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Papoutsi, Georgia and Drichoutis, Andreas and Nayga, Rodolfo

Dept. Agricultural Economics and Rural Development, Agricultural University of Athens, Dept. of Economics, University of Ioannina, Dept. of Agricultural Economics and Agribusiness, University of Arkansas, Norwegian Agricultural Economics Research Institute

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Georgia Papoutsi[1], Andreas Drichoutis[2] and Rodolfo M. Nayga, Jr. [3, 4]

[1] Dept. Agricultural Economics and Rural Development, Agricultural University of Athens, Greece, email: gpapoutsi(at)aua.gr

[2] Dept. of Economics, University of Ioannina, Greece, email: adrihout(at)cc.uoi.gr

[3] Dept. of Agricultural Economics and Agribusiness, University of Arkansas, USA, email: rnayga(at)uark.edu

[4] Norwegian Agricultural Economics Research Institute

Abstract

Childhood obesity rates are rapidly rising in many countries. Since it is highly likely that obesity will persist into adulthood, current rates undermine the health and future of people in developed as well as developing countries. This public health epidemic carries significant economic, social as well as individual-level consequences and has become a research topic of significant interest for various disciplines including economics. We survey the literature in economics and related disciplines associated with the causes of childhood obesity and synthesize the results to provide a better understanding of the explanations for the rising childhood obesity rates. This is an important step in crafting effective policies to combat global childhood obesity trends.

Keywords: childhood obesity, child health, overweight

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1. Introduction

Childhood obesity is rapidly rising in many countries. The World Health Organization (WHO) indicated that, globally, the percentage of overweight children under the age of five is estimated to be over 42 million (WHO, 2009). Close to 35 million of these children are living in developing countries. In the United States (US),

obesity rates among preschool children aged 2-5 increased from 5% to 10.4% between the periods 1976-1980 and 2007-2008 (Ogden and Carroll, 2010). The rates for obese children and adolescents are even more alarming. Specifically, Ogden *et al.* (2010) estimated that in 2008, 19.6% of US children aged between 6 to 11 years old were obese and that the percentage of obese adolescents aged 12-19 was 18.1%. Although the OECD (2010) indicates lower childhood obesity rates in the EU than in the US, one in every seven children is overweight or obese in most EU countries.

Childhood obesity is recognised as a disease by the WHO (2000) and is associated with sleep apnea, asthma, cardiovascular diseases, dyslipidemia, hypertension, type II diabetes mellitus, osteoarthritis, gallbladder disease as well as renal, colon and genitourinary diseases (Bray, 2004; Brennan *et al.*, 2009; Eriksson *et al.*, 2003; Franks *et al.*, 2010; Must and Strauss, 1999; Williams *et al.*, 2005). What is most worrying is that health conditions that were once almost exclusively associated with the elderly, such as type II diabetes, are now being diagnosed in children, mainly due to the increasing prevalence of childhood obesity. Furthermore, childhood obesity may also inflict psychological harm, resulting from social stigmatization, depression, and poor body image (Paxton, 2005; Reeves *et al.*, 2008; Strauss, 2000).

The scientific literature to date has also strongly linked childhood obesity with adult excess weight status (Power *et al.*, 1997), with long-term consequences in terms of direct medical costs such as diagnostic/treatment costs, and indirect costs such as morbidity/disability/mortality costs. Finkelstein *et al.* (2009) estimated that in 2008, obesity related medical care expenditures in the US were approximately $147 billion; more than the annual medical expenditures associated with cigarette smoking. Cawley and Meyerhoefer (2010) reported even higher obesity related medical costs at 16.5% of US national health expenditures. The numbers outside the US territory, although of lower magnitude, are also non-trivial. For example, the estimates for Australia, Canada, England, France, and New Zealand indicate that 1%-8% of national health expenditures in these countries are due to obesity-related treatments (Drichoutis and Lazaridis, 2008). As far as medical expenditures among children is concerned, Finkelstein and Trogdon (2008) examined data on US children aged 8-13 years old and concluded that medical expenditures per year per child are $220 more due to overweight children. At present, indirect cost estimates are only available for those associated with adult obesity and not childhood obesity (Hammond and Levine, 2010;

Trogdon *et al.*, 2008). Hence, there is a lack of comprehensive research on the estimation of indirect costs associated with childhood obesity.

Due to alarming growth of childhood obesity rates and the associated costs, childhood obesity has become the topic of research of various and diverse disciplines as well as the target of many public policy programs. The multidimensional concept of this problem rests on the fact that obesity is related to individual characteristics (that are genetic or acquired) and to individual's socioeconomic environment. While genetics or biological factors are important factors that can influence childhood obesity, the rapid increase in obesity rates over the last decades suggests that genetics is not one of the major drivers of recent increases in childhood obesity. At a basic level, the simplest and immediate determinant of childhood obesity is environmental-metabolic in nature, i.e., the energy balance which is the amount of calories consumed and the amount of calories expended. With respect to caloric intake, children (after infancy) generally consume the same foods as their parents (Philipson and Posner, 2008), which implies that factors related to food that contribute to adult obesity will work similarly with children. Ditto, caloric expenditures can also be determined by parents' decisions (or adult-framed decisions in general), as parents have the power to compel their children to allocate their time in certain ways. Energy can be expended not only by physical activity but also through dietary thermogenesis and the basal metabolic rate (Anderson and Butcher, 2006a) although it is usually difficult to collect data on the latter. Consequently, the economic literature has mainly focused on the correlation between physical or sedentary activities and weight gain.

Our aim in this paper is to review the socio-economic literature on childhood obesity. We conclude that there is multitude of factors that have contributed to the recent childhood obesity growth rates, including changes in the environment where children are raised. Consequently, public policies and interventions targeting childhood obesity could focus on ways of changing the environment that affects children's health behavior and weight outcomes. Parents, home, food market, neighborhoods, school, media and social networks are all parts of this environment.

The rest of paper is structured as follows: The next section presents an overview of economic theoretical approaches that have been used to explain weight gain and obesity. The rest of the sections present empirical work on the role of various factors on childhood obesity, namely parental behavior (section 3), the food market

structure (section 4), built environment and urbanization (section 5), labor force participation (section 6), schooling and school environment (section 7), time preferences (section 8), information (section 9) and socio-cultural status and social networks (section 10). We conclude in the last section.

2. Theories of obesity

Existing economic explanations of weight gain and obesity are largely based on the utility maximization theory. From an economic point of view, individuals make decisions about their diet, physical activity, time allocation and weight in order to maximize their utility subject to constraints such as time, resources, genetic predisposition and biological factors. The rapidly growing economic literature on obesity presents several models of weight gain classified under the umbrellas of "Neoclassical Theory" and "Behavioral Theory" of weight gain.

The Neoclassical theory of weight stresses that "the marginal benefit of eating today is equal to the current pleasure of eating and the present-discounted marginal utility or disutility of weight gain" (Lakdawalla and Philipson, 2006). This theory includes the Capital Investment model of weight, developed by Philipson and Posner (1999) and Lakdawalla and Philipson (2002) and the Rational Addiction model of weight proposed by Cawley (1999).

The Capital Investment model is a dynamic model of weight in which weight is considered a durable capital good and individuals make decisions after comparing the lifetime costs and benefits of weight gain. Philipson and Posner (1999) claim that over-weightiness could be prevented by behavioral change since weight is the result of personal choices (food intake, occupation, leisure time activity or inactivity and area of residence) and people may rationally prefer to be under- or over-weight in a medical sense. They also argue that technological change provides the best and natural explanation of the growth in obesity trends. Along with Philipson and Posner (1999), Lakdawalla and Philipson (2002) argue that technological change has induced weight growth by decreasing food prices (through agricultural innovation) and by increasing the price of exercise (i.e., by making home and market production more sedentary). An examination of individual-level data from 1976 to 1994 showed that about 40% of the recent growth in weight could be due to innovation in agricultural production while 60% may be due to demand factors such as increased productivity at

home or market production associated with declining physical activity (Lakdawalla and Philipson, 2002). Later on, Lakdawalla *et al.* (2005) confirmed not only the changes in strenuousness of work leisure caused by economic development but also explored how declines in relative prices of certain types of foods can affect weight, health and well-being. Furthermore, Lakdawalla and Philipson (2009) illustrate how body weight varies with income within a country and across countries of different levels of technology adoption and stress that additional income might make people strive to move towards their perceived ideal weight. Income raises weight among the poorest groups but lowers it throughout the upper half of the income distribution (Philipson and Posner, 2008).

Complementary to the Capital Investment model is the Rational Addiction model where eating is considered addictive and past eating raises the marginal utility of current eating. In this model, addiction is modelled as a forward-looking consumption plan under a budget constraint, full certainty and perfect information (Becker and Murphy, 1988). The addicted person knows how the good will affect him/her and consumes more of it because this consumption pattern maximizes his/her discounted utility. Cawley (1999) uses the Rational Addiction model to explain that the variation in weight is attributed to choices even if people have genetic predispositions to a certain outcome. He found support for the hypothesis that consumption of net calories (i.e., caloric intake minus energy expenditure) is addictive. He also emphasized that increases in the future price of food can lead to current reductions in food intake, because current food intake shifts up the future demand for food.

Overall, both the Capital Investment and the Rational Addiction models based on the Neoclassical theory of weight share the view that individuals are rational and forward looking about their weight. An alternative to the Neoclassical theory is the Behavioral theory of weight proposed by Cutler *et al.* (2003). Cutler *et al*. argue that although eating is considered addictive, individuals have problems of self control and time inconsistencies that deter them from committing in advance to a prescheduled plan for food, exercise and weight choices. For example, some people prefer current food (over)consumption to have immediate gratification, although they are aware of the health costs of this (over)consumption in the future. Other people also face times of indulgence where they overeat even though they try to lose weight. Dockner and

Feichtinger (1993) observed that consumption behavior seems to contradict rational choice theory. Using the Becker and Murphy (1988) rational addiction model to eating decisions and the assumption that food consumption is addictive, they concluded that consumption decisions, and the consequent weight path, can exhibit cycles with gradual increases followed by gradual decreases.

Levy (2002) explained cyclical food-consumption and over- and under-weightiness through a dynamic model where eating is neither addictive nor a form of habit. Consumers rationally balance the marginal satisfaction from current and future consumption against marginal deterioration of health and the risk for being over- and under-weight. He found that when physiological, psychological, environmental and socio-cultural reasons for divergence from a physiologically optimal weight do not exist, the steady state is a state of over-weightiness. He also showed that the optimal stationary level of over-weightiness is positively associated with the individual's rate of time-preference and elasticity of utility but negatively associated with his/her rate of calories burning. Even a small divergence from this rationally optimal stationary weight[1] is followed by cyclical food consumption and weight which may lead to chronic loss of weight in old age. After incorporating socio-cultural norms into his basic model, he concluded that the stationary weight of fat people is lower than otherwise and the stationary weight of lean people is greater than otherwise.

The studies discussed above generally pinpoint that weight gain and obesity are the result of individual choices. However, when considering this theoretical framework (which applies to adult agents) for children, we must take into consideration that children are not perfectly rational, have time-inconsistent preferences and are affected strongly by the environment created by their parents. Although adults have the freedom to make their own choices over energy intake and expenditure, the child's choice set is limited by the environment created by the parents (Barlow and Dietz, 1998)[2]. In fact, Cawley (2006) stresses that parental control and bounded rationality are of great importance for childhood obesity. A series of recent papers explicitly focus on parental influence as potential contributor to childhood obesity and present parental environment as a good explanation of the large socioeconomic differences that exist in children's health outcomes. These are presented separately in the next section.

3. Parental behavior and child health outcomes

Case and Paxson (2002) examined how parental actions in prenatal period and during childhood affect children's health and presented evidence on the correlation of parental behavior with income and socioeconomic status. They concluded that policy makers should not focus on health insurance coverage and advances in medical treatment alone, even though these are important determinants of children's health. Governments should also focus on a broader set of policies that target the health behavior of parents.

In addition, Dickie (2005) examined how family resource allocations affect children's health through a model of parental decision-making. He found that children with greater stocks of health capital (long term health status), whose parents invest in preventive and remedial medical care, experience fewer days of illness. Furthermore, he found that, all else equal, single parents or parents that cannot afford insurance for their children are more willing to pay to avoid one day of illness. Anderson *et al.* (2007) also stressed the increased role of environmental factors created by parents on childhood obesity. They examined the correlation between parental and child BMI and concluded that the relationship between mother's and child's BMI has increased over time, pointing to the importance of the shared environment in the growing obesity rates. However, they also found that children's environment outside the family plays a substantial role in the determination of children's body mass.

The significance of parental influence on children weight is also examined by McIntosh *et al.* (2006) through a novel approach. They adopted an interdisciplinary approach to study the influence of parenting on children's dietary intakes and weight status. Their theoretical framework is based on the collective household production model from economics coupled with role theory from sociology. With this model, behavioral expectations can be identified and preferences of household members can be different from each other. It is also assumed that there are incentives for the household decision makers to allocate their income and time in an efficient manner. This study was one of the first in the economics of obesity literature to examine the relationship between the time parents spend with children and children's dietary intake or obesity. The collective household production model was also used in You and Davis (2010) in order to investigate the relationship between household food expenditures, parental time allocation and childhood overweight. The results from the

collective model are then compared with the results from a unitary household production model. The traditional unitary model was rejected relative to the collective model. Policy implications from the two models were significantly different. Their model illustrates the importance of taking into account, in these types of studies, not only the mechanism that parents have for influencing their children's choices but also the fact that parents implement this mechanism taking into consideration the response of the children (i.e., they used a 2-stage Stackelberg game structure)[3].

4. Obesity and the food market

Food availability and food markets evolved along with technological changes. Evidence suggests that the timing of these changes in the food market coincided with the growth in childhood obesity (Lakdawalla *et al.*, 2005; Lakdawalla and Philipson, 2009). Food has become more convenient, cheaper and tastier but also more energy dense. Portion sizes have become larger (Nielsen and Popkin, 2003) and the consumption of beverages, particularly soft drinks, has become almost a "side dish" (French *et al.*, 2003; Putnam and Gerrior, 1999). Anderson and Butcher (2006a) argued that convenience has been highly valued by families. As parents spend more and more hours at work and face tighter time constraints they are forced to find easy and convenient solutions for food consumption. Thus, food-away-from-home (FAFH) items such as snacks, soft drinks and fast foods seem more appealing than time-consuming healthy meals prepared at home. Anderson and Butcher (2006a) presented strong evidence for the contributing role of soft drinks on childhood obesity, followed by slightly mixed results on the role of fast food on childhood obesity and small evidence for the role of snack foods.

The positive association between children's soft drinks consumption and obesity rates has largely been acknowledged in nutrition and public health studies (Andersen *et al.*, 2005; Ariza, 2004; Troiano *et al.*, 2000). This link was confirmed by the recent findings of Chang and Nayga (2010) using a nationwide survey in Taiwan. The authors suggested that soft drinks consumption is influenced by children's characteristics and household features and is positively associated with children's overweightness and negatively associated with degree of unhappiness. Although the increased consumption of soft drinks or carbonated beverages among children is documented by French *et al*. (2003), there are conflicting evidence about the effect of

taxing soft drinks on obesity rates. Fletcher *et al*. (2010) concluded that soft drink taxation leads to a moderate decrease in the quantity of soft drinks consumed by children, but does not affect obesity rates, as any reduction in soft drinks consumption is offset by consumption of calories from other sources. On the other hand, Smith *et al.* (2010) found that a 20% tax included in the price of soft drinks would decline the at- risk-of-overweight prevalence from 32.2% to 2.0% and the overweight prevalence from 16.6% to 13.7%.

As far as FAFH is concerned, there are two points worth investigating in the economics literature: the types of food offered at these types of restaurants and the availability of FAFH by geographic location. Lin *et al.* (1999) showed that while the percentage of calories from FAFH was only 18% in 1977-78, it increased to 27% by 1987-1988 and 34% by 1995. With respect to the availability of FAFH restaurants, Chou *et al.* (2004) employed data from the 1984-1999 Behavioral Risk Factor Surveillance System and concluded that the per capita number of restaurants has a positive and significant effect on Body Mass Index (BMI) and obesity probability. In fact, they argued that 61% of the actual growth in BMI during the period of investigation and 65% of the rise in obesity rates can be attributed to the rapid increase in the per capita number of restaurants. Rashad (2006) reached a similar conclusion after studying data from the 1980s.

The aforementioned studies aimed to provide an explanation of the general impact of FAFH on obesity, but they did not deal with specific groups classified, for example, by gender, race and geography. Dunn (2010) filled this gap, by investigating the effect of availability of fast food restaurants on weight outcomes, using data from the 2004-2006 Behavioral Risk Factor Surveillance System and interstate exits as instruments for fast food restaurant location. He found that availability of fast food restaurants increases BMI among females and non-whites in medium density counties in the US. He found no correlation in rural countries. However, Cawley (2007) pinpoints the need for further research since the evidence are not clear enough to suggest if the increase in obesity rates is caused by the availability of fast food restaurants *per se* or whether it is an effect of changing consumption patterns.

Interestingly, economists have not given prompt attention to the association between fast food consumption and children's weight outcomes as much as they did for adults. You and Nayga (2005) found that fast food expenditures has a statistically

significant and negative effect on the diet quality of children and this effect differs between children younger than 11 years old and children at least 11 years old. They stressed that the elasticity of children's dietary quality with respect to household fast food expenditures is quite inelastic. More recent evidence showed that the amount of fast food consumption has clear and strong contribution to the increased risk of children being overweight and obese (Chang and Nayga, 2009). Moreover, Alviola *et al.* (2011) presented more recent evidence of a significant correlation between the number of fast-food restaurants within a 0.25 mile from a school and school level obesity rates.

In addition to FAFH, more attention should also be given to the fact that although food prices (including preparation costs) have been decreasing over the last decades, high-fat high-sugar (HFHS) convenience food tend to be cheaper than healthy food. The combination of convenience and low cost attributes makes convenience foods more attractive not only to parents but also to children. It is worth noting that nowadays, even in young ages, children have in their possession money to spend (i.e., pocket money). Lakdawalla and Philipson (2002) attributed 40 percent of the recent growth in body weight to lower food prices. However, one might argue that children have preferences over specific foods and that these preferences may not be sensitive to changes in prices. On the contrary, French *et al.* (2001) and Hannan *et al.* (2002) presented evidence from data collected in school cafeterias and vending machines which indicates that children tend to be sensitive to price changes of high-fat and low-fat foods.

With respect to the effect of snack foods on obesity, French *et al.* (2001) concluded that variation in snack food prices may cause adults to alter their consumption behavior; however, there is very little evidence on the direct effect of snacking on children's and adolescents obesity rates. A number of studies concluded that there is no strong relationship between the consumption of snack foods and body over-weightiness (Bandini *et al.*, 1999; Phillips *et al.*, 2004).

Furthermore, many scientists claim that the big change in the daily caloric intake is due to increased portion sizes and not because of decreased food quality. Nielsen and Popkin (2003) concluded that food portion sizes both at home and away from home increased between 1977 and 1996, but that the greatest increases appeared for food consumed at fast food restaurants. Similar evidence were provided by Young

and Nestle (2002) for the years after the 1980s, a period which coincides with the increased rates of childhood obesity. This fact along with the conclusion presented by Rolls *et al.* (2000), which argues that children (of average age 5 years old) eat more when they are provided larger portion meals[4], show a strong causality of the effect of portion sizes on childhood obesity.

In addition to the food environment, a number of studies have provided evidence that the built environment surrounding children can also significantly influence childhood obesity. These studies are discussed in the next section.

5. Obesity, Built environment and urbanisation

Lakdawalla and Philipson (2002) attributed 60% of the recent rise in body weight to demand factors such as increased productivity at home or market production being associated with declined physical activity. Since technological developments increase the derived utility from sedentary leisure, economists would expect people to spend more time in sedentary leisure. In fact, people, in order to increase the utility derived from sedentary activities, not only developed home equipment that makes their life more convenient, but also designed their spatial environment in a sedentary friendly style (Robbins, 2006). Modern developments do not provide facilities such as parks that permit and encourage physical activity. In addition, public transportation and street networks discourage people from walking and bicycling, resulting in daily lifestyles that are more sedentary. A study conducted in the Atlanta-Georgia region in the US argued that every additional 30 minutes of driving per day is equivalent to a 3% increase in the likelihood of being obese (Frank *et al.*, 2004). On the other hand, the same study found that each additional kilometer of walking per day was associated with a 4.8% reduction in the likelihood of being obese.

Changes in the built environment[5] can have a large impact on child's everyday life. Some years ago, going to school on foot or by bicycle was a routine. Nowadays, an overwhelming majority of children go to school by motor vehicles. In particular, Belden *et al.* (2003) conducted a national random telephone survey of 800 adults in the US and concluded that most school-aged children (7 to 17 years old) are driven to school by either parents (53%) or a school bus (38%). This happens because schools are often too far away from home and even if they are close, urban growth patterns do not provide safe walking and bicycling routes. Furthermore, parents are reluctant to

let their children walk to school due to increased crime rates like kidnappings, crimes etc. Some schools even have policies against children walking or biking to school which according to a 1999 survey accounted to 7% of schools in the US (Dellinger and Staunton, 1999) (Dellinger, 2002).

In addition, over the last decades the hours of physical activity in school programs have decreased and most often, even during the gym class, children do not follow a program that helps them expend calories (Burgeson *et al.*, 2001; Grunbaum *et al.*, 2004). Parents try to close this gap by subscribing their children to extracurricular activities like gyms and athletic parks[6]; however, this is an additional economic burden that not all families can afford. Low-income families that live in neighborhoods with poor physical infrastructure, and most of the time dangerous and unsafe environments, cannot normally afford to pay for extracurricular activities. Given this, researchers consistently present evidence that residents of these areas are less active and have a higher probability of becoming obese (Black and Macinko, 2008; Yen and Kaplan, 1998).

Overall, it is becoming clear that trends in the built environment and lifestyle have resulted in reduced physical activities and consequently have played a role in the growth of childhood obesity. Ewing *et al.* (2003) adhere to the theory that urban sprawl has strongly increased body weight. They studied residents of metropolitan counties of US that participated in the 2000 Behavioral Risk Factor Surveillance System Survey and used a sprawl index based on four measures of population density for each county and control variables for age, sex, education, diet and smoking status. They found significant evidence of the positive association between urban sprawl and obesity. Similar evidence were found in studies by Lopez (2004), Loureiro and Nayga (2005) and Zhao and Kaestner (2010), although the latter pointed a relatively modest association. On the contrary, Eid *et al.* (2008) controlled for unobserved heterogeneity and found no evidence that urban sprawl causes obesity. Finally, Plantinga and Bernell (2007) did not treat urban sprawl as exogenous to weight, as previous studies did, but recognized the endogeneity between BMI and sprawl. In particular, they concluded that although individuals moving to dense neighborhoods lose weight, such areas are unlikely to be selected by individuals with high BMI.

Another factor that has garnered attention in the childhood obesity literature apart from the build environment is the change in labor force participation of parents, particularly those of mothers. This topic is discussed in the next section.

6. Obesity and parental labor force participation

There are two noticeable structural changes over the last thirty years in the labor market: the rising female labor force participation and the non-standard working hours for both genders. The inevitable effect of this recent family model[7] i.e., the dual-career family, is the limited time available for other activities beyond work, including childcare. Researchers have found that standard working hours and more parental involvement in child's activities decrease the likelihood of emotional and behavioral problems and improves well-being of the children (Mashberg, 1999, May 23 ; Strazdins *et al.*, 2004). Gutiérrez-Domènech (2010) concluded that if working parents finished their working day at (maximum) 6 pm, the time allocated to childcare would rise significantly. In addition, Courtemanche (2009) estimated that changes in labor force participation can account for 10.4% of the rise in childhood overweightness.

In general, one could claim that a working parent who faces difficulties in controlling his/her working time may agree with his/her spouse to compensate for his/her time not allocated to the child. However, mothers and fathers provide different childcare and have different impacts on their children's' nutrient intake and outcomes (McIntosh *et al.*, 2006). Gutiérrez-Domènech (2010) used data from the 2002-2003 Spanish Time Use Survey (STUS) and found that employed mothers provide almost three times as much time in basic primary childcare (e.g. feeding) than employed fathers, although insignificant differences were found in the time spent in quality primary childcare (e.g. reading) by both parents. This is why more and more scientists suggest that the growing maternal involvement in labor force may have a more detrimental effect on children's weight than paternal involvement since mothers tend to be more intensely involved with children's diet.

The rising female labor force participation has increased the opportunity cost of time of women. Working mothers do not follow the traditional allocation of time in home activities and they have limited time to invest in quality of diet (cook, prepare meals) and in physical activities with their children (Cawley and Liu, 2007; Loureiro

and Nayga, 2005). As a result, it is not unusual in dual-career families who value convenience to skip some meals or consume pre-processed and ready to eat meals. This type of meals are likely to be more caloric dense with lower nutritional value than home cooked meals (Cutler *et al.*, 2003). Furthermore, because of their limited spare time, parents cannot find enough time to play or exercise with their children[8]. Therefore, children may spend a lot of time in sedentary indoor activities (watching television, playing with game consoles, internet etc.), or in the care of others (after-school care, child caretakers) who may care less about the health of children than their parents (Anderson *et al.*, 2003a; Fertig *et al.*, 2009). Zhu (2007) analyzed data from the Longitudinal Survey of Australian Children (LSAC) and after addressing the problems of self-selection bias and endogeneity concluded that children of mothers who work have a slightly higher probability of becoming overweight/obese. Similar evidence have been found by García *et al.* (2006) and Möser *et al.* (2011) for European samples of children (Spanish and German respectively).

However, a strand of the literature about mother's labor supply on children's weight status argues that the main cause of the rising prevalence of childhood obesity/overweightness is the intensity of the work and not the working per se (Anderson *et al.*, 2003a; Courtemanche, 2009; Fertig *et al.*, 2009; Gutiérrez-Domènech, 2010; von Hinke Kessler Scholder, 2008). Analyzing data from the 1976-1995 Current Population Survey (CPS) matched with the 1971-1975 and 1988-1994 National Health and Nutrition Examination Survey (NHANES), Anderson *et al.* (2003a) found that an increase of 10 hours of work per week will increase the probability of a child being overweight/obese between 0.5% and 1%. Anderson *et al.* (2003a) did not investigate the channels for this effect although they discussed that working mothers may have less time to monitor the children and consequently, their children would spend a significant amount of time under institutional child care or grand parents' supervision. To this point, Coneus *et al.* (2009) estimated that a 10 hour rise in mother's working time per week can lead to an 11% increase in the probability of kindergarten attendance, which in turn may result in more exposure to poor quality foods. Other mechanisms that are affected by mother's labor force participation and simultaneously have an impact on children's BMI are the average number of meals, the time spent reading/talking/listening to music and the time spent

watching television (Fertig *et al.*, 2009). Although individually their magnitudes are rather small, they need not be cumulatively.

Other related dimensions of maternal employment, such as education level and the timing of employment (point in life of the child), are also considered to be important factors determining children's probability of being overweight/obese. Fertig *et al.* (2009) concluded that excess working hours of highly educated mothers have more detrimental effect on child's BMI than those of less educated mothers, which is consistent with previous findings by Anderson *et al.* (2003a) and Ruhm (2005). Even if highly educated mothers can hire someone to provide high quality care for their children during their time spent at work, this care appears to be of less value than mothers' direct care on their children (Araneo, 2008). Timing of employment has also been found to be significantly associated with an increase in the risk of the child becoming overweight or obese. For example, von Hinke Kessler Scholder (2008) showed that children of mothers who work full time during their child's mid-childhood have greater probability of being overweight at age of 16. Similarly, Chia (2008) using a dataset of children and their families across Canada predicted that a 10 hour increase in working hours per week in the period after the child's birth and before the child starts school will increase the probability of a child being overweight/obese later on to a range of 2.5% to 4%.

In contrast to the above cited studies, Johnson *et al.* (1992) reject the causality between maternal employment and obesity after analysing data on 442 child participants from the 1987-1988 Nationwide Food Consumption Survey. They concluded that the sample's nutrient intake is not directly related to maternal employment status. In fact, one could claim that when a mother works, she has more money to spend on childcare, healthful meals and extracurricular sports activities, which could then keep the children away from limited and unhealthy choices made at home. Even the argument of the detrimental effects of irregular bed and breakfast time on children's health seems weak. Anderson (2010) concluded that although these are correlated with child weight, they cannot explain the association between maternal employment and childhood obesity. Gutiérrez-Domènech (2010) examined the quality of primary childcare between working and non-working parents and showed similar results. In addition, she concluded that parents who work reduce their time spent with children much less than an hour for every hour spent in the labor market. Goldberg

and Lucas-Thompson (2009) found that mothers who work full-time spend only 100 minutes less per day with their children than do non-working mothers. They also pointed that mothers who work generally reschedule their activities so that they can use their time with children creatively, engage in interactive and social activities, and spend more time of their free time (non-working time) with their children.

7. Obesity, Schooling and School Environment

The school environment is of great importance because children spend a great deal of their time in schools and are bounded by the options offered at schools. Among all other activities, children consume some of their every day meals and are possibly engaged in physical activity during time spent in school. In this sense, parents' choice for their child's school (where children grow, are educated and acquainted with healthy or unhealthy eating habits) creates part of the environment that their child grows in. Consequently, schooling could act in a health promoting way through knowledge.

Kenkel (1991) found that more schooling was related to healthier lifestyle choices regarding smoking, drinking and exercise which is consistent with Anderson et al.'s (2011) conclusion which stresses that school exposure, per se, seems unlikely to cause weight gain. Unlike Kenkel's findings, Nayga (2000), after controlling for diet-disease health knowledge, concluded that the effects of schooling on weight outcomes and the probability of being obese are due to differences in individual knowledge. In addition, Jürges et al. (2009) analysed data from the German Microcensus and found no causal effect of education on reduced overweight and obesity rates, although they did find causality among other health behaviors such as smoking. Furthermore, Nayga (2001) showed that schooling has a significant negative effect on the probability that a person becomes obese, while health knowledge has a negative effect on the probability that a female (but not a male) becomes obese. The causal effect of education on the probability of overweight and obesity among multi-country European[9] females was investigated by Brunello *et al.* (2010) as well; they found that schooling has a protective effect on BMI. In all, these results point that governments should aim to increase individual health knowledge probably through more schooling to succeed in the fight against obesity. In fact, it has been reported

that increased expenditures on educational policies can have a significant effect on decreasing weight outcomes (Loureiro and Nayga, 2005; Nayga, 2000).

Further on this point, Cawley (2007) claims that governments act through schools in place of the parents and have some control on children's behavior by regulating the choices offered in schools. Children are susceptible to the school environment since a great percentage of them participate in subsidised school lunch programs if offered in their school and many consume food from the cafeteria and vending machines that are available at schools. Unfortunately, researchers have concluded that school lunch programs in US often fail to meet nutritional requirements (Gleason and Suitor, 2003; Schanzenbach, 2009). Specifically, Schanzenbach (2009) used a panel data set that followed over time, children that participated in the National School Lunch Program lunch (NSLP). She found that children that consume school lunches are about 2% more likely to be obese than children that bring lunches prepared at home, all else equal. Similar findings are presented by Millimet (2010) who concluded that NLSP is contributing to childhood obesity. However, he did not find similar evidence for the School Breakfast Program (SBP). On the contrary, Gleason *et al*. (2009) found no significant relationship between NSLP participation and students' BMI, although they found that students who participated in SBP exhibited significantly lower BMI. In fact some years before, Veugelers and Fitzgerald (2005) analysed a sample of Canadian elementary school children who participated in school healthy eating programs and concluded that these children had healthier lifestyle (healthier diet and more physically active) and exhibited lower obesity rates. Moreover, Howard and Prakash (2011) found evidence that students of subsidised programs consume significantly higher amounts of vegetables, fruits and juices than unsubsidized students and that they adopt healthy dietary patterns over a time period longer than one school week. A more recent study records a different aspect counter to the mixed results presented above. Campbell *et al.* (2011) showed that the NSLP affects the participants' dietary outcomes (i.e., increased vitamin, mineral and fat intakes), which is consistent with previous cited findings, but this effect is not due to quality differences but rather to higher quantity of food consumed by the NSLP participants.

Lunch meals offered by school lunch programs are not the only food offered in schools. The availability of ready-to-eat convenience foods containing high levels

of saturated fats, salt, or sugar, snacks and beverages inside (school cafeterias and vending machines) and outside school campuses has increased over the last decades (Anderson *et al.*, 2003b; Anderson and Butcher, 2006a). Anderson and Butcher (2006b) found that these products are usually adopted by schools which have lower financial resources. They concluded that students with a genetic or a family susceptibility to obesity will exhibit a 2% increase in their BMI, if the access to junk food in school increases by 10%. In addition, positive associations have been found between a meal's fat content and the presence of a la carte foods and vending machines, which are thought to indirectly affect the nutrient content of USDA-subsidized meals (Newman *et al.*, 2009). These findings are consistent with the findings presented by O'Toole *et al.* (2007) who concluded that elementary and middle schools with vending machines and access to junk food have increased since 2000. Furthermore, the increasing number of fast food restaurants around the school district is pretty deleterious to children's BMI. It is estimated that a fast food restaurant within 0.1 mile of a school results in a 5.2% increase in obesity rates (Currie *et al.*, 2010). Alviola *et al.* (2011) also found that the impact of fast-food restaurants on school level obesity rates is greatest when they are within a quarter of a mile of schools and this impact declines as distance between the school and fast-food restaurants increases. Therefore, children are recipients of fairly confusing messages; in the classroom they are taught about healthy eating and lifestyle (if at all) while at the same time they are surrounded by an obesogenic environment created by the school itself. This should prompt researchers to study how to overcome deficiencies created by the school environment on children's' choices. Just *et al.* (2008) found that college students that used a prepaid card that allowed them to buy only healthy foods, made more nutritious choices than students that used either cash or general debit cards. One could therefore apply this idea to younger-school aged children by allowing parents (instead of their children) to pre-commit to healthful meal options, which could result in increased consumption of healthier foods.

Food consumption is only one part of the picture on the effect of schools on obesity rates. Although the research is more limited, researchers have also focused on the effect of physical activity during school on students' BMI. School physical activities include school physical education, the available play or gym equipment in school and the available type of after-school child care. Cawley *et al.* (2007)

investigated the effect of physical education time in schools on student's BMI and the probability that a student is overweight/obese. They concluded that such an effect does not exist, although they recommended future research to focus on fat and muscle measurements, rather than BMI, since it is possible that increased physical education decreases fat and increases muscle with no net effect on BMI. As far as the after-school child care is concerned, some researchers claim that it is more important not to leave the child at home unobserved (Anderson *et al.*, 2003a; Chia, 2008) than to worry about the type of care (physically active or less active) the child receives. Although research on the impact of in-school physical education and obesity is rather limited, the benefits of physical activity on health in general (Maffeis, 2000; McGinnis and Foege, 1993) and the economic costs of physical inactivity (Chenoweth and Sugerman, 2005; McInnes and Shinogle, 2009) are well documented. A good way to go forward with this is for schools is to find ways to incentivize children, through monetary and non-monetary competitions and symbolic awards, (Johannesson *et al.*, 2010) in order to actively engage them to a less sedentary way of living.

In addition to food, school and built environments discussed above, individual time preferences are also now considered an important factor that influences how people behave health wise. This issue is covered in the next section.

8. Obesity and time preferences

Although the relationship of time preferences and health outcomes has been largely recognized in the economics literature, the relation of time preferences to obesity rates had remained unexplored until the last decade. Time preference is the rate at which people are willing to trade current utility for future benefit (see Frederick *et al.* (2002) for an in depth treatise). Grossman (1972) used the concept of time preference and future utility to analyze health choices followed by Fuchs (1982) who concluded that a number of health choices, such as diet, exercise and smoking could be explained by differences in the rate of time preferences. In addition, Ehrlich and Chuma (1990) argued that individuals, who have high rates of time preference, will have a relatively low demand for future health capital and longevity. This has been reported as a positive correlation between time preference rates and unhealthy behavior (Scharff, 2009).

Many other studies have enhanced the significance of time preferences for health behavior/outcomes. Komlos *et al.* (2004) used the concept of time preference in international cross-sectional macro data to, in part, explain the obesity epidemic and found that this connection is plausible. Individuals with high rates of time preference prefer current utility to future potential health benefits. Therefore, in order to enjoy immediate gratification they consume high-calorie convenience foods and invest less in physical activity, resulting in weight gain and increased risk of obesity. Komlos *et al.* (2004) developed a model in which individuals maximize their lifetime utility according to consumption of goods and services, expected lifetime and marginal rate of preference, and used the saving rate and household debt ratio as proxies for time preference. This theory is consistent with findings by Zagorsky (2005) and Smith *et al.* (2005). Zagorsky (2005) concluded that there is an inverse relationship between BMI and net worth, suggesting that BMI changes are potentially negatively related to saving rates (which later on in the economics literature are commonly used as proxy for time preference). Smith *et al.* (2005), after breaking the data down by gender, found that higher time preferences are associated with greater BMI among men and to a lesser extent among women. They also concluded that there are ethnic differences in the effect of time preference on BMI which may relate to cultural beliefs and attitudes towards body image. This finding is supported by Zhang and Wang (2004) who found that ethnicity, gender and family cultural history have an impact on time preference and health behaviors of individuals.

A strand of the literature (Loewenstein and Prelec, 1992; Thaler, 1981) criticizes the assumption of a constant rate of time preference and instead, argues that individuals' time preference vary by the time horizon faced. In particular, individuals exhibit a higher level of impatience in decisions involving immediate gratification than they do in the case of delayed gratification in the distant future. These rates of time preference are characterized by a hyperbolic or a quasi-hyperbolic functional form. Although plenty of investigation has been done on the hyperbolic discounting associated with general behavior, little research has been made on the association between the hyperbolic discounting and obesogenic behavior. Cutler *et al.* (2003) stated that hyperbolic agents take decisions about food consumption that may lead to exceed optimal levels and eventually to obesity for some of them. Shapiro (2005) presented evidence that behavioral health questions, such as food consumption, are

strongly consistent with quasi-hyperbolic discounting. Scharff (2009) is perhaps the first study which tested the hypothesis that individuals acting in a manner consistent with hyperbolic discounting are more likely to be obese. He used a sample from the 1994-1996 Continuing Survey of Food Intakes by Individuals and concluded that there is a correlation between obesity and hyperbolic discounting. Ikeda *et al.* (2009; 2010) took the literature one step further and showed a strong effect of time discounting and time discounting anomalies on BMI and the probabilities of being obese, severely obese, and underweight, by building a model where impatience, hyperbolic discounting and sign effect[10] are included.

While the issue of time preference and hyperbolic discounting and their role on weight gain is still an open research agenda, there is little doubt that children are not perfectly rational even with extensive information, and have time-inconsistent preferences. Although children may be persuaded by their parents to commit to a strategy that maximizes their health in long term, they consistently succumb to unhealthy temptations and short-term gratification. Children's inclination to time-inconsistent preferences along with the evidence presented by O'Donoghue and Rabin (2002) that self-control problems create a tendency to over-consume addictive products[11], fits well with the increasing childhood obesity trend.

Given the current epidemic of overweight and obesity, it seems prudent to find ways to encourage people to lower their time preference and place more value on their future well-being. Hence, if we take into consideration the claim of Maital and Maital (1977) that time preferences are probably nourished during childhood, future research could focus on finding out ways to lower the time preference of parents and their young children to help them overcome their temporally inconsistent preferences (e.g., through commitment mechanisms[12].

9. Informational causes of obesity

Consumers make decisions about their caloric intake and caloric expenditure with imperfect information (Cawley, 2007). In particular, they generally lack credible nutritional information on the nutritional value and caloric content of foods consumed either at home or away from home and also lack information about the health consequences of their actions associated with poor eating habits and high levels of inactivity. Even when information is present, sometimes it is too complicated for the

average consumer and requires significant time investment to be processed and comprehended.

Sometimes, information may be intentionally provided to be unclear or misleading that could eventually make consumers misinterpret the information signal with deleterious results for their health. Frazao and Allshouse (2003) found that consumers have misinformation or misperceptions about the nutritional value of food they eat in general. Cawley (2006) pointed that this misinformation or lack of information about the caloric content is typically observed in foods consumed away from home. The degree of consumers' misperception regarding the diet quality was analyzed by Variyam *et al.* (2001). They estimated that 40% of the people who prepare the meal in their household perceive that the quality of their diet is better than their actual diet is.

When it comes to children, information is more likely to be poor and obscure. Even if information is full and credible, children are not what economists call "rational consumers" (Cawley, 2006) and this is why they are incapable of evaluating the future consequences of their actions as they weigh present gratification (e.g. taste) more highly than future benefits (e.g. stable weight). Thus, it is important for food companies to attract children's' attention in order to manipulate their preferences and eventually prompt them to pester their parents to purchase the company's products (Wooten, 2003). Even in the majority of occasions where children do not have the freedom to buy their own food and parents are the ones who purchase the food for them, children's persistent request (also known as "pester power") over a certain food could eventually persuade parents to give in.

Dissemination of information has become the target of many public programs and policies. Governmental education campaigns give credible information about nutrition and the health benefits of physical activity. This kind of information is presented to people through media, reports for doctors and patients and school dietary teaching classes. However, the governmental information dissemination campaigns are, most of the time, drown out by food industry advertising (Cawley, 2007). Other public policies of governments and non-profit organizations include mandatory food labelling and caloric posting in fast food restaurants which aim to provide accurate information to the consumer.

The introduction of nutritional labelling in the US brought significant changes in the way information on nutrients and calories is disseminated to consumers. Even

though nutritional labelling allows consumers to make healthier food choices, obesity rates have been rising even after the mandatory disclosure of nutrition information on labels. Results with respect to the effectiveness of nutrition information on improving health outcomes have been mixed. Kim *et al.* (2000) found that the use of nutritional labels tends to reduce the daily intake of total and saturated fat, cholesterol and sodium, and tends to increase intake of dietary fiber. In addition, Mathios (2000) pointed that after the introduction of salad dressing labels, an increase in low-fat salad dressing purchases occurred with a simultaneous decrease in the high-fat dressing purchases. However, Variyam (2008) after controlling for the confounding effects of unobserved label user characteristics concluded that although nutritional labelling contributes to higher fiber and iron intakes, there is no evidence that it is associated with a reduction in total fat, saturated fat, or cholesterol intake. Variyam and Cawley (2006) compared body weight data in the US in 1990 before and after the implementation of labelling required under the Nutrition Labeling and Education Act (NLEA) and concluded that labelling was associated with significantly lower BMI and decreased probability of obesity but only among non-Hispanic white women. Similarly, Drichoutis *et al.* (2009) used data from the 2005-2006 NHANES and did not find a significant effect of nutritional label use on people's BMI. Previous studies have also generally found that women are more likely to read nutritional labels than men (Mandal, 2010) and that unemployed individuals are more likely to read nutritional labels than employed individuals, probably because using food labels is time consuming (Nayga, 2000).

Another way for policy makers to disseminate health information is through mandatory posting of nutrient content on menus in food away from home establishments. This issue has gained significant attention since the rise of fast food consumption has been considered responsible for the rise in obesity rates (McCann, 2004). Bollinger *et al.* (2011) examined the impact of mandatory calorie posting on consumers' purchase decision using data from Starbucks company stores, before and after the legislation[13] that mandated the presence of nutrition labeling for restaurants. They concluded that caloric posting influences consumer behavior and the effects are long lasting. Particularly, they estimated that the average calories per transaction decreased by 6% but the average calories per transaction from beverage purchases did not change considerably. A more recent study (Stutts *et al.*, 2011) examined whether the extra nutritional information in the fast food menus or a symbol indicating the

healthiness of the food affected the purchase decisions of 6-11 year old children. They found that a health symbol in menus have more impact on the children's meal choice than nutritional information in menus, especially for children who visit fast food restaurants at least once a week.

However, the aforementioned policies for dissemination of credible information mostly influence adults' choices rather than children's. A strand of the literature has emphasized the impact of advertising on children's diet and weight outcomes. Advertising signals information about the product to children but it may be more than simple information transmission about the nutrient contents of the food product; it is a way of marketing the product and consequently it can manipulate children's food choices. According to Kovacic *et al.* (2008), 44 major food and beverage marketers in the US spent $1.6 billion in 2006 to promote their products to children under 12 and adolescents ages 12 to 17; the overall spending on advertising and promotion directed at children grew from $6.9 billion in 1992 to $15 billion in 2002 (Wooten, 2003). Furthermore, Kunkel (2001) estimated that the average American child in 1970s watched 20,000 television advertisements per year and that this numbered increased to 40,000 advertisements per year in the late 1990s. Kunkel pointed out that these estimates include only TV commercials.

However, the amount of exposure to food and beverages advertisements is not uniform across ages. In particular, Gantz *et al.* (2007) found that children 8–12 years old watch more food advertisements than children of other ages. This is due to the fact that children between 8–12 years watch more TV and is therefore the group most affected and targeted by food marketers. This is consistent with the findings by Burros (2005, December 7) who concluded that television advertisements mostly influence the food preferences of children under 12, thus contributing to unhealthy food choices of these children. The age differential is very important because age is closely related to children's cognitive ability and cognitive ability is central to interpreting and decoding television advertisements. Therefore, cognitive differences among the age groups can lead to varying attitudes towards advertisements, different levels of vulnerability to deceptiveness and consequently to varying demand for the commercialised products (Oates *et al.*, 2002; Priya *et al.*, 2010). In fact, children's excess weight status has been found to be related to the quantity of advertisements per hour broadcasted on children's television (Lobstein and Dibb, 2005).

Recent work on food advertising clearly highlights the severity of the impact of fast-food advertising on childhood obesity rates. Chou *et al.* (2008) analysed data of US children and their families' background and found a strong positive effect of fast-food restaurant advertising on the probability that children and adolescents are overweight. In particular, they found that the effect is stronger for males than females. For boys aged 3-11 years old, increased exposure to fast-food advertising by half an hour per week results to a 15% increase in the number of overweight boys in the population. For girls of the same age the effect seems to be less in magnitude (a 12% increase in the number of overweight girls in the population). This effect is not restricted to studies using US data. Chang and Nayga (2009) analyzed data drawn from the National Health Research Institute of Taiwan (NHRIT) in 2001 and showed that it is important for policy makers to encourage a fast-food advertising ban in order to decrease the risk of childhood overweightness and obesity. Similar findings were presented by Garde (2008) who suggested tighter marketing regulation in European Union member states.

Nowadays, TV advertising is not the only tool that food marketers use since food companies have increased their use of other media and marketing venues in order to reach children. Product packages with children's heroes (cartoons), toys in boxed meals, web sites, advergaming[14], billboards at bus stations into the school district, banners in school vending machines and children's magazines are a few new venues. Companies are now using these new ways to target children in response to tighter governmental food television advertising regulations imposed lately in many parts of the world. Indicative of the intensity of food marketing is the fact that the food industry is the second largest advertiser in the US, right behind the automotive industry (Story and French, 2004).

10. Obesity, Socio-cultural status and Social networks

The behavioral and socioeconomic literature posits that for centuries, body image was used as a gauge of socioeconomic status and cultural beliefs. Fat was often considered to be a sign of good health and prosperity and thinness was a sign of poverty. Nowadays this image has been reversed, although some developing populations still value fatness highly (Monteiro *et al.*, 2004).

Generally, researchers have highlighted a strong association of low socioeconomic status of adults and children [e.g., population groups with high poverty rates and low education (Drewnowski and Specter, 2004)], ethnic minority groups (Kumanyika, 2002), and immigrants (Ali and Crowther, 2009)) to excess weight. In particular, Goldblatt (1965) using a sample of 1,660 adults representative of a residential area in midtown Manhattan, concluded that women of low socioeconomic status are six times more likely to be obese than women of high socioeconomic status. In addition, Zhang and Wang (2004) after applying the concentration index (see Wagstaff *et al.* (1991)) found that gender plays a crucial part in the differences of the degree of socioeconomic inequality in obesity. Specifically, they found that the inverse association between socioeconomic status and obesity is stronger in women than in men. For youths, the perception they have about their weight compared to their ideal weight standards and social norms is strongly influenced not only by their current socioeconomic status, but also by the socio-cultural environment at home during childhood (Baum II and Ruhm, 2009; Thompson *et al.*, 1997). Therefore, it is possible that overweight children who grow up in obesogenic home environments have higher ideal weights and different social norms than normal weighted children.

However, in raising a child, the home environment is only one part of the picture. Children are also significantly affected by their communities where they are trying to gain social acceptance. Children's behavior is strongly influenced by the behavior of those in their classroom or in their neighbourhood and that of their friends. The new wave of economics literature on the role of social interactions (see Zanella (2004) for more details) stresses that the social context can be a powerful motivator of human behavior. If the social interactions and impact are strong enough they can lead to the existence of a so-called social multiplier effect [See Glaeser *et al.* (2003) and Glaeser and Scheinkman (2001)] which could partly explain the rapid growth of obesity over the last years.

The assumption that people desire to have a weight close to other people's weight has been largely used in recent literature in order to construct models of weight problems related to social norms (Burke and Heiland, 2007; Etilé, 2007). However, lately many studies have recorded evidence of imitative excess body weight status within social networks such as classroom mates, household members, friends and colleagues (Blanchflower *et al.*, 2011; Carrell *et al.*, 2011; Christakis and Fowler,

2007; Costa-Font and Gil, 2004). In particular, Blanchflower *et al.* (2011) using data from European citizens and considering that a person's utility may depend on relative weight, concluded that obesity could be contagious within networks where people subconsciously compare themselves with each other and emulate their weight with that of their peers. It appears that interconnections among friends strongly influence weight status of each other. Christakis and Fowler (2007) estimated that a person is 57% more likely to become obese if s/he has a friend who is obese. Carrell *et al.* (2011) also found that poor physical fitness spreads among friends. Interestingly, weights among siblings and spouses tend to be less correlated with each other than among friends (Carrell *et al.*, 2011; Christakis and Fowler, 2007). This indicates that social distance is more crucial on people's weight status than geographic distance within social networks (Christakis and Fowler, 2007).

However, Cohen-Cole and Fletcher (2008) have been critical of Christakis and Fowler's (2007) work, arguing that shared environmental factors can cause the appearance of social network effects. In fact, Cohen-Cole and Fletcher (2008) replicated the Christakis and Fowler results using their specification and a complementary dataset and showed that there is weak evidence of endogenous social interactions and that it is difficult to distinguish social network effects and environmental factors of weight gain. A non strong causal effect of social multipliers on body weight is also found by Auld (2011). He concluded that body weight outcomes (analyzed at the country/state level) could be more attributed to social norms that affect body weight, unobserved prices and other contextual effects than to social multipliers. Despite all the criticism, policymakers can not completely rule out the possibility of the social spread of childhood obesity. However, more research is indeed warranted to definitively assess the impact of social networks or peers on the growth of childhood obesity. We stress that these causative factors may not be discrete but rather multi (and inter) dimensional.

11. Conclusion

This paper has reviewed the literature in economics and related disciplines associated with childhood obesity. In light of the recent dramatic rise in childhood obesity rates, identifying the factors that have contributed to this growth is becoming the target of many studies from diverse disciplines. This literature review survey

indicates that there is multitude of factors that can act as possible contributors to childhood obesity. It is known that genetic susceptibility and heredity are major contributors to this problem; however they cannot explain the recent rapid growth by themselves since many complementary behavioral and environmental changes have simultaneously contributed to the obesity epidemic.

The literature on childhood obesity is by no means settled. The results of the studies surveyed are often mixed and still an open research agenda. The high costs of obesity as well as the high costs of public interventions coupled with undesirable results in some cases make the identification of the major causes of childhood obesity essential and necessary for efficacious policy responses. We conclude that childhood obesity is a complex problem interlinked with a variety of factors including parental factors, time preference and allocation of time, neighborhood structure or built environment, socio-cultural factors, social interactions, school and informational policies. Undoubtedly, more research is needed to further examine the causes of childhood obesity and to test the robustness of the findings of previous studies discussed in this review. Future studies must also consider not just the important factors influencing childhood obesity but also the complexities and potential interactions between these factors especially when making social welfare judgments and recommendations[15] due to possible tradeoffs and heterogeneity issues involved when dealing with public policy.

12. References

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Notes

[1] Levy (2002) defines as a rationally optimal weight trajectory the weight trajectory associated with the food-consumption path which maximizes the individual's expected lifetime-utility.
[2] One may argue that in certain circumstances, environmental and social factors constraint adults' food choices as well.
[3] Admittedly, these theories are parental closed-world theories and do not reflect on the influence of other environmental systems. Bronfenbrenner (1979) developed an alternative child development model, the Ecological Systems Theory which holds that child development reflects the influence of five environmental systems namely the microsystem, mesosystem, exosystem, macrosystem, and the chronosystem.
[4] Wansink (2004) found that individuals would eat more when given larger portions [which is consistent with previous findings by Rolls *et al*. (2002)] even when they had great distaste for the food. Geier *et al*. (2006) have termed this situation "unit bias".
[5] The built environment has been defined by Sallis and Glanz (2006) as "roads, building, neighbourhoods, food sources and recreational facilities in which people live, work are educated, eat and play".
[6] However, Cawley *et al*. (2007) criticized the effect of physical education on body weight as they concluded that more days of physical education have no measurable effect on BMI.
[7] It is worth noting that the dual-career family model in US was the product of post-world war II period that first took women out of the labor market (veterans reclaimed millions of factory jobs), then placed them into the role of mothers (hence the baby boom generation) and then transformed women into nation's primary consumer (Ayers *et al.*, 2009, pp.793). The new consumer society, however, led women back into the labor force and gradually gave rise to the dual-career model.
[8] Even if time is not limited it may be that non-working time is directed to other things than cooking and playing with the children. For example, cooking may be seen as discretionary time while television watching is not.
[9] The countries included in this dataset are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Portugal, Spain, Sweden and the United Kingdom.
[10] Quoting from Ikeda *et al.* (2010) "*the sign effect makes people reluctant to borrow because persons who operate under this effect require a more favorable (i.e., lower) interest rate to borrow than they would to save* (Loewenstein and Prelec, 1992)…*Similarly, the sign effect induces people to control*

food consumption and avoid the future costs of obesity, such as the hardships associated with dieting and the costs of obesity-related medical care."

[11] Richards *et al*. (2007) showed that specific food nutrients are strongly addictive (e.g. carbohydrates and fat).

[12] See, for example, Burger and Lynham (2010), Giné *et al*. (2010), Goldhaber-Fiebert *et al*. (2010) and http://www.stickk.com/

[13] The Patient Protection and Affordable Care Act passed by the federal government in March 2010.

[14] Advergaming is a portmanteau of "advertising" and "gaming" and defines the practice of using (online) video games with embedded brand messages to engage a target audience.

[15] See discussion in Bhattacharya and Sood (2011).