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Knowledge is Power: School-Based Nutrition Education and Childhood Obesity

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Abstract: The obesity epidemic is a growing problem. Adolescent and childhood obesity is compounding the already high obesity rates in the United States. If something is not done, almost all adults in the U.S. could be overweight or obese by 2048. The costs associated with obesity are immense, with over one-fifth of annual medical expenses being obesity-related, and they are only expected to increase. In order to reduce the escalating obesity crisis, intervention is needed. This paper analyzes the impact of school-based nutrition education programs on obesity and overweight rates among students of low socioeconomic status in elementary schools, and, furthermore, how such programs could maximize their impact on obesity and overweight reduction in such schools. I find that school-based multicomponent nutrition education and obesity prevention programs focused on both healthy eating and increased physical activity lower BMI percentiles and alleviate health risks for children. Going forward, there should be a focus on implementing long-term obesity prevention programs, especially in rural schools, low-income schools, or schools with a higher prevalence of 'at risk' youth in order to fulfill an individual's nutrition capabilities.

Global and domestic obesity is rising at an increasing rate. The health ramifications connected to obesity are extensive and could arguably be quantified as a health crisis. In order to comprehend the growing health crisis associated with obesity, it is necessary to understand exactly what obesity is. Obesity is defined as having a Body Mass Index (BMI) greater than thirty whereas overweight is defined as having a BMI greater than 25 (Drewnowski, 2004). As many characteristics are disproportionate in America, obesity is also disproportionately skewed towards low-income individuals (Ogden, C L, Carroll, 2006). Since obesity is predicted to increase throughout the twenty-first century, something needs to be done to address the growing problem, especially with regards to low-income individuals and families. What better place to start than with the future of America – children. This paper will analyze the impact of school-based nutrition education programs on obesity and overweight rates among students of low socioeconomic status in elementary schools, and, furthermore, how such programs could maximize their impact on obesity and overweight reduction in such schools.

The structure of the paper is as follows. In section one I will begin by outlining the costs of obesity and why we need to address the ongoing crisis. In section two I will describe the capabilities framework and why obesity is morally unequal. In section three I will address the poverty and obesity relationship, emphasizing the 'at risk' populations. In section four I will provide an analysis of school-based nutrition education and obesity prevention and intervention programs. In section five I will address the alternative, family-based intervention programs. In section six I provide a discussion and recommendations.

I. The Costs of Obesity

The costs associated with the ongoing obesity epidemic are overwhelming. To put things into perspective, the estimated health care costs of obesity-related illnesses equal 190.2 billion U.S. dollars, which makes up almost 21 percent of annual medical spending in the United States. The current medical costs associated with childhood obesity alone are over 14 billion U.S. dollars. The costs for disability and unemployment benefits are also increasing at an increasing rate ("Economic"). If the obesity trend continues at the current rate, the obesity-associated cost burden will incur irreversible damage (Wang, 2008). The medical expenditures associated with current obesity rates are projected to be 549.5 billion U.S. dollars within the next two decades ("Economic"), and potentially as high as 860.7 billion U.S. dollars (Wang, 2008). If a small portion of this cost were put towards educating America's population, especially future adults, in how to live healthy lifestyle, the costs would be diminished innumerably.

The direct and indirect costs of obesity are detrimental to wide-ranging firms and individuals. Businesses and organizations that stimulate jobs and growth in U.S. cities are being driven out or going under ("Economic"). A recent study predicted that, if obesity keeps increasing at its current rate, not only would all American adults would become overweight or obese by 2048, but also the current generation will have a shorter life expectancy (Wang, 2008). Figure 1 demonstrates the trend in obesity from 1976 to 2004 and the projected trends for men, women, and children. If these predicted numbers are similar to what we will see in the future, we need to act now in order to prevent the majority of Americans from becoming overweight.

Obesity has countless detrimental consequences including health, social, psychological, and economic distress for both the individuals affected and society at large

(Wang, 2008). The numerous health ramifications, including, but not limited to, a greater likelihood to develop cardiovascular disease, hypertension, diabetes, and several types of cancer, place a toll on economic, social and political sectors (Drewnowski, 2004, Wang, 2008, Seguin, 2014)). In addition to the various chronic diseases obesity exposes an individual to, there are also many psychological health problems associated with obesity, especially if it begins at a young age (Bailey-Davis, 2012). Obesity is no longer solely a health issue, but also a social problem, a social problem that is morally unequal.

II. The Capabilities Approach

Renowned economist and philosopher Amartya Sen developed a capabilities framework to evaluate and address human well-being and development. Sen incorporated the theories of Aristotle, Karl Marx, and Adam Smith to establish a differing approach to the dominant growth approach – the capabilities approach (Wells). The capability approach "sees human life as a set of 'doings and beings' – 'functionings' – as it relates to the evaluation of the quality of life to the assessment of the capability to function (Sen, 2003)." The capabilities approach is a valuable way to approach the question of fundamental entitlements and rights (Nussbaum, 2003). By assessing the quality of life and "evaluating functionings and the capability to function," human well being in its truest form can be measured. Every human has the right to basic capabilities that secure the freedom to be able 'to do' and 'to be' (Sen, 2003). By focusing on what people are actually able to do and to be, inequalities of resources and opportunities such as educational attainments and nutritional opportunities are put in the foreground of the discussion (Nussbaum, 2003).

Sen's framework includes several terms that are crucial in the understanding of

the capability approach. Resources are an input that depends on their personal physiology, social norms, and physical environment. Capabilities are the valuable functionings that an individual has access to. Achieved functionings are the functioning that the individual selects. Conversion factors establish and secure the relationship between a good and the achievement of certain beings and doings. Sen uses 'capabilities' not to "refer exclusively to a person's abilities or other internal powers but to refer to an opportunity made feasible, and constrained by, both internal (personal) and external (social and environmental) conversion factors (Robeyns, 2011)." The language of capabilities leaves room for choice, which is essential when discussing human rights and opportunities. There is a big difference between pushing people into functionings in way that may seem valuable and leaving the choice up to the individual (Nussbaum, 2003).

Since Sen's development of the capability approach, Martha Nussbaum has expanded upon his framework. Nussbaum's theory is founded on "respecting human dignity," whereas Sen is more concerned with "enhancing individual freedom (Wells)." Nussbaum outlines ten central human capabilities that are crucial in allowing what "people are actually able to do and to be." Two of these ten capabilities are bodily health and play. Bodily health and play capabilities are basic capabilities needed to form more advanced capabilities, which means that they are basic and central aspects to a functioning life. A society that neglects a central human capability to one individual in order to promote others is shortchanging its citizens, and "there is a failure of justice in the shortchanging (Nussbaum, 2003)." Sen and Nussbaum agree that it is "not sufficient to know the resources a person owns or can use in order to be able to assess the well-being that he or she has achieved or could achieve; rather, we need to know much more

about the person and the circumstances in which he or she is living (Robeyns, 2011)."

An individual should not be punished for having an inadequate amount of money that hinders their ability to fulfill their basic functionings. Prolonged obesity obstructs numerous capabilities. However, in this paper, I argue that the lack of knowledge about a healthy life and physical activity, especially with regards to children, acts as a major barrier to two basic and central capabilities – bodily health and play. Bodily health and play are both basic and central aspects to be able to achieve a free and functioning life. Going forward, I lump bodily health and play together to form the concept of nutrition capabilities. In the next section I will describe the poverty – obesity relationship with regards to nutrition capabilities.

III. Poverty and Obesity

As time progresses, more Americans are becoming overweight and obese. Countless studies have been done to determine why there has been a stark increase in obesity rates since the turn of the century. In turn, each study has discovered a relationship between the growing population of low-income individuals and the rising rates of obesity. During the past several decades, studies have established that poverty is associated with a higher risk of obesity. At first this may seem counterintuitive because less disposable income would tend to mean less money spent on food. However, wealth inequality promote high-caloric intake because easily accessible, cheaper foods are typically high in salt, fat, and sugar (Bratanova, 2016). There are barriers to healthy eating and physical activity for people of varying socioeconomic backgrounds. However, research suggests that there are three prominent 'at risk' populations for obesity, – minorities, low-income families living in rural areas, and children – with the underlying

commonality being low socioeconomic status. This confirms the established premise that poverty in America is unequally distributed.

The first mechanism for a higher risk of obesity is people of low-income status residing in rural communities. Low-income families and individuals face innumerable barriers compared to people and families above the poverty line. When looking specifically at the differences in disparities of rural, low-income schools and urban schools, Bailey-Davis found that adults and children living in rural areas and in socioeconomic distress demonstrated a significantly higher prevalence of obesity than families living in more urban, metropolitan areas (Bailey-Davis, 2012).

In a study completed to quantify the barriers associated with healthy eating for low-income, rural families, it was found that healthy eating barriers consisted largely of cost, frequency of eating cheap, unhealthy foods away from home, and large, dense portion sizes served at home when available (Seguin, 2014). Access to healthy, affordable foods is problematic to find in rural areas. The small grocery and corner stores may lack high-quality, healthy options, and without the knowledge or means to have a small garden, there are not many alternatives to healthy food (Seguin, 2014, Chopra, 2015). In my experience from living in a food desert and working directly with food insecure families in Greensboro, North Carolina, I can confirm that both proximity and affordability to healthful foods are massive barriers to achieving a healthy lifestyle.

The second mechanism of being 'at risk' for obesity due to the obesity, poverty connection is being a minority in America. The two largest minorities in the United States are African Americans and people of Hispanic origin, with more than one in four Americans belonging to one of these two minorities (Gradín, 2012). Blacks and

Hispanics show poverty rates over twice as high as those who are non-Hispanic Whites, and together, make up half of all poor Americans (Gradín, 2012). Figure 2 illustrates the prevalence of obesity among adults is highest for Hispanic and non-Hispanic blacks for both men and women (Ogden, C L, Carroll, 2015).

A recent study assessing the reason for disproportionate poverty rates among ethnic and racial minorities in America established that demographic, education and labor-related factors acted as defining variables in socioeconomic status. Both minorities share different combinations of factors leading to socioeconomic and demographic deprivation patterns including less education overall, less health insurance coverage, larger risk of being in prison, more dependent children in their families, larger share of female-headed families, especially single mothers, and a higher risk of being unemployed or low-paid workers (Gradín, 2012, Painter 2016). All of these factors could contribute to a lack of access to healthy food due to income, proximity, knowledge, and time. However, the two main barriers for low-income families, including both minorities and families residing in rural areas, to a healthy lifestyle full of healthful food and physical activity include the cost of healthy food and lack of time to engage in physical activity due to working many hours and being far from work (Seguin, 2014). For clarification, higher obesity rates cannot solely be attributed to extreme poverty among minorities, rural communities, or unequal societies in general. The number of individuals identified as obese or overweight and have obesity-related health conditions is rising among all levels of the social gradient, but especially so in lower-income households (Bratanova, 2016).

The third mechanism of long-term obesity is being an overweight or obese child. Obesity rates for adults are soaring, and this directly plays into adolescents and children's lives. The future of America is getting substantially more overweight and obese with each passing decade. A longitudinal study on socioeconomic status and obesity from birth through adolescence established that poverty exposure before the age of 2 years has a 'robust association' with long-term obesity, and, furthermore, low socioeconomic status during a child's upbringing is associated with higher adult BMI (Lee, 2014). Approximately one in three youths between the ages of 12 and 19 are currently overweight or obese (Lohman, 2009). Figure 3 depicts the prevalence of obesity among U.S. children and adolescents aged 2-19 years, by subsections of poverty income ratio, sex, and race and ethnicity from 2005 to 2008. As illustrated, when the poverty income ratio is below the poverty line, there are higher rates of obesity in children and adolescents for both girls and boys, with the exception of Mexican Americans (Ogden, C L, Lamb, 2010). However, in a more recent study, depicted in Figure 4, there were higher rates of obesity in all children, and especially so in Hispanics and non-Hispanic blacks (Ogden, C L, Lamb, 2015).

There is also a divide between children living in rural, low-income communities and urban communities. Past research on the apportion attributes the disparity of childhood obesity between rural and urban areas to a lack of access to healthy, affordable food, community socioeconomic deprivation, access to safe parks, and a limited diversity of physical activity centers in more rural, low-income communities (Bailey-Davis, 2012).

Substantial research and literature relating poverty exposure and obesity in the adolescent years attributes several environmental aspects for the strong relationship. The

number one factor is the family's income status. A high proportion of children living in low SES households are overweight, obese, malnourished, or food insecure. Family and home stressors then tend to exacerbate the relationship between poverty and obesity. Lohman, et al. address the relationship between individual, maternal and family stressors experienced by low-income adolescents during childhood and the negative health outcomes associated with these stressors, mainly obesity. Household stressors were found to be factors that contributed to poorer eating habits and reduced physical activity in most adolescents. There was also a direct link between individual stressors faced by the child and obesity (Lohman, 2009). This direct influence supports the supposition that exposure to adverse household stressors may only add to the likelihood of obesity.

To further explore the link between psychological stressors and the increase of health-problems among poorer individuals, Bratanova et al. replicated a psychological approach to investigate the consumption of calorie-dense foods during anxiety and stress in low-income individuals. Stress triggers increased anxiety. They found that when individuals were induced to feel poor and more stressed, they consumed over 54 percent more calories. They also found a connection with increased anxiety and increased calorie consumption in people already below the poverty line (Bratanova, 2016). These findings that increased stress and anxiety among lower-income individuals results in a greater consumption of high-caloric food confirms the Lohman study.

Furthermore, the unequal opportunity to basic nutritional and play capabilities compounds stresses already faced by lower-income families and individuals. The capability approach considers subjective well-being as a valuable functioning in its own right, which means that if stress is impeding well-being, then the individual does not have

the ability to perform basic functionings (Nussbaum, 2003). There is a ripple effect of nutrition capabilities on other health and emotional capabilities, and barriers to nutrition capabilities intensify the effect. Barriers to nutrition capabilities include external factors, such as stress, affordability of and access to fresh foods, and knowledge about healthy eating. Therefore, by securing nutrition capabilities, the ripple effect can be alleviated at least partially.

The strong association between poverty and obesity can also be accredited to the low cost of calorie-dense foods that are high in sugar and fat (Drewnowski, 2004). In response to limited food resources, low-income households are inclined to purchase cheaper, high calorie and fat-dense foods (Lohman, 2009). Due to the high prices of healthy, fresh food and overall increase in cost of food, poorer Americans are spending a lower percentage of disposable income on food by buying cheaper, yet highly caloric, sugary, and fat-dense food (Drewnowski, 2004). Low-income families further combat limited food resources by overeating when food is more plentiful and overprotecting their children by giving them more food than needed when food is available (Lohman, 2009). When food is not available, children tend to seek food from outside sources that do not represent a well-balanced diet (Lohman, 2009; Bratanova, 2016).

The consumption of foods high in fat, sugar, and overall calories is regarded as the leading of obesity, and children's food instake is influenced by environmental and external factors (Ogden, C L, Carroll, 2006; Golan, 2006). Then, considering the results from the Bratanova study, the result of stressful conditions experienced in a high number of lower-income individuals would reveal the psychological mechanisms that link socioeconomic conditions to obesity. This would just be one cause that accounts for the

connection between poverty and obesity. However, because the existence of obesity is greater for low-income individuals than for higher income individuals and obesity decreases as income increases, there is a major need to address the complex socio-environmental situation which exposes children living in more rural areas to a higher risk of obesity (Ogden, C L, Lamb, 2010; Ogden, C L, Carroll, 2015).

The influence of poverty in the adolescent years directly relates to the association of low-income status and adult obesity (Lee, 2014). Therefore, with the knowledge that prevention of obesity at a younger age is easier to reverse than intervening during adulthood, obesity prevention and intervention programs should focus on adolescents and children. Furthermore, with regards to nutrition capabilities, children should be allowed to have the freedom and opportunity to achieve good nutrition because it is a central functioning. The adolescent and childhood years are critical years of development that must be fueled by eating nutritiously in order to be able fulfill functionings to the highest capacity. So, if nutrition capabilities are a central functionings, what is society doing to fulfill these capabilities in children today?

IV. School-Based Nutrition Education and Obesity Prevention and Intervention

The researchers behind a study estimating the progression and cost of the US obesity epidemic call for "timely, dramatic, and effective development and implementation of corrective [obesity] programs" to attempt to mitigate the "inevitable health and societal consequences" of such a drastic epidemic (Wang, 2008). Although the obesity trends may slow down in the future, the number of obese will continue to grow unless intervention becomes a priority. Until the past few years, there has been minimal emphasis on the true costs of obesity. This could be due, in part, to the lack of any

discussion regarding the incorporation of healthful foods into the diets of food insecure and low SES families, which is a reason to intervene and address the problem. Obesity is increasing at an increasing rate and affecting United States children and adolescents at a disproportionate level. The severity of this obesity epidemic and its impacts on society as a whole need to be both well known and fully understood. So the question then becomes, how can we make the impacts of obesity known while simultaneously helping the cause by reducing obesity and improving the health and nutrition capabilities of our children's lives?

There are two natural points to intervene: at school and at home with the family. Children's development stems directly from the daily influences and interactions they experience – at home, in school, and in society at large. According to the Social Cognitive Theory (SCT), behavior is influenced by individual and environmental factors, such as school factors, peers, and teachers (Evans, 2016). Beginning in adolescence and progressing throughout childhood, the majority of American children go to school. Children go to school to be engaged and to learn. Schools are responsible for children's behaviors while they are present at school. Why should this not include eating and physical behaviors as well?

Schools need to take responsibility for both directly and indirectly influencing children's eating and physical activity behaviors. They are uniquely positioned to play a key role in preventing childhood obesity. Sen blatantly states, "conversion factors influence how a person can be or is free to convert the characteristics of resources into functionings (Robeyns, 2011)." If schools are not providing adequate resources for children to convert their nutrition capabilities into functionings or even posses nutrition

capabilities, then schools could arguably be acting as a direct barrier for children to reach their full potential of functionings. Therefore, I will provide a thorough analysis of school-based nutrition programs in order to decipher what impact school-based nutrition education programs have on obesity and overweight rates among students of low socioeconomic status in elementary schools, and, furthermore, how such programs can maximize their impact on obesity and overweight reduction in such schools and help to give children the freedom to achieve proper nutrition capabilities.

In order to evaluate the impact of school-based nutrition education and obesity intervention and prevention program, I look at eight unique studies focused on low-income elementary-aged students in schools throughout the United States. In Figure 5 I outline each successful study by breaking them down into length, population/sample, outcomes measured, location, and type of intervention. All of the studies I analyze measure BMI to assess the impact of the program, which directly links results to obesity prevention and reduction. Locations of the studies include multiple counties and rural communities in Texas, Pennsylvania, Colorado, Louisiana, Mississippi, Florida, and Tennessee, and the samples consist largely of African American or Hispanic children. The majority of the studies I analyze are in the South, but the southern states are relatively more obese than anywhere else in the country. However, the variation in location helps to identify how different states implement obesity prevention and intervention programs.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) was one of the earliest and largest school-based intervention studies. CATCH promoted healthy eating, physical activity, and tobacco non-use in over 32 elementary schools (Hollar,

2010). Large cohorts at various centers were measured at baseline and 2 years later during a follow-up. The intervention program consisted of environmental changes in in school lunches, a behavior-oriented classroom curriculum, and family-oriented activities based on organizational and behavior change theories (Dwyer, 2000). Many CATCH studies found no significant results for changes in obesity low-income students who were not a prominent part of the intervention group (Hollar, 2010).

Although this is not promising information, it further aligns with the supposition that low-income children are more 'at risk' of obesity. Furthermore, in several CATCH studies, the rates of overweight and obese were higher for African American and Hispanic children than for non-Hispanic whites, and the authors concluded that American children, and especially African American and Hispanic children, are becoming heavier and fatter as time progresses (Dwyer, 2000). CATCH studies were completed in the late 1990s and early 2000s, which means the results are limited. School-based intervention programs were not as prevalent after the CATCH studies established a definite increase in childhood obesity, but an inadequate prevention and intervention method. However, in recent years, school-based nutrition education and obesity intervention programs have been on the rise. Several notable studies include: Healthier Options for Public Schoolchildren (HOPS), Coordinated Approach To Child Health – Basic Program/Community (CATCH-BP/BPC), and Winning With Wellness (WWW).

The Healthier Options for Public Schoolchildren program adopted aspects from The Child and Adolescent Trial for Cardiovascular Health and aimed to reduce childhood obesity in lower-income children through implementing a dietary intervention, a curricula component, and a physical activity component. HOPS modified school-provided

breakfasts, lunches, and extended-day snacks to allow children to take what they learned in the program and apply their knowledge on how to make healthy choices. The curricula component incorporated parents and the family by sending home activities to complete at home, and it was found to be successful (Hollar, 2010). The physical activity aspect included having desk-side physical activity for roughly 10 minutes throughout the day and pedometers to track their steps. Several other studies, such as Winning With Wellness, Advancing School and Community Engagement Now for Disease Prevention, and the Mid-Atlantic Study (all included in 5), also gave pedometers to intervention students and saw promising results (Schetzina, 2009; Foster, 2008; Treu, 2017).

The Coordinated Approach To Child Health – Basic Program and The Coordinated Approach To Child Health – Basic Program and Community were two similar obesity intervention programs aimed to increase physical activity in students, increase fruit and vegetable consumption, and encourage healthy lifestyle patterns, such as healthy meal patterns and reduction of sugary-beverages. The main difference in the programs was the addition of a community aspect, which involved a 'community action' team to support the children and work alongside them to spread awareness about a healthy lifestyle within the community. The results of the study established that school-based, community-enhanced obesity prevention programs could be effective in reducing the prevalence of childhood obesity and overweight in low-income populations (Hoelscher, 2010). When the community is involved to some extent, children feel more responsible and proud to share and continue their healthy lifestyle.

The Winning With Wellness program is an excellent example of sustainability. In 2005, the WWW pilot program commenced in rural, low-income communities and

elementary schools in Appalachian County, Tennessee. Every four years since the program began, follow-up studies have been conducted to make sure the program is cost-efficient and effective. The WWW pilot program emphasized healthy eating and physical activity by implementing nutrition education services, health education, a daily physical activity routine, counseling services, and family and community activities. For the nutrition services aspect, 'Go, Slow, Whoa' lesson plans, developed by a registered dietitian, taught students about how to make healthy food and beverage choices as part of a balanced eating plan. For the health education and physical activity aspect, 'Move It Moments,' adapted from 'America on the Move,' were announced over the intercom every day and allowed the children to get up out of their desks for 10 to 15 minutes to move around. Additionally, pedometers were passed out to children in order for them to track their steps while at school and at home. The school made environmental changes such as changing the foods and beverage items offered at the school to healthier, yet appealing alternatives. Notable results included significant reduction in 'Whoa' foods and significant increase in physical activity after program implementation (Schetzina, 2009).

The follow-up study found even more significant results. The schools increased their healthy food options, children were choosing healthier foods, and children had increased their daily pedometer steps (Schetzina, 2011). The program is ongoing, sustainable, and effective in reducing and preventing obesity in rural Appalachian communities. Furthermore, the program is found to be "accessible to teachers and successfully implemented by utilizing existing and newly developed resources (Schetzina, 2009)." Future pilot programs aimed at preventing obesity and increasing healthy behaviors should replicate aspects of the WWW program.

One other prominent aspect of successful programs was the implementation of environmental modifications. Both the Louisiana study and the Integrated Nutrition and Physical Activity Program study (see Figure 5) integrated environmental modifications as a crucial part of the obesity prevention and intervention program. Environmental modifications entail changes in the school environment to support the students on their path to a healthy life. The support took the form of daily motivational quotes over the intercom, healthy messages on school menus, changes to the school cafeteria menu to incorporate healthier options, more integrated physical activity time, the creation of school gardens, and supplementary cooking and tasting classes after school (Williamson, 2012; Puma, 2013). Changing the school environment was beneficial to teachers, staff, and students alike in the nutrition education and obesity intervention programs.

In sum, features of successful nutrition education and intervention programs are wide-ranging, yet specific. All successful programs that reduced children's BMI lasted at least one full year, but almost all of them recommended longer-term programs, with an implementation date earlier than elementary school. Intervention programs that were school-based but had a home or community aspect had the highest proportion of BMI reduction and an increase in healthy behaviors. Children succeeded the most when being engaged in experiential learning, not mere instruction. Children enjoyed having more time to play and engage in physical activity throughout the day. The pedometers and desk-side 10-minute spurts of activity played a key role in increasing the amount of physical activity the students participated in. Environmental modifications, such as healthier food in the cafeteria and the implementation of school gardens, were highly significant. A school-based nutrition education and obesity prevention program with all

the above components would address children's nutrition capabilities in a cost-efficient and effective manner. Nutrition education is only one intervention to tackle the barriers to nutrition capabilities in low-income families and children, but knowledge about a healthy lifestyle should not be overlooked or pushed aside.

To further assess the effectiveness of obesity prevention programs, a study was completed to measure the longer-term effectiveness of intervention programs by monitoring children during the summer. Alexander and Lyons find that children regain the weight they lost during the school-based obesity prevention program during the summer (Alexander, 2016). Summer weight gain could be attributed to the non-school summer diet and inactivity of the home environment; but also, the parents could endorse a major portion of the weight gain, either directly or indirectly. Although this is not solely attributable to low income or obese and overweight children, it should be taken into consideration. One other limitation with the review of these studies is that there may be many intermediate variables that could be causing the beneficial outcome seen in the majority of studies completed. However, in all studies, expanded knowledge about healthful foods and physical activity did not cause any negative consequences.

Although the school environment could be more stressful at times for children than the home environment, the Lohman study gives reason to believe that this is not the case the majority of the time (Lohman, 2009). Therefore, due to the high level of stressors experienced in a majority of low-income households and the proven link between greater individual stress for the child and obesity in adolescents, obesity prevention and intervention programs need to focus on the school environment. However, this is exactly the opposite of what has been happening in the past.

V. Parents as 'Agents of Change"

Before schools started to become involved in obesity intervention and healthy lifestyle education, parents were regarded as the exclusive 'agent of change.' Most family-based intervention programs include at least one children and the obese child. Most effective family intervention programs use varying levels of parental involvement and behavioral therapy (Golan, 2006). Some studies suggest that the focus should be shifted from family-based intervention to targeting parents as exclusive agents of change. This would mean having the parents involved in skill training to learn how to effectively support their overweight or obese child physically and emotionally (Jansen, 2011). However, a major problem with this approach is time and resources. Children of obese children already face a variety of obstacles and may not have additional time to attend 'therapy training' sessions. Additionally, there is a correlation between overweight and obese parents and having overweight and obese children (Epstein, 2001). Parents that are already embedded in their bad habits could actually have detrimental effects on obesity prevention of their children if they are to act as the sole agent of change.

Therefore, family-based obesity treatment and prevention may be the "most well-established intervention," but it may not be the most effective (Golan, 2006). The home environment is important in shaping children's eating and physical activity behaviors, but as low-income children spend more time at school due to their parents working multiple jobs or just being less present, the home environment is becoming less prevalent in shaping children's lives. School-based preventative obesity intervention and healthful eating programs are needed in order to reach children that would not receive support at home. When parents are single, are unemployed, have a lower income, have lower

educational attainment, and live in more rural, low income communities, parents have a hard time acting as the 'agent of change' (Bailey-Davis, 2012).

These past intervention programs focus on parents as the "agents of change." With this former focus on parents, it would be reasonable to argue that parental intervention would stem from the parents' perception of their child's weight during adolescence and childhood, meaning, that if a parent realized their child was becoming increasingly overweight, the parent would intervene. However, an Australian study from 2016 found results contrary to this thought process. Parents that identified their child as being "overweight" rather than "about the right weight" gained more weight from baseline to follow-up in all analyses (Robinson, 2016). Similar studies prove that, counter to popular belief, self-identification and labeling by peers as 'fat' during childhood resulted in an increased risk of future weight. Although minimal research exists regarding the impact of parents' perceptions of their child's weight status on weight gain during childhood, past observations conclude that parents of children who are obese or overweight often fail to recognize their child as being overweight (Epstein, 2001, Robinson 2016). Robinson's findings align with these observations and also provide evidence that children perceived as underweight by their parents gained less weight than children whose weight was perceived as being normal (Robinson, 2016). This goes to show that parent perceptions are not the sole factor of weight gain, but also provides further reason to believe the prejudices of parents' perceptions of their child's weight.

How can we rely on parents to solely act as the "agents of change" when parents of overweight or obese children either fail to recognize their child as overweight or perceive them as overweight and, thus, end up contributing to more weight gain?

Household production theories even go as far as suggesting that families may "produce" children's health outcomes through the allocation of parental resources. Additionally, maternal stress, compounded by poverty and food insecurity, leads to higher probabilities of childhood obesity or being overweight (Lohman, 2009). If this is so, then parents who are stressed and making efforts to help combat their child's obesity could be making matters worse. Parents are definitely a piece in the obesity-prevention puzzle, but research informs that a more efficient, sustainable approach must be implemented. Therefore, going forward, I believe parents should coordinate efforts with the school to see the best results in a healthier lifestyle and obesity prevention programs for children.

The rapidly increasing obesity issue needs to be addressed early in life because obese adolescents are much more likely to either remain obese or become obese as adults (Bailey-Davis, 2012). Nutrition education and obesity prevention programs will help alleviate the knowledge barrier to a healthy lifestyle. Children can help their families move in the right direction if they receive knowledge on how to live a healthy life. Prevention programs will not give families more money or remove food deserts, but they could help eliminate the lack-f-knowledge factor that lower-income children face with regard to a healthful life, which could potentially mitigate other factors increasing the likelihood of becoming obese or overweight. Additionally, children deserve the access to resources that will enhance their capabilities, and thus their functionings. Therefore, going forward, I propose that parents should coordinate efforts with school to see the best results.

VI. Discussion and Recommendations

The connection between low income and obesity has been established and solidified by countless studies, but there are almost no policies in place to help alleviate the mechanisms connecting poverty and obesity. The prevention of childhood obesity would have significant implications for the United States due to the strong relationship between poverty, adolescent obesity and adult obesity (Lee, 2014). Creative initiatives that play into environmental changes are crucial. Wang, et al argue that this will require a "strong and sustained collaboration among public and private sectors, educators, food producers, urban planners, transportation experts, parents, and the general public," and I absolutely agree (Wang, 2008). Nutrition education is only one ingredient needed for the entire recipe to be efficacious. The first step is formulating a sustainable and replicable program that is cost-efficient and effective.

The school is the best place to start because children go to school with the intention and understanding of going to learn. However, multifactorial prevention initiatives that include collaboration between family, community, and school are necessary to form successful nutrition education and obesity prevention programs. I am proposing a three-pronged system involving the school, parents and home life, and the community. Schools are the ideal location for obesity prevention because nearly all adolescents and children attend school and parents are accustomed to semi-regular visits to the school site (Hoelscher, 2010). Additionally, elementary-aged students eat at least one, if not two, meals a day at school, so children should have the freedom to eat healthy and utilize their nutrition capabilities. Most schools have gymnasiums, playing fields, and playgrounds to promote daily physical activity and assist children in fulfilling their play capabilities as well.

Current studies suggest that school-based obesity prevention programs are most effective when implemented with complementary, community-based characteristics. Community aspects could entail walk to school campaigns, cooking lessons after school, community gardens, or even promoting portion size control in local restaurants. Other ideas for school-based intervention could include allowing kids to taste healthful foods at school, having physical activity breaks during class time, having after-school physical activity sessions, changing school nutrition policies, disseminating parent obesity programming, promoting healthy social marketing such healthy messages on school menus, or having a community-wide social marketing group to advocate for healthy habits (Hoelscher, 2010).

Although there are many ways to implement school-based nutrition and obesity prevention and intervention programs, there are several limitations and difficulties that need to be addressed. One major difficulty is identifying the minimum threshold of intervention required to achieve success or deem a program effective in reducing childhood obesity. Another problem is sustainability and cost efficiency, in addition to how to generalize and replicate the programs throughout all schools. However, obesity prevention in schools is much more cost efficient than unsuccessful parent or behavioral therapy approaches. As for sustainability, the Winning With Wellness program provides an ongoing image of sustainability, and the programs aspects could easily be replicated.

Going forward, there should be a focus on implementing long-term obesity prevention programs beginning at the earliest possible age, especially in rural schools, low-income schools, or schools with a higher prevalence of 'at risk' youth. School-based obesity prevention and nutrition education programs should consider off-campus sources

to help children maintain their weight when they are not enrolled in nutrition education and physical activity at school (Alexander, 2016). In order to help mitigate the rising obesity rates, all measures of obesity prevention and promotion of a healthy lifestyle should be considered. Since the cost of healthy food is one main barrier to achieving a healthful life, providing children healthy foods at school can mitigate the cost of healthy food for the families. One or two healthful meals a day are better than no healthy or fresh foods during the day.

Intervention programs must be crafted to increase nutrition capabilities for all children. Nutritional knowledge is an essential step in order to reach the full spectrum of capabilities. Without the key component of knowledge on how to fuel the body, children and adults alike will not be able to achieve an above-adequate well-being. Low socioeconomic families do not even have the ability to choose a healthy lifestyle due to a variety of factors, namely cost and knowledge. However, with the implementation of school-based, community-enhanced nutrition programs, the knowledge aspect of nutrition capabilities becomes not only a choice, but also a fundamental part of the educational system. Nussbaum highlights that the central human capabilities should be a priority and made central by states as "fundamental entitlements of each and every citizen," and that is exactly what would be done with the implementation of school-based, community-enhanced programs (Nussabum, 2003).

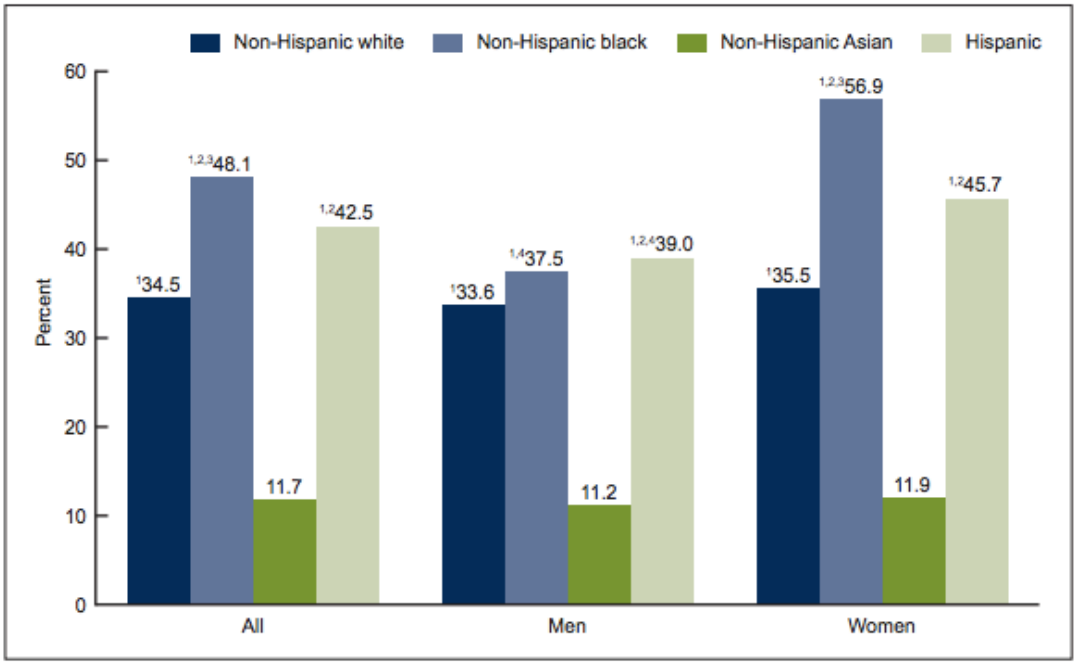
School-based, community-enhanced nutrition education and obesity intervention programs are worth enforcing for short and long run benefits. Children will be exposed to healthy eating and how to life a healthy lifestyle on a daily basis. They will be able to share their nutritional school experiences with parents and family, and potentially help

fuel or reinforce healthy habits at home. Healthy habits beginning at a young age are much more likely to translate into healthy habits long term. Today's obese children will become tomorrow's obese adults if something is not done to prevent the obesity epidemic from multiplying. The implementation of school-based, community enhanced nutrition education should be prioritized.

VII. Figures

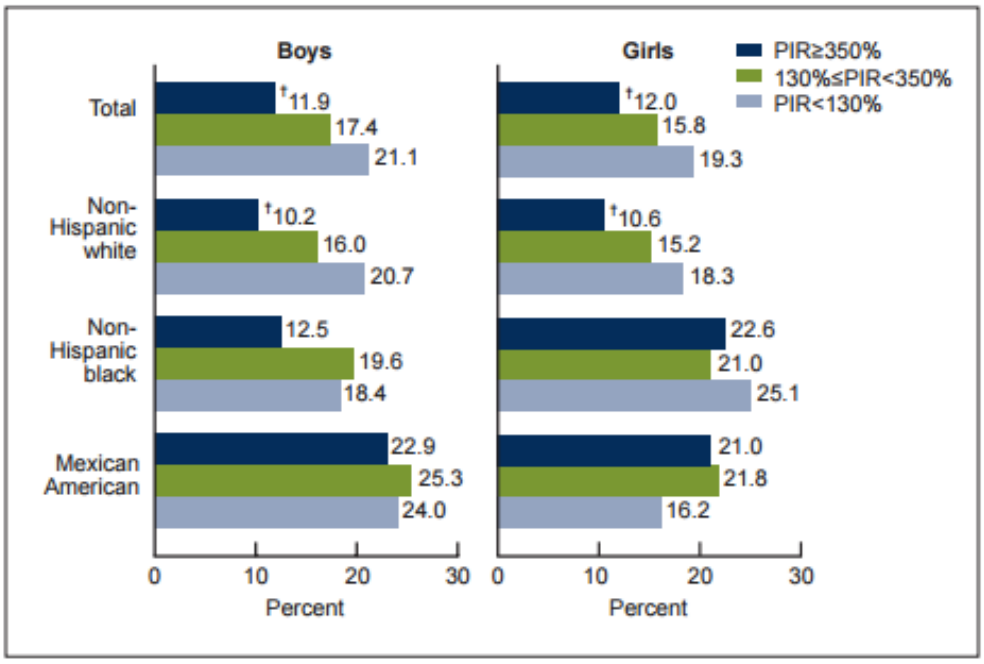
Figure 1: Prevalence of obesity and overweight among US adults: Observed during 1976–2004 and projected trend

Figure 2: Prevalence of obesity among adults aged 20 and over, by sex and race and ethnicity: United States, 2011-2014



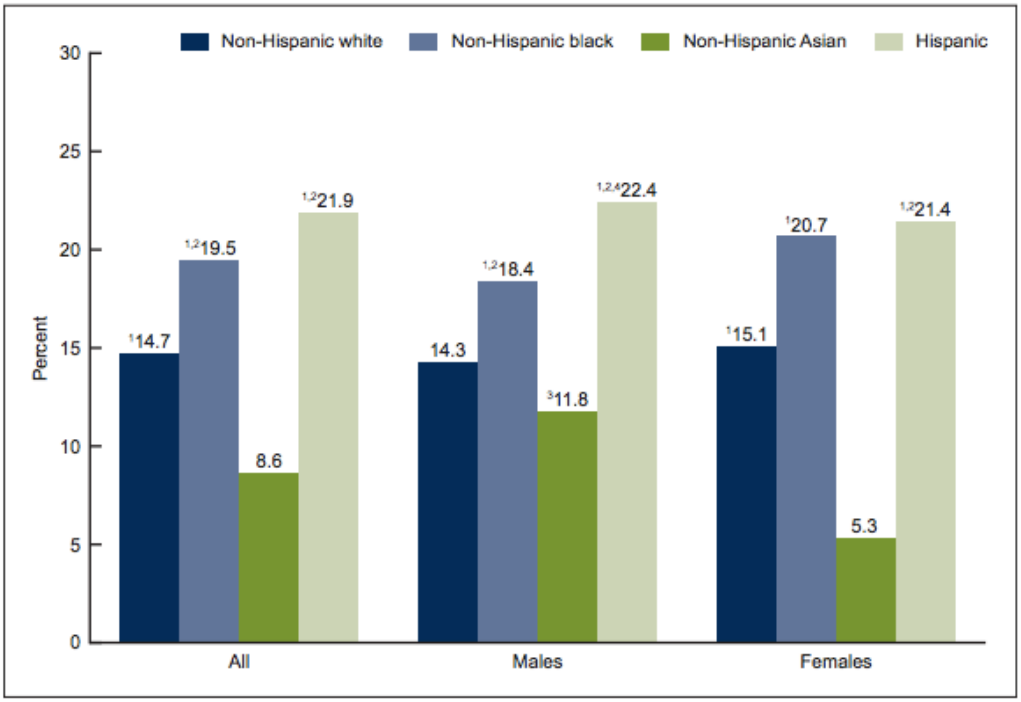
[1]Significantly different from non-Hispanic Asian persons.
[2]Significantly different from non-Hispanic white persons.
[3]Significantly different from Hispanic persons.
[4]Significantly different from women of the same race and Hispanic origin.
NOTE: All estimates are age-adjusted by the direct method to the 2000 U.S. census population using the age groups 20–39, 40–59, and 60 and over.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2011–2014.

Figure 3: Prevalence of obesity among children and adolescents aged 2-19 years, by poverty income ratio, sex, and race and ethnicity: United States, 2005-2008



†Significant trend.
NOTES: PIR is poverty income ratio. Persons of other race and ethnicity included in total.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2005–2008.

Figure 4: Prevalence of obesity among children and adolescents aged 2-19 years, by sex and race and ethnicity: United States, 2011-2014



[1]Significantly different from non-Hispanic Asian persons.
[2]Significantly different from non-Hispanic white persons.
[3]Significantly different from females of the same race and Hispanic origin.
[4]Significantly different from non-Hispanic black persons.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2011–2014.

Figure 5: Successful School-Based Studies

Name	Length	Population / Sample	Outcome Measured	Location of school(s)	Type of Intervention
1. Texas, Grow! Eat! Go! [TGEG] (Evans, 2016)	5 years	Primarily Hispanic (53%) and African American (18%) low-income elementary-aged students (73 % eligible for free and reduced-price School meals, 43 % food insecure)	Student's weight (BMI z score), vegetable consumption, physical activity, and sedentary behavior measured by student, teacher, and parents surveys pre- and post-program	Randomized trial with 28 elementary schools in five different geographic areas in Texas	School-based, multicomponent program to focus on healthy eating and physical activity grounded in social cognitive theories including the implementation of a community garden, daily physical activity, and a nutrition education segment
2. Mid-Atlantic Study (Foster, 2008)	2 years	1,349 students in grades 4 though;	Prevalence and remission of overweight and obesity,	Randomized trial with 10 schools in the Mid-	School-based, multicomponent SNPI; components:

		greater than 50 % of students eligible for free and reduced-price meals	BMI z score, total energy and fat intake, fruit and vegetable consumption, hours of activity	Atlantic region (districts of Philadelphia)	school self-assessment, nutrition education, nutrition policy, social marketing, and parent outreach
3. Integrated Nutrition and Physical Activity Program [INPAP] (Puma, 2013)	1 to 2 years	400 students in grades 3 and 4; 56 % Hispanic; 55 % students on the free and reduced-price meal program	Nutrition and physical activity knowledge, self-efficacy, attitudes and behaviors, BMI measured through classroom surveys, writing samples and BMI percentiles	Quasi-experimental trial with 1 low-income school district in rural south-central county in Colorado	Experiential school-based nutrition education program grounded in social cognitive and development theories
4. Healthier Options for Public Schoolchildren [HOPS] (Hollar, 2010)	2 years	4,588 school children 48% Hispanic; all intervention school children qualified for free or reduced-price school lunch program	BMI percentiles and academic performance	Quasi-experimental trial in Florida with 4 intervention schools and 1 control	Multicomponent school-based obesity prevention program with emphasis on healthy eating and physical activity
5. Louisiana Health Study (Williamson, 2012)	28 months	Students in grades 4 to 6 primarily African American children (68 %) and majority female (58 %)	BMI, percent body fat, changes in behaviors related to energy balance	Randomized trial with 17 school clusters in rural communities in Louisiana	Two types of school-based nutrition education and obesity prevention programs using environmental modifications and an online support system
6. Advancing School and Community Engagement	1 year	1,487 third-grade students in rural, low-	BMI, food label literacy, physical fitness,	Quasi-experimental trial in 2 school	School-based nutrition education and obesity

Now for Disease Prevention [ASCEND] (Treu, 2016)		income community	academic performance, behavior, medication use for asthma or ADHD	districts in East Jackson County, Mississippi	prevention including daily physical activity in classrooms and a program on making healthful foods and using food labels; supplement included components for students and their families
7. Coordinated Approach to Child Health BasicPlus [CATCH BP] and BasicPlus + Community [CATCH BPC] (Hoelscher, 2010)	4 years	1,107 students in grade 4 (53% female; 61 % Hispanic; 14% African American)	BMI, physical activity, and diet by PA and nutrition questionnaires	Serial cross-sectional design with 30 low-income schools in four districts in central Texas	School-based, multicomponent grounded in social cognitive and development theories; supplement for BPC included 'community action team'
8. Winning With Wellness: Pilot Program [WWW] (Schetzina, 2009)	18 months	114 students in grades 3 and 4	BMI, student health behavior, pedometer data, menu data by student, teacher and parent pre- and post-program surveys	Preliminary trial in a rural elementary school in northeast Tennessee	School-based and community-enhanced program promoting healthy eating and physical activity
9. Winning With Wellness, four-year follow up [WWW] (Schetzina, 2011)	4 years after impleme ntation	65 students in grade 4	BMI, student health behavior, pedometer data, menu data by student, teacher and parent pre- and post-program surveys	Trial in a rural elementary school in northeast Tennessee	School-based and community-enhanced program promoting healthy eating and physical activity

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