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Ecological Risk Model of Childhood Obesity in Chinese Immigrant Children

Nan Zhou^a and

Department of Psychology, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD, U.S. 21227

Charissa S. L. Cheah^a

Department of Psychology, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD, U.S. 21227

Nan Zhou: zn1@umbc.edu; Charissa S. L. Cheah: ccheah@umbc.edu

Abstract

Chinese Americans are the largest and fastest growing Asian American subgroup, increasing about one-third during the 2000s. Despite the slender Asian stereotype, nearly one-third of 6-to-11 years old Chinese American children were found to be overweight (above the 85th percentile in BMI). Importantly, unique and severe health risks are associated with being overweight/obese in Chinese. Unfortunately, Chinese immigrant children have been neglected in the literature on obesity. This review aimed to identify factors at various levels of the ecological model that may place Chinese immigrant children at risk for being overweight/obese in the U.S. Key contextual factors at the micro-, meso-, exo-, macro- and chronosystem were identified guided by Bronfenbrenner's ecological systems theory. The corresponding mediating and moderating processes among the factors were also reviewed and proposed. By presenting a conceptual framework and relevant research, this review can provide a basic framework for directing future interdisciplinary research in seeking solutions to childhood obesity within this understudied population.

Keywords

U.S. Chinese immigrants; Childhood obesity risk; Ecological system

Childhood obesity is a critical public health threat in the U.S. (Skinner & Skelton, 2014). Over the past three decades, the childhood obesity rate has doubled for preschool children aged 2–5 years and tripled for children aged 6–11 years in the U.S. (Institute of Medicine,

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Corresponding author: Charissa S. L. Cheah^a, Department of Psychology, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD, U.S. 21250, ccheah@umbc.edu, Phone: 410-455-1059, Fax: 410-455-1055.

^aUniversity of Maryland, Baltimore County

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2005). Moreover, more severe forms of childhood obesity (i.e., class 2 and 3 obesity) have increased over the last 14 years (Skinner & Skelton, 2014). Childhood obesity has both immediate and long-term risks to children's physical health, such as Type 2 diabetes, high cholesterol, metabolic syndrome, and sleep apnea (National Institutes of Health, 2010). Children who are obese also suffer socioemotional health problems (e.g., low self-esteem, social marginalization) leading to poor academic and social adjustment (Harrist et al., 2012; Strauss & Pollack, 2003).

Chinese Americans are the largest and fastest growing Asian American subgroup, increasing about one-third during the 2000s (Hoeffel, Rastogi, Kim, & Shahid, 2012). Children of immigrants in the U.S. appear to be at higher risk of being overweight than their non-immigrant counterparts (Baker, Balistreri, & Van Hook, 2009; Balistreri & Van Hook, 2009). Despite the slender Asian stereotype, 23.5% of 4-years old Chinese American children were found to be at risk of being overweight or obese in a nationally representative sample (Jain et al., 2012) and nearly one-third of 6-to-11 years old Chinese American children were reported to be overweight or obese (Au, Kwong, Chou, Tso, & Wong, 2009; Chen & Kennedy, 2005).

In addition, Chinese individuals carry higher health risks of being overweight or obese compared to their counterparts of European descents (Razak et al., 2007). Chinese individuals with the same BMI as Whites have higher percentage body fat and are at a higher risk of developing chronic diseases, cardiovascular disease, and Type 2 diabetes mellitus, possibly because of genetic differences in body composition, metabolic responses, and epigenetic factors (e.g., Pan et al., 2004; Razak et al., 2007). Despite their rapid population growth, increasing obesity prevalence, and the severe health consequences of being overweight in this population, Chinese immigrant children have been neglected in the literature on obesity.

Although there are important biological predispositional causes of obesity that require continued attention, emerging research suggests that a transdisciplinary understanding of obesity through an ecological perspective is also needed (Harrist et al., 2012). Bronfenbrenner's (1979) ecological model of human development has guided developmental researchers for decades in understanding the contributions of the environment from the perspective of the developing person within a set of nested and intertwined structures, including the microsystem, mesosystem, exosystem, macrosystem, and chronosystem (see Figure 1). This ecological model also highlights the complex reciprocal interactions between the active developing person and his/her immediate environment, referred as *proximal processes*, in which development takes place (Bronfenbrenner, 1994). Also, *distal processes* are included, such as families' ability to interact with their environment and utilize resources, which indirectly impact children's risk for obesity. Moreover, given that children's obesity is associated with nutrition and diet, physical activity, and personal and relational attributes, this review identifies and discusses key factors reflecting these attributes at various levels of the ecological model (Harrison et al., 2011; Neumark-Sztainer, 2005). With the rates of childhood obesity at their highest point in the history, it is imperative to understand the risk factors in Chinese immigrant children's ecological context to guide future prevention and intervention efforts that might

be more culturally appropriate and effective in preventing obesity and promoting healthy behaviors.

In this review, Chinese immigrant children refer to children who are born to foreign-born first-generation immigrant parents of Chinese descent. These children include both foreign-born (first-generation and/or 1.5 generation) and U.S. born (second-generation) individuals (Garcia Coll & Marks, 2012). Due to the limited research on these topics among Chinese immigrant families, we reviewed relevant research from other immigrant groups or individuals of Asian descent, when appropriate. In some cases, findings from studies conducted on non-immigrant or non-Asian descent will also be presented in highlighting important processes that might be relevant for Chinese immigrant groups. This review was not intended to be exhaustive in its identification of risk factors or in the research reviewed. Instead, specific key characteristics in each system of the ecological model were identified and discussed. Moreover, the mediating or moderating linkages among these characteristics were proposed from an ecological perspective, in determining possible maladaptive processes, which may put Chinese immigrant children at risk of being overweight or obese. Overall, the full ecological model involves a view of the development of childhood obesity as influenced by specific risk characteristics in the child and families as well as the mediating and moderating processes among these factors at different system levels. By presenting a conceptual framework and relevant research, this review can provide a basic foundation for directing future interdisciplinary research in seeking solutions to childhood obesity within this understudied population.

Microsystem: Family Food and Lifestyle Patterns

The microsystem is a pattern of social roles, activities, and interpersonal relations experienced by a child in an immediate setting and environment. Also, the microsystem involves the complex reciprocal interactions between the developing child and his/her immediate environment, referred to as *proximal processes* (Bronfenbrenner, 1994). The family is the most important part of the microsystem for young Chinese immigrant children, who may be particularly vulnerable to unhealthy weight gain due to various family food and lifestyle patterns in this particular group. The proximal process between child temperamental characteristic and parenting is also discussed. In addition, children's institutional setting and professional health services are important parts of the microsystems for Chinese immigrant children. However, for young children in particular, the potential risks related to peers and health services tend to be mediated by their parents and were discussed in the mesosystem section below.

Parental Feeding Practices

Chinese parenting in general has been characterized as being highly controlling (Chao & Tseng, 2002). Highly controlling parenting leads children to rely on external influences to regulate their behaviors, which can result in poor self-regulation in young children (Karreman, van Tuijl, van Aken, & Dekovie, 2006). Similarly, young children learn to control the amount of food they eat based on the satiety effect (Kaiser, Melgar-Quinonez, Lamp, Johns, & Harwood, 2001). High parental control in food-related interactions directs children's attention to external standards for eating behaviors and away from their own

physical sensations, which in turn decreases children's ability to regulate their food intake (Harrist et al., 2012).

The associations between highly controlling feeding practices (e.g., food restriction and pressuring the child to eat) and less healthy diets and higher BMI in children have been found among diverse ethnic and socioeconomic groups in the U.S. (e.g., Faith, Scanlon, Birch, Francis, & Sherry, 2004; Wehrly, Bonilla, Perez, & Liew, 2014). However, little empirical attention has been paid to specific parental feeding practices in Chinese immigrant families. When feeding practices are examined in Chinese or Chinese immigrant populations, inconsistent associations between feeding practices and children's unhealthy diet and BMI have been found (Cheah & Van Hook, 2012; Huang et al., 2012b; Liu, Mallan, Mahrshahi, & Daniels, 2014).

Specifically, restriction of unhealthy foods and sweets is common among Chinese parents, and a positive association between food restriction and higher BMI in children has been found in a mainland Chinese sample as well (Jiang et al., 2007b). Moreover, Huang and colleagues (2012b) found that Chinese American parents engaged in higher levels of restriction of children's access to foods in both the 2–5 and 6–12 years age groups, and more monitoring in the 2–5 years age group than non-Hispanic white parents. However, parents' use of restriction, pressuring the child to eat, and monitoring were unrelated to child BMI in Chinese American families. Interestingly, in a recent qualitative study on Chinese immigrant mothers' parental feeding practices, child control and restriction were cited as the most frequently discussed themes (Zhou, Cheah, Van Hook, Thompson, & Jones, 2015). Moreover, these mothers discussed using spoon-feeding and social comparison to pressure their children to eat as culturally-emphasized practices. In conclusion, Chinese immigrant parents have higher tendency to engage in highly controlling feeding practices, but the potential negative impacts of these practices on their children's development of obesity remain unclear concurrently and longitudinally.

Proximal process between child temperament and parenting—Children's temperamental characteristic has been shown to be a critical correlate and antecedent of parenting (Belsky, 1984). Increasing evidence suggests that the link between parenting and child temperament may be reciprocal in nature (e.g., Laird, 2011). However, the contribution of child temperament has received little attention in research on parental feeding (Bergmeier, Skouteris, Hooley, & Richardson, 2013), particularly in Chinese immigrant population. Children's emotion-related self-regulation has been found to be an important predictor of Chinese American children's developmental outcomes (Liew, Kwok, Chang, Chang & Yeh, 2014), and is proposed to be a key child characteristic in parent-child food related interactions and child eating and weight status in this review. Emotion-related self-regulation consists of two temperamental characteristics, negative affectivity and effortful control. First, negative affectivity, defined as the tendency to experience fear, anger, and frustration and social discomfort, may increase the risk of childhood obesity (Anzman-Frasca, Stifter, & Birch, 2012). Children with negative affectivity tend to show tantrums over being denied food (Leung et al., 2014) and engage in emotional overeating and food fussiness (Haycraft et al., 2011). Using food to regulate children's behaviors or emotions is quite common among mainland Chinese parents (Jiang et al., 2007a), and

Chinese immigrant mothers (Zhou et al., 2015). The exchange of desired child behaviors with unhealthy foods tends to increase children's preferences for rewarded foods, leading to a higher risk of being overweight and negative long-term effects in children's self-regulation of emotion and energy intake among non-immigrant samples (Frankel et al., 2012).

Second, children's effortful control, defined as their capacity to refrain from a desired behavior, maintain attention on a task, and resist distraction, may be important for children's eating behaviors and weight status in particular. Children's effortful control is the executive-based ability regulating attention, emotion and behaviors, and serves as a key basis for self-regulation (Lengua, 2009; Rothbart & Putnam, 2002). Chinese children with more responsive and affectively involved parents were found to develop better self-regulatory abilities (Eisenberg, Chang, Ma, & Huang, 2009; Zhou, Eisenberg, Wang, & Reiser, 2004). In turn, children who show higher self-regulatory capacities in eating, such as controlling their impulse for food, are less likely to have excessive weight gain and become obese in a culturally diverse national sample (2% of the sample was Asian, Francis & Susman, 2009). Moreover, parents with diverse ethnic backgrounds who believe their children are better at self-regulating their eating tend to use less controlling feeding practices (Tan & Holub, 2011). In contrast, Chinese children's lower temperamental effortful control has been found to be associated with more authoritarian and harsh controlling parenting (Zhou et al., 2004). Children's poor effortful control may work to reinforce the use of controlling feeding practices, which further exacerbates negative parent-child food-related interactions in this population (Tan & Holub, 2011). Therefore, children's negative affectivity and effortful control should be examined as potentially evoking certain parenting practices, as well as mediating or moderating the associations between parental controlling feeding practices and children's eating behaviors and weight status among Chinese immigrants.

Obesogenic Lifestyles

Dietary intake—Chinese immigrants are found to have unhealthy changes in dietary intake after immigration. For instance, Chinese immigrants in Canada reported an increase in portion size, frequency of dining out, and consumption of convenience or processed foods that are more available to them (Rosenmöller, Gasevic, Seidell, & Lear, 2011). Moreover, immigrants in the U.S. in general tend to consume more fat but less fiber in meals, alter meal patterns with more snacking, and engage in low levels of physical activities (Kaiser et al., 2001). Chinese individuals in the U.S. were found to gain fewer calories from carbohydrates but more from fat, and consumed more red meat and less fruit than those living in China (Lee et al., 1994). Also, a qualitative study with Chinese American women found that food cost and availability were the important determinants of their dietary change after immigration to the U.S. (Satia et al., 2000). For instance, some women reported that they consumed fewer vegetables in the U.S. than in China due to greater cost, and they tended to eat more available and lower-cost foods because some preferred Chinese foods were not available. Moreover, these women were unfamiliar with American dietary guidelines, food labels, or other sources of dietary information, and reported that their primary sources of nutrition information were friends and Chinese newspapers. In addition, Chinese immigrant mothers reported that they may not be familiar with how to prepare or cook American dishes for their children (Zhou et al., 2015). Given that these immigrants

experience unhealthy dietary changes and unfamiliarity with Asian diet, these immigrant parents may be less competent in providing nutritious meals and information to their children compared to native-born parents. Therefore, these immigration-related dietary changes among Chinese immigrants may create unhealthy food-related family environment for Chinese immigrant children.

Physical activity and sedentary lifestyle—Parental support and encouragement of physical activity has been found to be associated with children's activity levels and healthy weight status (Gubbels et al., 2011). However, Chinese individuals tend to believe in the strong connection between diet and health (Satia et al., 2000), but engage in less physical activity to maintain health. Asian Americans were much less likely to meet CDC recommended levels of leisure time physical activity than U.S.-born non-Asians (Kandula & Lauderdale, 2005). Moreover, foreign-born Asian immigrants were least likely to participate in physical activity, but the engagement in physical activity increased along with their length of stay in the U.S.

Also, the greater emphasis on academic achievement of children in the Chinese culture may result in children spending more time on studying than being physically active (Chen & Kennedy, 2004; Ha, Macdonald, & Pang, 2010). When asked to compare the differences between U.S. parenting and Chinese parenting, Chinese immigrant mothers with young children indicated that U.S. families placed greater emphasis on physical activities than Chinese immigrant families. Instead, these mothers said that they tended to focus more on education and other extracurricular (non-sporting) activities (Cheah, Leung, & Zhou, 2013). Even though some of these mothers reported acculturating in their parenting towards favoring and trying to incorporate more physical activity for their children, they still perceived Chinese parents to be emphasizing physical activity less than U.S. parents. However, the overall sedentary lifestyle Chinese immigrant families tend to engage in may be an important risk factor for childhood obesity in this particular group.

Mesosystem: Utilization of Resources

The mesosystem comprises the linkages and processes taking place between two or more immediate settings in which the child belongs (i.e., microsystems) (Bronfenbrenner, 1994). As discussed in the previous section, parents, children's institutional setting (e.g., school, daycare) and professional health services are important parts of the microsystem for Chinese immigrant children. The link between parents and children's institutional setting, and the link between parents and professional health services were identified as two potential risk factors within the mesosystem.

Link between Parents and Children's Institutional Setting

Many children of Chinese immigrants tend to prefer American food after attending daycare or school (Diep et al., 2013; Lv & Brown, 2010). Lv and Brown (2010) suggested that these children may be motivated to be liked by their majority friends at school, proposing the role of peer influences on children's dietary preferences. Emerging research has indicated the role of peer influences in children's and adolescents' eating and physical activity among

non-immigrant children (e.g., Salvy, Haye, Bowker, & Hermans, 2012), but no research has examined these influences among Chinese immigrant families.

Here we proposed two pathways through which children's institutional experiences may increase the risk of the development of obesity in Chinese immigrant families. Children of immigrants' dietary preference may change due to institutional experiences (e.g., type of food available at school, children of immigrants' desire to fit in the majority of the group). However, Chinese immigrant parents may not be familiar with how to prepare or cook American dishes as discussed previously. Conflicts tend to arise due to children's request for American food that are disliked by their parents (Lv & Brown, 2010; Zhou, et al., 2015). These conflicts between parent and child may create unpleasant mealtime environment at home. The family mealtime of obese children involves more conflicts and forceful parental feeding behaviors compared to non-obese children of different ethnicities (Harrison et al., 2011; Neumark-Sztainer, 2005).

In contrast, positive and open parent-child communication is associated with less Chinese American children's overweight (Chen & Kennedy, 2005). Moreover, to appease their children, Chinese immigrant parents typically take their children's preferences and desires into consideration when preparing food (Zhou et al., 2015). However, when new American foods are incorporated into the diets of less acculturated Chinese immigrant families, the most accessible types of foods are more likely to be unhealthy ones, including desserts, salty snacks, soft drinks, and high-fat meat (e.g., sausage, hot dogs) (Demory-Luce, Morales, & Nicklas, 2005; Satia, Patterson, Kristal, Hislop, & Pineda, 2001). In conclusion, children's institutional experiences may influence children's dietary preferences, which in turn modify parent-child food related interactions and family dietary intake.

Link between Parents and Professional Health Services

Another important factor at the mesosystem level that may place Chinese immigrant children at risk for being overweight or obese is Chinese immigrant parents' challenges with utilizing available professional health services (Huang, Calzada, Cheng, & Brotman, 2012a). For Asian immigrant children, health issues are often compounded by the challenges of adapting to a new culture, particularly for children whose parents have limited English proficiency. Asian children were more likely to be without health insurance and a usual place for health care compared with non-Hispanic whites (Yu, Huang, & Singh, 2004). Even when Asian immigrants have health insurance, they lack access to formal and informal supports to help them use services effectively due to limited English proficiency. Importantly, Asian immigrant children receive the lowest quality of care compared to other ethnic groups, because their parents often have limited ability and time to advocate for their children in health care settings (Stevens & Shi, 2002). Chinese immigrant children, in particular, have shown to be more likely than non-Hispanic whites to be without a contact or follow-up with a health professional within the past 12 months (Yu et al., 2004). These findings clearly suggest Chinese immigrant families' linguistic and cultural backgrounds create barriers to accessing and benefitting from the health care system, which in turn increases the risk of childhood obesity.

Exosystem: Parents' Occupation and Environmental Barriers

The exosystem comprises the linkages and processes taking place between two or more settings, at least one of which does not contain the child, but in which events occur that indirectly influence processes within the immediate setting of the child (Bronfenbrenner, 1994). In the exosystem, Chinese immigrant parents' occupation and the environmental barriers to engaging in physical activity or accessing healthy types of groceries and foods were identified as risk factors.

Parents' Occupation

Chinese immigrant families in the U.S. tend to be dual earners (Glenn, 1983; Cheng, 2014). These dual-earner immigrant families are often too busy due to their jobs to exercise with their children or supervise them in physical activities. Indeed, Chinese mothers reported being able to count only on their daily chores and errands as the main sources of physical activity because of their busy work schedules (Eyler et al., 1998). However, research shows positive associations between mothers' engagement in physical activities and children's participation in sports activities among Chinese families with young children (Dearth-Wesley, Gordon-Larsen, Adair, Zhang, & Popkin, 2012). Thus, when Chinese immigrant parents do not engage in physical activities themselves due to demanding work schedules, their children tend to have fewer opportunities to exercise.

Environmental Barriers

Environmental barriers in the community to engaging in physical activity also exist among Chinese immigrant families. Walking together with children is viewed as an important and healthy physical activity by Asian immigrant parents. However, safety in the neighborhood is a concern for many immigrant parents (Greves et al., 2007). Chinese immigrants in neighborhoods with higher proportions of immigrants in general reported fewer environments considered appropriate or safe for walking, and recreational exercise resources, and lower levels of safety (Osypuk, Diez Roux, Hadley, & Kandula, 2009). Chinese individuals living in the U.S. compared to those in China spend significantly less amount of time in vigorous activities and walking, and more time sitting (Lee et al., 1994). Also, the connections between young children and their community may be primarily mediated by parents' behaviors and their involvement in the neighborhood. Immigrant parents may lack the social networks to and familiarity with arranging play dates or activities for their children in the community (Wong & Song, 2006). The social environment of neighborhoods may influence Chinese immigrant children's obesity development because their parents may lack the necessary language skills to navigate their new living environments. The percent of neighborhood residents who spoke the same language as the Chinese immigrant mothers was negatively associated with their preschool-aged children's BMI (Nobari et al., 2013). In addition, for low-income Chinese immigrant families, the prohibitive costs of attending extracurricular activities or sports programs and the lack of culturally appropriate programs available in their communities can decrease Chinese immigrant children's participation in physical activities (Chen, Kwan, Mac, Chin, & Liu, 2013).

Traditionally, the Chinese diet is typically low in fat (Woo, Leung, Ho, Lam, & Janus, 1998). However, depending on the geographic region in the U.S. and the size of the co-ethnic communities that Chinese immigrants live in, these parents may not have access to the types of groceries that they can use to prepare foods from their country of origin (Satia et al., 2000). Thus, immigrant mothers may be less familiar with how to make healthy versions of what is available to them at the grocery stores in their neighborhood. As mentioned above, when incorporating available American foods into their diets, immigrant families are less likely to prepare healthy American foods due to this lack of familiarity with the products (Demory-Luce et al., 2005; Satia et al., 2001). In conclusion, the environmental resources in Chinese immigrant families' neighborhood and communities may limit parents' ability to navigate their new living environment, which in turn, influence Chinese immigrant children's engagement in physical activity and dietary intake.

Macrosystem: Cultural Ethnotheories and Societal Attitudes

The macrosystem consists of the overarching pattern of the characteristics of the micro-, meso-, and exosystems of a given culture, with particular reference to the belief system, bodies of knowledge, customs, and life-styles embedded in each of these broader systems (Bronfenbrenner, 1994). Specific cultural beliefs and values from their parents' heritage culture, which may put Chinese immigrant children at risk of being overweight or obese, were identified at the macrosystem level. Moreover, societal attitudes towards Chinese immigrants in the American mainstream culture may add additional risks for young children of Chinese immigrants.

Cultural Ethnotheories

Chinese food-centered culture—The Chinese culture has been characterized as food-centered, and eating is considered to be one of the rare joys of living (Simmons, 1991). Given the centrality and enjoyment of food in traditional Chinese culture, cooking an impressive range of dishes for family dinners as well as family holiday gathering is considered desirable (Simmons, 1991). Growing up in a food-centered family context, the valuing of food and the enjoyment of eating are rooted in young children's minds, which may later result in their overeating. Moreover, diet therapy and food modification to prevent illness and maintain one's health has been emphasized since ancient times in Chinese history (Koo, 1984). For example, Sun Szu Miao (581–682 A. D.), a highly regarded physician in his period, said, "When one wants to cure, use diet therapy first; only when it is not successful, should medication be used" (Ho, 1985). Due to this cultural belief, Chinese immigrant parents may be reluctant to seek out child obesity prevention or intervention programs in the U.S., because they prefer to rely on diet to maintain their children's health.

Cultural beliefs about children's ideal body shape—Historically, the Chinese have regarded plumpness, particularly in females and children, as desirable (Lee, Ho, & Hsu, 1993). Even now, Chinese parents report believing that overweight children reflect their healthy and wealthy family backgrounds (Bush, 2003). In China, children's weight increases with household income (Wang, Popkin, & Zhai, 1998). This pattern suggests that being overweight may be considered culturally to be an indicator of wealthy socioeconomic status,

or at least not perceived as unhealthy in an environment where food sources are historically less secure. These cultural beliefs about ideal body shape along with highly controlling parenting practices may lead Chinese immigrant parents to pressure their children to eat more.

Tendency to use food to express love—Related to the historical cultural belief valuing heavier weight status, Chinese caregivers, including both parents and grandparents, believe that providing food and cooking for the child is an important way to show parental care and love (Cheah & Li, 2009). For instance, Chinese grandparents express enjoying watching their grandchildren eat, because food is viewed as a way to transmit love (Jiang et al., 2007a). Chinese culture has traditionally endorsed three-generation childcare and valued the involvement of grandparents in caregiving (Mjelde-Mossey, 2007). A growing number of new Chinese immigrant parents send their child back to be cared for by grandparents in China due to their desire to socialize traditional values in their children and the financial cost of childcare in North America. These children have been referred to as “satellite babies” (Bohr & Tse, 2009). Another form of three-generation childcare among immigrants is to bring grandparents to the U.S. to help take care of young children (Yoon, 2005). Thus, grandparents take on the main responsibility of planning and cooking the meals in many three-generation Chinese immigrant families. Chinese grandparents prepare and buy food for their families according to the young children’s preferences and wishes and tend to be indulgent. Furthermore, most grandparents believe that a heavier child and accumulated body fat are the results of their successful feeding and care (Jiang et al., 2007a). Thus, young Chinese immigrant children tend to be overfed and may be vulnerable to unhealthy weight gain.

Model Minority Stereotype

Asian immigrants have been stereotyped as model minorities in the American society, which refers to an immigrant group experiencing successful adaption and excelling in academic and economical domains (Wang, Siy, & Cheryan, 2011). Consequently, the predominant research emphasis on Asian Americans and immigrants has been on their academic achievement, resulting in little empirical attention given to the health conditions in this group (Juang, Qin, & Park, 2013; Tahseen & Cheah, 2012). Even though Asian Americans have been reported to have lower rates of overweight and obesity compared to non-Asian Americans, there is a general failure to recognize the diverse levels of health status among this heterogeneous group (Jain et al., 2012), likely because of the model minority stereotype depicting Asian Americans as having adapted successfully to the larger American culture (Matloff, Lee, Tang, & Brugge, 2008). The growing issue of obesity among Chinese American children has been suggested in recent research (e.g., Matloff et al., 2008). However, the existing research on obesity and health disparities among ethnic minority children within the U.S. extensively focuses on Hispanics and African Americans groups (e.g., Caprio et al., 2008; Yu et al., 2004).

As suggested by Harrison and colleagues (2011), distal factors may interact with proximal factors through media. When media portray Asians as successful model minorities with few challenges, such misleading stereotypes may decrease Chinese immigrant parents’

awareness and concerns of obesity risk, and result in their poorer ability to identify potential weight problems, engagement in lower levels of help-seeking behaviors, and resistance to clinical interventions that challenge this stereotype. Moreover, despite the increasing obesity prevalence and the unique health risks associated with obesity in Chinese immigrants, American society is less aware of the need for outreach efforts to educate them on accessing and navigating the health care system, particularly in obtaining preventive services for childhood obesity.

Chronosystem: Family Acculturation and Children's School Transition

The chronosystem encompasses change or consistency over time not only in the characteristics of the child but also of the environment in which the child lives (Bronfenbrenner, 1994). Parents' early life food insecurity and the families' acculturation-related experiences may put Chinese immigrant children at risk of being overweight or obese. In addition, the school transition was identified as a challenging change for Chinese immigrant families with young children.

Parents' Early Deprivation and Acculturation

Parental early life food insecurity—The majority of the first-generation Chinese immigrants with young children were born in the 1970s and early 1980s. These parents were raised in the shadow of the Great Chinese Famine, causing tens of millions of deaths between 1958 and 1961 in China. As late as 1987, the prevalence of child stunting was 32.1% in China (Svedberg, 2006). Although the economic reforms of the 1990s rapidly increased income and food security in subsets of the mainland Chinese population, this current generation of Chinese immigrants grew up in a time and place in which food insecurity and child stunting still posed significant hardships (Xiao & Nie, 2009). Many of these immigrants may have parents or other family relatives who suffered the Great Chinese Famine. Cheah and Van Hook (2012) reported that a large proportion of Chinese immigrant parents in their middle-class sample (38%) reported experiencing food insecurity as children in their country of origin, compared to 9.9% of children in the U.S. who live in a food insecure household (Coleman-Jensen, Gregory, & Singh, 2014).

Parental early life food insecurity may be an important risk factor for child obesity through food-related parent-child interactions. Immigrant parents are unaccustomed to protecting their children from obesity risks if they were socialized in contexts where food insecurity and material deprivation were common and obesity was rare (Kuyper, Smith, & Kaiser, 2009; Van Hook & Baker, 2010; Van Hook & Balistreri, 2007). Chinese immigrant parents who experienced food insecurity were less likely to perceive responsibility for their children's diet, but more likely to perceive their children as weighing less than ideal, even after controlling for their children's actual BMI (Cheah & Van Hook, 2012). As such, parents who experienced early life food insecurity also value and do not want to waste food, resulting in pressuring their children to finish their plates even if their children are full. Chinese parents who experienced poverty and stunting in their early lives do not want their children to be hungry now, given that both money and ample amount of food are available. They want their children to experience a "happy life" by providing them with plenty of food (Jiang et al., 2007a).

Parental acculturation—Chinese immigrants, in general, initially tend to have a lower risk of cardiovascular disease compared to people who are already living in Western countries. However, the risk of their cardiovascular disease increases over time after immigration to a Western country due to changes in dietary patterns (Rosenmöller et al., 2011). Hence, immigrant parents' acculturation experiences are an important factor associated with child diet and weight status at the chronosystem. However, recent research suggests that lower levels of parental acculturation seem to be a risk factor for child development of obesity. For instance, Chen and Wu's (2008) study of Chinese American children found that parental acculturation among recent immigrants was positively associated with child BMI, potentially related to a lower level of physical activity among these children compared to their white and African American counterparts. Chinese immigrant parents, who depended upon their children and their greater English proficiency to negotiate the new U.S. culture, experienced a role reversal of authority in the family. These parents with low English proficiency also lost their ability to better control the eating habits of their children, leading to greater obesity in children (Matloff et al., 2008). Also, Chinese immigrant children with highly acculturated mothers have lower BMI, possibly because of an enhanced awareness of the health issues related to obesity in the new cultural context (Chen & Kennedy, 2005).

Given the inconsistent role of parental acculturation in children's health outcomes, it is important to understand the mechanism by which acculturation contributes to children's diet, physical activity and interpersonal relationships. For instance, immigrant parents' acculturation level should be examined as a moderator in the associations between parents' early life experiences and their feeding beliefs and practices. Among less acculturated Chinese parents, those who grew up in poorer households are less likely to monitor what their children eat, less concerned about their children eating too much or becoming overweight, and perceive themselves to be less responsible for their children's diet than parents growing up in wealthier households (Cheah & Van Hook, 2012).

Children's School Transition and Acculturation

Young children's school transition—Preschool is a critical start for all children. The transition from home to American preschools is particularly challenging for children of Chinese immigrants, because they engage in social interactions with teachers and other children from mainstream society in an unfamiliar environment (Cheah & Leung, 2011). These children may encounter numerous social, cultural, and language challenges posed by their peers and teachers, including with regard to food. As mentioned in the mesosystem, children's food preferences may be influenced by their institutional experiences (Lv & Brown, 2010). As such, Chinese immigrant parents also face cultural challenges during the transition. For instance, parents may be unfamiliar with the snacks provided by school, and have to intentionally check on the snacks in order to monitor children's dietary intake (Zhou et al., 2015).

Children's acculturation—Asian immigrant children's generational status is an important predictor of obesity rates, which tend to increase with the length of time living in the U.S., likely related to the adoption of mainstream eating, physical activity and television

watching habits (Jain et al., 2012). However, like with parental acculturation, Chinese immigrant children's acculturation may not have a simple linear association with their health outcomes. For instance, Chinese immigrant children's low acculturation levels may also limit their recreation participation, resulting in more sedentary behaviors at home. Yu and Berryman (1996) found that Chinese immigrant adolescents most frequently engaged in home or indoor activities, and were attracted to Chinese language mass media with their family members or Chinese friends. These adolescents and their parents reported acculturation-related barriers to recreation participation (e.g., outdoor activities), including lack of English proficiency, opportunity, activity partners, monetary funds, and knowledge about relevant activities.

Future Directions

It is important to note that very limited research has been conducted on Chinese immigrant samples that has examined whether and how varying ecological factors might impact children's eating behaviors and weight status. As such, this review aimed to identify some potentially important developmental mechanisms and cultural processes, and mediating/moderating links at different levels of the ecological system, which may act as risk factors for obesity in Chinese immigrant children based on the available literature.

Four recommendations are provided for future research in this area. First, greater attention to the issue of childhood obesity and associated research and prevention efforts within the Chinese immigrant population is needed. Given that Chinese Americans are one of fastest growing immigrant groups in the U.S., it is imperative to understand the risk factors related with childhood obesity and service needs of this particular group. In order to provide a comprehensive understanding of childhood obesity, the ecological perspective should also be incorporated in examining the developmental mechanisms in this understudied population. Moreover, even though the focus of the present review is on risk factors, it is important to focus future efforts on identifying protective factors in Chinese immigrant families when seeking solutions to childhood obesity.

Second, researchers should consider the role of culture seriously in health research (Dressler, 2006; Hunt, 2005). Instead of focusing on general markers of ethnic or cultural groups, researchers and health practitioners should be more explicit about where culture is situated in the ecological context for Chinese immigrant children. As discussed earlier, parents' cultural ethnotheories and tradition can influence children's physical health through many pathways, such as parental perceptions of risks associated with obesity, daily parenting practices related to food and eating, and the utilization of health services. Cultural factors, therefore, affect the likelihood that childhood obesity can be prevented or effectively treated through many different systems and avenues. Also, it is possible that different family demographic characteristics may moderate the associations identified at different levels of the ecological model. For example, maternal education, family socioeconomic status, and family structure may interact with feeding practices in predicting children's dietary intake and weight status (Van Hook & Balistreri, 2007).

Third, future studies should focus specifically on the immigration and acculturation experiences of Chinese immigrant families, and how they may impact child health through various systems. It is possible that Chinese immigrants' pre-migration experiences (e.g., early life food insecurity, traditional cultural beliefs and perceptions, family structures and lifestyles) and characteristics of post-migration communities into which they settle (e.g., limited social network and resources, unhealthy changes in dietary intake, access to healthy or familiar foods) contribute to the risks of childhood obesity in their children. Unfortunately, most current research examining the role of parental acculturation in immigrant children's health focuses on parents' general level of behavioral integration into the mainstream culture and its separate correlations with feeding practices, children's dietary intake, or BMI. Future research and intervention programs should aim to better understand the effects of contextual factors on Chinese immigrant children in partnership with co-ethnic communities to encourage health awareness and create supportive dynamics (e.g., Chen, Kwan, Mac, Chin, & Liu, 2013).

Finally, future research should help guide policy makers and health practitioners in developing strategies to meet the needs of this growing population to prevent childhood obesity. For instance, prevention and intervention efforts can offer anticipatory guidance and focus on education about the health benefits of physical activity and potential risks of practices like controlling feeding and overfeeding to show love. Additionally, training in cultural competency is crucial for health practitioners in order to understand Chinese immigrants' specific health-related behaviors and barriers (Caprio et al., 2008). The ecological model calls for research designs and programs that incorporate process, person, environment and time (Bronfenbrenner & Morris, 1998), that work together to promote the positive health of immigrant children and their families.

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Highlights

- An ecological risk model of obesity in Chinese immigrant children was proposed.
- Various risk factors in five systems within the ecological model were identified.
- The mediating and moderating processes among the risk factors were discussed.
- Use of the ecological model for directing future obesity research was highlighted.
- Chinese immigrant children in the U.S. have been neglected in obesity research.

Figure 1.
Ecological Risk Model of Childhood Obesity in Chinese Immigrant Children