinions on Increasing Physical Activity and Strengthening Physical Fitness of Teenagers (“关于加强青少年体育增强青少年体质的意见” in Chinese). According to the Opinions, the government provided funding to support schools to increase their physical exercise equipment, and physical education classes and the mass exercise were required. Moreover, a physical fitness test has become a part of High School Entrance Exam.

In the same year, the Bureau of Disease Control published the School-age Children and Teenagers Overweight and Obesity Prevention and Control Guidelines in China (中国儿童超重肥胖预防控制指南), which has recommendations for the school dining and advice on healthy diet and physical activity. The Guidelines on Snacks for Chinese Children and Adolescents (“中国儿童零食消费指南” in Chinese) were published in 2008. Figure 4.1 is a fan-like guide on snacks for Chinese children distributed as part of these guidelines. The foods in
the green circle are the recommended snacks, including animal-source products which are low in fat, fruits, dairy, nuts, and juice without added sugar. The foods in yellow circle are the “snacks that can eat in an appropriate amount,” such as dark chocolate, cheese, dried processed vegetable and fruits, and food contains moderate fat, salt, and sugar. The foods in the orange circle are the snacks which children should avoid, including, fried food, canned fruits, candies, desserts, and soft drinks. Also, children and students are required to take the annual physical quality test to provide data for the government to monitor the health status. Since 1985, China has conducted the physical quality test for children every five years. The National Institute for Nutrition and Health (NINH, former National Institute of Nutrition and Food Safety) cooperates with the Carolina Population Center at the University of North Carolina, Chapel Hill to conduct the China Health and Nutrition Survey (CHNS) every ten years.

Figure 4.1 Guideline on Snacks for Chinese Children and Adolescents.
**Policy Implementations and Assessments**

Schools are the places where most of the policies are implemented, especially for the policies that focus on children and adolescents, as education before high-school is compulsory. Based on the government policies and guides, schools are required to reform their curriculums. For example, according to the policies and guidelines, the curriculum of each school at all levels (primary schools, junior, and senior high schools) must have two physical education classes and one calisthenics class every week, and the mass exercise every day (sankeyicao, 三课一操). Since the physical and fitness test is a part of the High School Entrance Exam, some schools train the students in specific sports which are in the test, such as 50-meter race and standing long jump, to ensure the enrollment rate.

The implementation of these exercise polices are not the same at all Chinese schools, and they vary by region. For instance, in 2004, the National Institute for Nutrition and Food Safety and China Center for Disease Control and Prevention launched a school-based program called *Happy Ten*, of which school children are required to do physical activities designed by the teacher in their classrooms (Gao et al., 2007). The program was first implemented in urban Beijing in 2004, and then expanded to other nine provinces and cites (Wang and Zhai, 2013). Teachers in different schools designed physical activities for the students, and students do these physical exercises at least once a day for ten minutes each time. In many cities, the implementation of Happy 10 started in several schools as trials, and then expanded to all schools (Liu et al., 2007; Zheng, 2011; Meng et al., 2013). It is well-documented that this program has been implemented in urban areas; however, Happy Ten has not been implemented in rural areas. According to Xiaoqi Hu, Director of Students’ nutrition in China CDC, Happy 10 is mainly focus on urban areas, while rural areas primarily focus on the policies
such as the Nutrition Meal Plan (government offers free milk and snacks to children in rural areas), which aims to eliminate malnutrition and enhance the nutrition level for rural children (ncd.org, 2015).

The effectiveness of these programs is not consistent in all studies. According to Liu et al. (2007), the prevalence of childhood obesity in the schools which carried out the Happy Ten program decreased. However, other scholars found that the programs had no significant effects on children’s BMI, weight-to-height ratio, or triceps skinfold thickness (Liu et al., 2010; Meng et al., 2013). But they do indicate that such programs increased children’s energy expenditure (Liu et al., 2010).

The interventions in China primarily target increasing physical activity but diet is also an included element. The interventions are almost always delivered as a form of health education based at schools. Most of the health education programs are for the students, but in some areas, parents also received health education delivered by schools (Cao et al., 2015). In Cao’s study, except for regular weekly physical activities, school children in the intervention group spent six hours on health education each semester, and they also attended group meetings talking about childhood obesity, healthy dietary habits, and other health-related topics. Moreover, the parents participated in health education about balanced diet and obesity every semester. The result indicated that children in the intervention group developed less obesity than their counterparts in the control group over three years (Cao et al., 2015). This finding is consistent with other research (Jiang et al., 2007). Although some studies which reviewed dietary interventions indicated that there were no significant differences between the intervention group and the control group, they found that the interventions had impacts on knowledge improvement.
and specific behaviors such as increased intake of vegetables and fruits and decreasing intakes of high-sugar snacks, soft drinks, ice-cream and desserts (Hu et al., 2010; Lee et al., 2014).

Gaps

Although there are some interventions investigating how to reduce obesity in China, the prevalence of childhood obesity is still on the rise – across both rural and urban regions. To best understand how to manage the childhood obesity problem in China, some gaps are needed to take into consideration.

The first gap is between the nutrition transition and the intervention approach. To be specific, the interventions in China do not directly target the dietary changes brought on by the shifting trends. The majority of interventions focus on increasing children’s physical activities at schools. Although some of these interventions are proven effective, they cannot solve the obesity problem. For example, one study showed that 76% of children’s physical activities were done at schools, which means except for the required school physical activities, they rarely have energy expenditure at home. Even though children spend most of their time at schools on workdays, increasing screen viewing and video game time indicates that many children live with a sedentary lifestyle. For another, other factors such as transportation and tremendous pressure from study reduce children’s physical activities.

Regarding improving dietary patterns, simplistic health education on diet restriction is not enough. People should notice that the energy intake has been declining during the past three decades, and shifting from a carbohydrates-based diet to a high-fat one (Cui & Dibley, 2011). High-fat diet is related to many chronic diseases (Kuller, 1997), and it has a life-
long negative impact on overweight and obese children. The shift in dietary pattern has multiple drivers. National increasing intake of edible oil, animal-source products, and fast food lead to the transition. Thus, more efforts are needed in how to create a healthy food environment and to cultivate children to have a healthier diet.

The second gap is between the intervention implementations and rural areas. It is understandable that most of childhood obesity interventions target urban areas, as prevalence of obesity among urban children is higher than their counterparts in rural areas (Yu et al., 2012; Sun et al., 2014). However, as many studies pointed out, rural areas are experiencing a very fast growth in prevalence of childhood obesity (Ji and Chen, 2008; Yu et al., 2012; Zhang et al., 2016). Reviewing nutrition transition in other countries, it is common that obesity is more prevalent among less developed areas as the nutrition transition is shifting more among the poor (Popkin, 2008). For rural China, many factors are the potential drivers of childhood obesity. First, rural China is becoming obesogenic, as an increasing number of supermarkets and fast-food restaurants are targeting rural areas as new markets open up with government support (Garnett & Wilkes, 2014). Second, previous studies found that rural areas had the largest decrease in total energy intakes in China (Zhang et al., 2011). It indicates that with the urbanization, industrialization, and growing income, people in rural areas engaged in less labor-intensive activities, and their diet shifts from traditional grain-based diet to high-fat diet (Cui & Dibley, 2011). Third, at the school and community level, many schools in rural areas do not have enough physical activity equipment and sites. Thus, school-based physical activity interventions are challenging to implement in these areas. Fourth, because of current rural-to-urban migration, many rural children whose parents are working in urban areas are cared for by their grandparents. Chinese grandparents tend to overfeed their grandchildren (Yang, 2007), because
in traditional Chinese culture, people prefer fat babies which mean good luck and fortune (Li et al., 2015). Research found that children who grow up with their grandparents tend to have two more servings of unhealthy snacks per day (Li et al., 2015). These cultural norm factors increase the risks of obesity among rural children and should be considered when developing future interventions.

**Suggestions for future interventions**

1. **Comprehensive intervention approaches.** Although many interventions are multi-component, most of them primarily focus on physical activity (Uijitdewilligen et al., 2016), as it is the most feasible way for intervention implementation and assessment. Admittedly, increasing physical activity is an effective way for increasing children’s energy expenditure, but interventions that focus solely on physical activity have no significant influence on children’s BMI (Liu et al., 2008; Meng et al., 2013), nor do the interventions that target only nutrition and education.

   A comprehensive intervention is suggested to be more effective. Studies found that in China, comprehensive interventions which include physical activity, diet and nutrition intervention, and health education are more effective in controlling children’s BMI (Dai et al., 2005; Zhou et al., 2014). Both dietary pattern and physical activity are the components of nutrition transition (Popkin, 2008).

   Among previous studies focused on Chinese childhood obesity, no evidence show whether dietary pattern or physical activity contribute more to weight gain, and no statistical analysis examine how each component affects intervention outcomes (Doek et al., 2006).
Nevertheless, diet interventions are likely to be impactful for children, as current diets are high in fat, sugar, and calories. Studies have shown that many cardiometabolic and chronic diseases are related to high-fat diet, such as cancer, hypertension, and diabetes (Kuller, 1997; Yan et al., 2012). In China, the rate of diabetes among children is four times higher than the United States (Yan et al., 2012). Previous research indicated that diet-oriented intervention is effective for controlling blood pressure, which is tightly associated with BMI, and waist circumstances (Wan et al., 2009).

2. Whole-system intervention. Although school-based interventions can target most of children, this multi-component health issue needs efforts from all levels of the society. Children not only spend time at schools, but also within communities and families. Behavior change is the result of the whole system influence.

Family plays an important role in interventions for children’s diet, as many school children eat at home in China. Parents have huge impact on children’s health, because the kind of food that they provide, the cooking methods, the frequency that they take the children to eat out, and the knowledge of nutrition and health consequences of childhood obesity play important roles in children’s diet. Indeed, studies found that when parents are involved in reducing weight, it has a positive impact on childhood obesity prevention (Hu et a., 2012; Cao et al., 2015), especially in obesity prevention behaviors such as purchasing fewer snacks and reducing fast food eating.

Aside from school and family, the food environment also has an impact on children’s weight (Li et al., 2011). Research conducted in Xi’an city found that food
environment factors such as availability of soft drinks and fast food restaurants are associated with childhood obesity. Additionally, students who have more exposure to soft drinks and fast food in schools tend to have a higher BMI (Li et al., 2011).

Parents are busier than before, but growing income levels makes them have more choices for their children’s diet. Fast food restaurants and supermarket chains are booming (Garnett & Wilkes, 2014), selling processed food high in fat and sugar. Marketing fast foods restaurants on television also influences eating behavior (Story & French, 2004). When children are watching their favorite cartoons on television, fast food and snack advertisements attract them. A whole-system intervention should target not only schools, but also parents, communities, and society. This kind of intervention should incorporate educating parents with basic health and nutrition knowledge, avoiding negative food environment exposure to children in school areas and children communities, and managing the advertisement of fast food, soft drinks, and snacks. Without a positive food environment, healthy behaviors are hard to cultivate (Uijitdewilligen et al., 2016).
3. Interventions in rural areas. Rural China is predicted as the area with the fastest growth in childhood obesity over the coming decades, as it is already experiencing a fast increase rate. The government’s plans such as letting more supermarkets get into rural areas and increasing the urbanization speed make rural China a potential obesogenic area. Because of the increasing accessibility to processed food and other energy-dense food in rural areas, fewer sports facilities, and cultural and social norms, rural children are likely to continue to experience an increase in overweight and obesity.

Despite the notice given to the increasing obesity rate in rural, few studies are focused on childhood obesity interventions and the policy implementation in rural China. In response to the current and potential trend of childhood obesity rate in rural areas, comprehensive and whole-system interventions which are specifically focus on rural China are needed. And the interventions also need to incorporate all sectors, such as the development of Chinese food system in China, increase in school sport facilities, and parent education.
Conclusion

The paper examines the trend and prevalence of childhood obesity in China, and it is found that during the past thirty years, obesity rates have increased in all age groups and among both boys and girls in rural and urban areas. From 1991-2006, the childhood obesity rate increased from 3.8% to 8.3% (Popkin, et al., 2010). China CDC reported that in 2012, over 120 million children in China were overweight or obese.

Childhood obesity is a multi-factor disease with many determinants. It is not only the result of an individual energy imbalance, but also caused by the obesogenic environment. Since the economic reforms in 1980s, China has been undergoing enormous social changes, all of which have led to an obesogenic environment. Food price have dropped and more food is available and accessible to people. Meanwhile, supermarkets and fast food restaurants are ubiquitous and processed food intake is on the rise (Garnett & Wilkes, 2014). Nowadays, children in China have better living standards than their grandparent and parent generations; however, they also have a higher risk of being overweight and obese as they can easily access the energy-dense and high in fat and sugar foods in the current food environment. China is experiencing the nutrition transition as are many other countries all over the world. The traditional Chinese diet is shifting towards a high-fat diet pattern (Popkin, 2013). With the decrease in grain and the increase in animal-source products, edible oil, snacks, and sugar-sweetened beverages, the intake of carbohydrates dropped dramatically while the percentage of fat in daily energy intake raised. These shifts in dietary patterns are a likely cause for the increasing childhood obesity rate, as a high-fat diet has a positive association with obesity (Golay & Bobbioni, 1997; Du et al., 2001). Shifts in physical activity patterns are another facet of nutrition transition. Since most people do not need to work in labor-intensive industry, and
with the increase of ownership of television and motorized vehicles, light physical activity increased while moderate and heavy physical activity decreased, resulting in less energy expenditure. From a household perspective, socioeconomic status plays a crucial role in childhood obesity. Evidence shows that children living in high SES family are more likely to be overweight and obese (Yu et al., 2011; He et al., 2014; Zhang et al., 2014; Liu et al., 2016). It is because high-income parents with high purchasing power have the advantage in accessing to energy-dense food which is expensive in China (Moreno et al., 2011). And children living in a high-SES family tend to have fewer physical activities than their counterparts with low or middle SES (Chang et al., 2015).

The rural/urban disparity in childhood obesity requires more attention. Since the economic reforms, disparities exist between the development of rural and urban areas. Children in urban areas have a higher overweight and obesity rate than their rural counterparts, because their parents tend to have a higher income, thus, they have more access to energy-dense food and engaged in less labor-intensive activities. However, recent studies found that the prevalence of childhood obesity in rural area is increasing at a faster rate (Ji & Chen, 2008; Yu et al., 2012). It indicates that with the process of urbanization, rural areas might have a potential explosion of childhood obesity in next few decades.

Some interventions have been implemented in China, but no evidence shows that the childhood overweight and obesity rate is declining. To battle childhood obesity efforts are needed from all sectors of the society, as obesity is caused by multiple drivers. Three approaches are suggested. First, a comprehensive intervention that combines interventions for diet and physical activity patterns and health education can be effective. Second, a whole-system intervention in which schools, communities, and families cooperate together is helpful to create a
healthy food environment for all children. Third, an intervention that is comprehensive and
systematic and specifically target in rural areas is needed, such as increasing sport facilities and
educating grandparents and parents.
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