Childhood Obesity Prevalence, Determinants, Disparities, and Interventions:

A Review of the Current Literature

By Robin M. Mertens

California Polytechnic State University San Luis Obispo

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Introduction

In recent years the issue of childhood obesity has received a great deal of attention in the scientific literature, but the implications of childhood obesity for the individual and society are less clearly understood by the general public. Overweight and obese children are more likely to suffer from a variety of orthopedic, pulmonary, and endocrine health problems (Must & Strauss, 1999). For example, obese children may suffer from un-fused growth plates and softer bones, which can lead to orthopedic issues; they are more likely to have asthma and other reactive airway diseases; and they often develop insulin resistance (Must & Strauss, 1999). In addition to physical health problems, Strauss (2000) found that obese children had lower levels of self-esteem than their normal-weight counterparts. Strauss noted that, regardless of weight classification, children with lower levels of self-esteem have higher rates of sadness, loneliness, and nervousness (2000). When compared to obese children with higher self-esteem, obese children with lower levels of self-esteem were also more likely to smoke and drink alcohol (Strauss, 2000).

In addition to the short-term emotional and physical consequences, childhood obesity also severely affects the child's health later in life. Reilly et al. (2003) demonstrated an association between childhood obesity and several cardiovascular risk factors, including high blood pressure, insulin resistance, dyslipidemia, and changes in endothelial functioning. These changes in cardiovascular health have been shown to persist into adulthood, which may lead to higher rates of morbidity and premature mortality for adults (Reilly et al., 2003). This data is consistent with a study done by Must et al. (1999), in which there was a strong association between an increasing weight status category and prevalence of high blood pressure. Must et al. also found a steep increase in Type II Diabetes, gallbladder disease, and osteoarthritis with

increasing weight class (1999). Because these negative health outcomes are so significant, childhood obesity has been on the forefront of public health agendas around the world. Furthermore, the current childhood obesity epidemic constitutes a public health priority because it inflicts an economic burden on society. MacEwan, Alston, and Okrent (2014) estimated that an increase in BMI by one unit for every adult in the United States would increase the annual public medical expenditure by $6.0 billion. They also estimated a $166.2 billion dollar decrease in annual public medical expenditure if every currently obese adult were to decrease their BMI to 25 kg/m^2 (MacEwan et al., 2014).

In order to understand the magnitude of today's obesity epidemic, it is necessary to examine the current prevalence statistics in a historical context. The Centers for Disease Control and Prevention (CDC) uses the National Health and Nutrition Examination Survey (NHANES) to assess the overall health and nutritional status of Americans. NHANES is comprised of both interviews and physical examinations, and the data are used to better understand trends in childhood obesity prevalence (http://www.cdc.gov/nchs/nhanes.htm). Fryar, Carroll, and Ogden (2012) analyzed data from NHANES and found that from 1971-1974, 5.0% of American children were classified as obese. By 1988-1994, this statistic had doubled to 10.0%, and from 2001 to 2002, the childhood obesity prevalence in the United States was up to 15.4%. Childhood obesity prevalence fluctuated throughout the next four measurement periods, rising to 17.1 from 2003 to 2004, falling to 15.5% from 2005-2006, and rising again to 16.8% from 2007-2008 (Fryar et al., 2012). In the 2009-2010 NHANES, Fryar, Carroll, and Ogden found that the prevalence of childhood obesity was 16.9% for children ages 2 to 19, which is essentially the same as the previous two years. The debate over whether or not this statistic indicates a plateau in the rate of childhood obesity has led to an abundance of studies that have examined both

prevalence rates and potential causes of obesity in different subgroups (Koleilat et al., 2012; Moreno, Johnson-Shelton, & Boles, 2013; Ogden, Carroll, Kit, & Flegal, 2012; Simmons, Alexander, Ewing, & Whetzel, 2012; Rosas et al., 2011). Among these factors are socioeconomic status, race, and caregiver influence (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a4.htm; Nobari et al., 2013; Erinosho et al., 2012).

There are two main systems that most researchers use to classify children's weight status and standardize measurements, thus facilitating comparisons between different studies. One is based on information from the CDC, and the other uses data from the World Health Organization (WHO). The majority of the studies examined in this review of literature use classifications based on the CDC BMI-for-age growth charts for the United States. BMI stands for Body Mass Index, and it is a measure of the child's weight (in kilograms), divided by their height squared (in meters squared). Children with BMI scores at or above the 85th percentile of the sex-specific BMI-for-age growth charts are designated to be overweight, and children with a BMI at or above the 95th percentile are considered to be obese. Other studies defined overweight as being greater than two standard deviations above the growth standard median set forth by the World Health Organization (Olds et al., 2011; de Onis, Blössner, & Borghi, 2010). Obesity was therefore classified as a BMI greater than three standard deviations over the WHO growth standard mean.

Current findings about childhood obesity have served as a call to action, but it is also necessary to understand the risk factors that predispose certain populations to high overweight and obesity prevalence. In this way, policy-makers and people involved in public health promotion can specifically target their intervention programs to the populations with the most need. This review of literature provides overweight and obesity prevalence statistics on a global,

national, and state level in order to draw comparisons with data from San Luis Obispo County in California. It will address several factors that researchers have suggested may influence childhood OW/OB rates and discuss the disparity between children of different races and socioeconomic statuses. Lastly, this review will discuss the effectiveness of a few interventions that were aimed at reversing trends in childhood overweight and obesity and the implications that these studies have for the future of childhood obesity.

Global Prevalence of Childhood Obesity

Research studies that examine the global prevalence of childhood obesity point to the impact of this epidemic on an international scale. In a study done by de Onis, Blössner, and Borghi (2010), researchers analyzed data from 144 countries in order to determine the global prevalence of obesity in children from birth to age five. They obtained their data from national nutrition surveys in the WHO Global Database on Child Growth and Malnutrition. Overweight and obese was defined as two and three standard deviations, respectively, above the WHO median. De Onis, Blössner, and Borghi (2010) found that the worldwide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010. The 2008 edition of *World Population Prospects* was used to estimate that the prevalence of childhood overweight and obesity will increase to 9.1% in 2020. Researchers also discovered that the percentage of overweight or obese children in 2010 was approximately 11.7% in developed countries, which is greater than the prevalence of 6.1% in developing countries. However, it is important to note that the percent change in prevalence from year to year is higher in developing nations (de Onis et al., 2010). The authors also analyzed the trends in childhood overweight and obesity prevalence for 111 countries, of which 31 showed no significant change, 53 showed an increasing trend, and 27 showed a decreasing trend.

Whereas the data from the aforementioned study suggest that 53 countries had increasing rates of overweight and obesity, another study found an overall plateau in the global trend of childhood obesity prevalence (Olds et al., 2011). This analysis included data from nine countries: Australia, China, England, France, Netherlands, New Zealand, Sweden, Switzerland, and the United States. However, this study has an important limitation: each country was selected because authors in each country had recently published data that indicated a leveling-off in childhood obesity trends. Researchers then asked the author of each study to assess recent evidence from their respective countries. After synthesizing all of this information, Olds et al. concluded that the average un-weighted rate of change in childhood OW/OB prevalence from the 112 gather reports was +0.00 (0.49%) (2011). Compared to the study by de Onis, Blössner, and Borghi (2010), this analysis found a greater number of reports with no significant change in childhood OW/OB trend and fewer indicating a falling trend. In both studies, the majority of reports showed either a decrease or stabilization in childhood OW/OB prevalence. However, when decrease, no change, and increase are all compared separately, the greatest number of reports from both studies showed an increasing trend (Olds et al., 2011; de Onis et al., 2010). Also of note, the research compiled by Olds et al. revealed that the rates of change in OW/OB prevalence varied by ethnicity, socioeconomic status, and sex (2010). These important factors associated with health disparities will be addressed later in the review.

Childhood Obesity Prevalence in the United States

Data assessment is made more meaningful through comparisons to national data on the prevalence of childhood overweight and obesity. Ogden, Carroll, Kit, and Flegal (2012; 2014) examined data from NHANES for the years 1999-2010. They found that the obesity prevalence for children ages 2 to 5 was 12.1% in 2009-2010 (Ogden et al., 2012). Each age group had a

higher obesity prevalence than the one below it, and children ages 12 to 19 had an obesity prevalence of 18.4%. Over the twelve-year period, there was a significant increasing trend in obesity prevalence for male children, but the same was not found for female children. When comparing the years 2007-2008 and 2009-2010, however, the data indicates no change in obesity prevalence. This leveling off trend supports the analysis of Olds et al. (2011) and points to a more promising trend. In their 2014 analysis, Ogden et al. (2014) found that there was a significant decrease in obesity prevalence for children ages 2 to 5 (8.6% in 2011-2012 compared to 12.1% in 2009-2010). Overall, there was no significant change in obesity prevalence for children ages 2 through 19.

A report from the CDC in 2013 examined national obesity prevalence for low-income preschoolers. The authors of this report analyzed data from the Pediatric Nutritional Surveillance System and broke down information state by state. From 2008-2011, 19 of the states or territories for which data were available showed a significant decreasing trend in obesity prevalence for low-income preschoolers. 21 states/territories reported no significant change in prevalence, and three states experienced a rising trend (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a4.htm). The CDC suggests that states with increasing obesity prevalence trends should consider the implementation of health promotion policies from states with a downward trend in childhood obesity.

Childhood Obesity Prevalence in California

Numerous researchers have conducted studies that aim to quantify the magnitude of the obesity epidemic in specific states and analyze how this compares to national prevalence rates. The CDC emphasizes the need for state-specific prevalence rates and the need for state and local health departments to create policies that specifically meet the demands of their constituents

(http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a4.htm). For low-income California preschoolers ages 2 to 4, the obesity prevalence in 2008 was 17.3%. This statistic dropped slightly to 17.0% in 2009, increased back to 17.3% in 2010, and dropped again to 16.8% in 2011. The adjusted odds ratio was 0.99, which indicates that there was no significant estimated annual change in odds of obesity through the years that were analyzed (CDC, 2013b). The Pediatric Nutritional Surveillance System (PedNSS) was discontinued at the end of 2012, but the fluctuation in prevalence between 2008 and 2011 calls for more recent data, which could establish a clearer trend.

Childhood Obesity Prevalence in San Luis Obispo County

In San Luis Obispo County (SLO), researchers have assessed childhood overweight and obesity prevalence rates since 2006 (Jankovitz, McGaughey, Tom, Ravalin, & McDermott, 2012). They have also examined trends in obesity between 2006 and 2009/2010 as well as the disparity between Hispanic and non-Hispanic white populations. Jankovitz et al. used cross-sectional, convenience samples from Head Start, California State, and private preschools in San Luis Obispo County (2012). The percentage of Hispanic children enrolled in Head Start and California State preschools was significantly higher than that of private preschools (78% and 81%, respectively, compared to 7.4%). It was found that SLO County children who attended Head Start preschool were 1.7 times more likely to be overweight and obese than children enrolled in private preschools (Jankovitz et al., 2012). In order to attend a Head Start preschool, a child's family may not be over 130% of the poverty level, but the majority of families sit below the poverty line (http://eclkc.ohs.acf.hhs.gov/hslc/standards/hspps/1305/1305.4%20Age%20of%20children%20and%20family%20income.htm). This socioeconomic discrepancy between Head Start and private

preschool enrollees is consistent with current literature (Fradkin et al., 2015; Jones-Smith, Dieckmann, Gottlieb, Chow, & Fernald, 2014; Moreno, Johnson-Shelton, & Boles, 2012; Simmons et al., 2012). In 2009/2010, the childhood obesity prevalence in SLO County was 34.8%, and children in the study were 1.7 times more likely to be overweight than in 2006, when the OW/OB prevalence was 26.4%. This increasing trend was especially pronounced in the Hispanic preschool population, who were 2.7 times more likely to be obese than their Caucasian classmates in 2009/2010 (Jankovitz et al., 2012). By comparison, in 2006, Hispanic children were no more likely than Caucasian children to be obese. The results from this study call for more recent local data in order to closely monitor changes in childhood overweight and obesity trends. The findings also identify a health disparity between Caucasian and Hispanic children, in which Hispanic children are disproportionately affected by childhood obesity.

Health Disparities – High Obesity Prevalence Among Hispanic Children

The disparity in childhood obesity prevalence between different ethnic groups has been consistent across numerous research studies (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6202a1.htm; Ogden et al., 2012; Ogden et al., 2014; Lo et al., 2014; Moreno, Johnson-Shelton, & Boles, 2013; Gee, Chin, Ackerson, Woo, & Howell, 2013). Of note are the high relative prevalence rates for Hispanic, African American, and American Indian/Alaska Native children. From 2003 to 2010, Gee et al. (2013) conducted an observational study in which they tracked the changes in BMI from Kaiser Permanente Northern California (KPNC) children. In 2010, researchers found that 11.9% of Hispanic/Latino children ages 2 to 5 were overweight and 16.0% were obese (Gee et al., 2013), which was the highest percent of any other race category. The second highest prevalence rate was for black children, who had an overweight prevalence of 10.5% and an obesity prevalence of 12.2%. The 2011

PedNSS showed slightly higher results nationally, indicating that 17.2% of Hispanic children ages 2 to 5 were overweight and 17.5% were obese (http://www.cdc.gov/nchs/nhanes.htm). Unlike the study conducted be Gee et al., this study also included American Indian and Alaska native children, and this group had the highest prevalence rates at 20.1% and 20.8% for overweight and obesity, respectively.

Other studies have shown similar findings. Moreno, Johnson-Shelton, and Boles (2012) collected data from elementary school students in one Oregon school district to determine the greatest predictors of childhood overweight and obesity. They found that the strongest predictor for overweight/obesity was the child's ethnicity and that Hispanic students were 1.81 times more likely to be overweight or obese than their white classmates (Moreno et al., 2012). Ogden et al., (2012) found that non-Hispanic black children and Mexican-American children had significantly higher odds of being obese than non-Hispanic white children. This trend remained apparent in the 2011-2012 NHANES survey period, in which the same researchers found that there were significant differences in OW/OB prevalence between different races (Ogden et al., 2014). Non-Hispanic Asian children had the lowest childhood OW/OB prevalence, followed by non-Hispanic white children. Non-Hispanic black children and Hispanic children had the highest prevalence of childhood overweight and obesity, but there was no significant difference within these two groups. Both studies controlled for the affects of age and survey period in order to maximize the accuracy of these results (Ogden et al., 2012; Ogden et al., 2014). However, Ogden et al. did point to a limitation in their study as well as others that assess the influence of race/ethnicity on BMI. Differences in body fat and body composition between ethnicities can have a large influence on results (Ogden et al., 2012). For example, black children tend to have a significantly lower body fat percentage than both Mexican-American and non-Hispanic white

children. This also highlights a limitation of BMI as an indicator of overweight and obesity: BMI does not account for lean body mass versus fat mass.

Differences in Childhood Obesity Prevalence Within Hispanic Populations

Research consistently shows that Hispanic children are disproportionately affected by childhood obesity (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6202a1.htm; Ogden et al., 2012; Ogden et al., 2014; Lo et al., 2014; Moreno et al., 2013; Gee et al., 2013). This information has led researchers to investigate the underlying reasons for this drastic health disparity. One group of researchers examined the influence of birth country versus country of longest residence (Hernández-Valero et al., 2012). Data were gathered from children living in Mexico and Texas who were then divided into three categories: children born and raised in Mexico, children born in Mexico and raised in the United States, and children born and raised in the United States. The key finding of the study was that the two groups of Mexican children who were raised in the United States were more likely to be overweight or obese than the children raised in Mexico (Hernández-Valero et al, 2012). Children who were born and raised in the U.S. had the highest rates of overweight and obesity at 20.6% and 28.1%, respectively. The study included children ages 5 to 19 and found that children ages 15 to 19 were less likely to be classified as overweight or obese than children ages 5 to 14. Researchers interpreted this outcome as an indication that obesity prevalence for Mexican children starts at younger ages and is continuing to increase overall (Hernández-Valero et al., 2012). Researchers did note that Mexican-American and Mexican immigrant children could be disproportionately affected by their lower socioeconomic status, which will be addressed in the next section.

There were similar results in a bi-national study that was aimed at identifying and comparing the determinants of overweight and obesity in children of Mexican origin (Rosas et

al., 2011). In the United States, researchers gathered pairs of mothers and their 5-year-old children from the Center for the Health Assessment of Mothers and Children of Salinas study. Mother-child pairs in Mexico were recruited from Proyecto Mariposa, and they also had to be part of the Oportunidades social welfare program. Through interviews with the mothers, researchers gathered information about several health indicators for the mother, child, and family. Similar to Hernández-Valero et al. (2012), there was a significantly higher prevalence of overweight and obesity in California (49%) compared to Mexico (33%). Interestingly, there was no significant association between the length of time that the mothers had lived in the United States and demographic characteristics, indicators of physical activity, or food intake levels (Rosas et al., 2011). For the children living in Mexico, there was a significant association between weight status and sex, socioeconomic status, and household food insecurity. For both samples, the mother's weight status was considered to be a determinant of childhood obesity. Lastly, researchers noted that children living in California were more likely to watch more television and eat more fast food whereas children from Mexico were more likely to have less-educated mothers, mothers who are unemployed, and household food insecurity (Rosas et al., 2011).

Nobari et al. (2013) examined the effect of living in "immigrant enclaves" in Los Angeles County on the prevalence of childhood obesity. The researchers proposed that preschool-aged children who live in neighborhoods where people speak the same language and share the same culture would be at lower risk for obesity. Their study identified English-speaking, Chinese-speaking, and Spanish-speaking neighborhoods using census tracts and thresholds specific to each language. Due to the large population of Spanish-speakers in Los Angeles County, an enclave was defined as Spanish-speaking if at least 50% of residents

preferred to speak Spanish whereas a Chinese-speaking enclave only required that 35% of its residents preferred to speak Chinese. Consistent with the literature, Nobari et al. found that children with mothers who prefer to speak Spanish were more likely to be obese than those with mothers who prefer English or Chinese (2013). Due to the influence of mother's preferred language on the association between child's BMI and percent of neighbors who speak the same language, researchers compared children with Spanish-speaking and Chinese-speaking mothers to children of the same ethnicity whose mothers preferred to speak English. The results of this study showed that, for Hispanic children, when 5% to 57% of neighborhood residents spoke the same language, average BMI increased. However, when the percentage of neighborhood residents who spoke the same language was between 57% and 90%, the average BMI of children decreased. Nobari et al. concluded that living in communities with people who speak the same language is therefore only effective in decreasing children's BMI above a certain threshold (2013). Lastly, similar to previous research, they also found that Spanish-speaking households tended to be more socioeconomically disadvantaged and have lower education levels than English-speaking and Chinese-speaking counterparts (Nobari et al., 2013).

Socioeconomic Status as an Indicator of Childhood Obesity

Research studies have been consistent in demonstrating the inverse relationship between socioeconomic status (SES) and child's BMI (Fradkin et al., 2015; Jones-Smith et al., 2014; Moreno et al., 2012; Simmons et al., 2012). Jones-Smith et al. used data from the Early Childhood Longitudinal Study- Birth Cohort (ECLS-B) to identify trends in childhood obesity prevalence from birth to age five (2014). Information was recorded at birth and then 9 months, 2 years, 4 years, and 5 years thereafter. Jones-Smith et al. used data from 4,950 children based on their completion of all check-ins and exclusion of children with low birth-weight. By two years

of age, white, Asian, and Hispanic children in the highest socioeconomic status classification had significantly lower odds of being overweight or obese than children in the lowest SES quintile (Jones-Smith et al., 2014). Researchers noted a clear, statistically significant inverse trend between SES and the prevalence of OW/OB for Hispanic children. By age 5, Hispanic children in the lowest SES quintile had an OW/OB prevalence of 24.1%, which is significantly higher than the 7.9% of children from the highest SES quintile. Jones-Smith et al. highlighted the importance of considering this disparity when creating public health campaigns targeted specifically for disadvantaged populations (2014).

The previous study defined socioeconomic status based on household income levels, but a more recent study looked at the relationship between SES and obesity prevalence based on the highest level of education in the household. Fradkin et al. (2015) analyzed data from the Healthy Passages study, which is a population-based study that collected data from children ages 10 to 11 from Houston, Texas; Birmingham, Alabama; and Los Angeles, California. Data was collected at baseline and two years thereafter. This study included information from 4,824 African-American, Hispanic, and white children. Like the study by Jones-Smith et al. (2014), this study showed that children with the highest SES had a significantly lower prevalence of obesity than children of a lower SES (Fradkin et al., 2015). This inverse relationship was most pronounced among Hispanic children, which is also consistent with the results from the study by Jones-Smith et al. (2014). The results from these two studies point to the importance of considering socioeconomic status when interpreting the analysis from studies on the prevalence of overweight and obesity (Jones-Smith et al., 2014; Fradkin et al., 2015; Moreno et al., 2012). They also emphasize the need to target programs at parents and children of lower socioeconomic

status in order to minimize SES as a health disparity. Lastly, it calls for more research regarding the specific reasons why SES is such a significant predictor of weight status.

A third indicator of socioeconomic status was used in the previously-mentioned study by Moreno, Johnson-Shelton, and Boles (2012), in which they found that free or reduced lunch was predictive of overweight and obesity for elementary school students. Researchers found that students who were eligible for free and reduced lunch, and therefore at a lower socioeconomic status, were 1.24 times as likely to be obese. These results are different from the results of a study that compared preschool-aged children who were enrolled in the Supplemental Nutrition Assistance Program (SNAP) compared to children who were not (Simmons et al., 2012). This study found that there was no significant difference between OW/OB prevalence in SNAP and non-SNAP groups. Although the difference was not significant, the data did show that SNAP participants had about a 5% greater prevalence of overweight and obesity (Simmons et al., 2012). This group of researchers called for more longitudinal studies to be done that examine the relationship between SNAP participation and prevalence of overweight and obesity in preschool-aged children.

Other Suggested Determinants of Childhood Obesity

The National Initiative for Children's Healthcare Quality (NICHQ) provides data on a variety of factors that may influence prevalence rates for childhood obesity (2011). Two of these statistics are relevant to physical activity levels, which is another indicator of childhood obesity. Hispanic children have the lowest rate of physical activity, with only 55.6% meeting the criteria for physical activity four times per week. Hispanic children also have the lowest percentage of children who live in neighborhoods that have adequate parks, recreation centers, and sidewalks (https://dl.dropboxusercontent.com/u/19550741/California /CA_ State_Factsheet.pdf). These

statistics draw attention to the disparity in access to physical activity opportunities, which is often the aim of intervention programs (Crespo et al., 2012; Falbe, Cadiz, Tantoco, Thompson, & Madsen, 2015; Barkin, Gessel, Po'e, Escarfuller, & Tempeti, 2012).

Another factor that influences childhood overweight and obesity is food intake. Erinosho, et al. (2012) explored the relationship between a child's dietary intake and characteristics of their caregiver. Their study focused on preschool-aged children, and information was gathered through questionnaires given to the caregiver. Unadjusted analysis showed that children with Hispanic caregivers drank significantly more 100% fruit juice and sugar-sweetened beverages when compared to children with white caregivers (Erinosho et al., 2012). On the other hand, children with caregivers that had at least some college education consumed fewer amounts of these beverages. This indicates the potential influence that educational nutrition programs can have in reducing the prevalence of childhood obesity. Hispanic caregivers also reported that their children consumed fewer servings of vegetables. Lastly, multivariate analysis revealed that the caregiver's level of acculturation was significantly associated with the amount of sweets consumed by the child (Erinosho et al., 2012).

One study utilized a case-control method to examine potential factors for obesity in three and four year olds who were WIC participants (Koleilat et al., 2012). Compared to their normal-weight counterparts, obese children were significantly less likely to be enrolled in preschool and significantly more likely to have obese mothers. The chances of being obese also increased for children who spent over an hour per day watching TV. Researchers suggest that future studies include a non-WIC control group so that the results are confirmed and more generalizable.

Interventions for Childhood Obesity

Due to the magnitude of the obesity epidemic in the United States, numerous efforts have been made to identify successful lifestyle interventions for preschool-aged children. Many researchers have successfully designed interventions that cater specifically to populations who are disproportionately affected by childhood obesity. The alarming prevalence of overweight and obesity in Hispanic children has made this population an important target for interventions. In one such study, researchers randomized elementary school students into four different intervention groups. One group received family intervention only, another received exclusively community intervention, one received both interventions, and the final group only had their measurements taken. This study was specifically targeted to Latino families through the use of promotoras, who function as health advisors by working with families to help them understand educational material on obesity topics (Falbe et al., 2015). Promotoras are typically from the community being served, which facilitates organizational and community change. At the three-year follow up, retention rate was only 55%, which indicates a limitation of the study (Crespo et al., 2012). Researchers in this study did not find statistically significant changes in weight measures, and the mean BMI z-score actually increased for children in all of the conditions. However, after secondary analysis, researchers determined that the family intervention had four significant child behavioral outcomes, which were a result of changes made by parents. These changes were fewer minutes of TV viewed while getting ready for school, an increase in physical activity, higher parental use of tactics to reduce their child's fat intake, and an increase in the child's consumption of fruits and vegetables (Crespo et al., 2012). In their discussion, Crespo et al. (2012) suggested that more targeted and intensive interventions could lead to greater improvement.

The study design in later research done by Falbe et al. (2015) exemplifies the targeted approach that Crespo et al. suggested (2012). This study was similar to that of Crespo et al. (2012) through the use of promotoras and emphasis on Latino children, but this intervention contained more design elements specific to Latinos (Falbe et al., 2015). Falbe et al. randomly assigned 55 parent-child pairs to either the Active and Healthy Families (AHF) program or a waitlist control condition. Participating families were eligible if they spoke Spanish and had a child age 5-12 who receives care from a "federally qualified health center" (Falbe et al., 2015). The AHF intervention lasted ten weeks and was comprised of medical appointments and biweekly group sessions. The group sessions focused primarily on parenting, healthy foods, and physical activity among other topics. This intervention was specifically targeted to Latinos through emphasis on the family and consideration of the parenting style associated with Latino eating patterns. Additionally, the AHF intervention was tailored to Latinos by focusing on culturally appropriate recipes/foods and emphasizing Latino and Hispanic cultural perspectives and traditions (Falbe et al., 2015). After the 10-week intervention, children in the AHF group showed a -0.5 change in BMI compared to the +0.32 change in the control group. The intervention group also showed greater improvement in triglyceride level and BMI z-score (Falbe et al., 2015).

Whereas the two previous studies worked with elementary school children, Barkin, et al. (2012) targeted preschool-age children. The sample size of this study is about twice as big as that of Falbe et al. (2012), but they experienced similarly positive results. This intervention was called the "Salud con Familia" program, and it involved 90-minute sessions that were created to help families establish better nutritional, television viewing, and physical activity habits (Barkin et al., 2012). Meetings also added in a social component through the formation of small groups,

which researchers believed would help maintain the longevity of these new habits. Salud con Familia was developed by the National Latino Children's Institute, and the intervention lasted for 12 weeks. At baseline, there were no significant differences between the groups, but at the three-month follow-up, the treatment group showed statistically significant results. Absolute BMI for the treatment group decreased by 0.59, and the greatest decrease was seen in the BMI of obese children (Barkin et al., 2012). This BMI decrease is consistent with the study by Falbe et al. (2012), in which there was a 0.5 decrease in BMI.

Another strategy that has been used to approach weight loss intervention is the incorporation of parents into the planning portion of the study (Davison, Jurkowski, Li, Kranz, & Lawson, 2013). This intervention took place over a two-year period. Year 1 (2009-2010) functioned as the planning year, in which parents collaborated with researchers to plan and assess community needs. They used the results from this assessment to create an intervention for childhood obesity that was centered on the family. Year 2 (2010-2011) required parents to lead the implementation of this intervention in the community. Parents were also involved in the evaluation of its effectiveness at the conclusion of the intervention period (Davison et al., 2013). The intervention was referred to as the Communities for Health Living (CHL) program, and it has four components. The first involves letters sent home to families regarding their child's BMI. Next, they began a communication campaign directed at parents to heighten awareness of what their child's BMI status means. Third, they incorporated nutrition education and counseling into Head Start family programs. Lastly, the intervention involved a 6-week program led by the parents that was intended to enhance communication, conflict resolution, self-efficacy, media awareness, and social networks for parents (Davison et al., 2013). At the conclusion of the intervention, children showed significant improvements in obesity rate, light physical activity,

daily television viewing, and dietary intake. There were also promising trends for BMI z-score and moderate activity though these statistics were not significant. After the intervention, parents showed increased self-efficacy to offer healthy foods to their children, slightly greater quantities of fruits and vegetables offered to children, and significantly higher support for their child's physical activity (Davison et al., 2013). This study took place in upstate New York, and the participants were exclusively non-Hispanic white and non-white. Though this study wasn't tailored to a Latino population, the incorporation of parents into the planning and execution phases of intervention might be successful in the family-oriented cultured of Hispanics and Latinos.

Summary

The prevalence of childhood overweight and obesity has more than tripled between 1971 and 2008 (Fryar, Carroll, & Ogden, 2012). Despite this alarming trend, obesity prevalence has essentially remained the same in recent years, calling for further analysis to determine whether this plateau is indicative of a future decreasing trend (Fryar, Carroll, & Ogden, 2012). In 2014, Ogden et al. noted a significant decrease in obesity prevalence for children ages 2 to 5 in the United States. This is consistent with a CDC report, in which data from the PEDNSS revealed a significant decrease in obesity prevalence in low-income preschoolers (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a4.htm). Some populations are disproportionately affected by overweight and obesity, specifically children of Hispanic and Latino descent (Gee at al., 2013; Ogden et al., 2014). Studies have also shown that non-Hispanic black children and American Indian and Alaska Native children experience similar health disparities (http://www.cdc.gov/pednss/ pednss_tables/index.htm; Ogden et al., 2014). This

discrepancy has led to an increased emphasis on these groups as targets for obesity intervention programs (Barkin et al., 2012; Falbe et al, 2015; Crespo et al., 2012).

Consistent inverse relationships have also been shown between socioeconomic status and obesity prevalence (Jones-Smith et al., 2014; Fradkin et al., 2015). Jones-Smith et al. analyzed data from the ECLS-B and found that by age three, white, Asian, and Hispanic children in the highest SES quintile showed significantly lower odds of being OW/OB than children in the lowest quintile (2014). Fradkin et al. (2015) used highest household education level as an indicator of socioeconomic status and found that there was a significantly lower obesity prevalence for children in households with higher levels of education. Researchers have suggested that low SES may also be responsible for the results of two studies in which Mexican children raised in the U.S. have been found to have a higher prevalence of OW/OB than children raised in Mexico (Hernández-Valero et al., 2012; Rosas et al., 2011). Both of these studies controlled for other demographic factors and pointed to food environment and acculturation as other potential factors that may have influenced the results.

The previously-mentioned studies point to the magnitude of the childhood obesity epidemic, and they draw attention to the fact that certain populations are disproportionately affected.. Childhood obesity is a public health concern due to the physical and emotional consequences for children later in life (Must & Strauss, 1999; Strauss, 2000; Reilly et al., 2003; Must et al., 1999). An association has been found between childhood obesity and cardiovascular risk factors, such as high blood pressure, insulin resistance, and dyslipidemia (Reilly et al, 2003). Childhood obesity is also associated with higher incidence of osteoarthritis and gallbladder disease (Must et al., 1999). These co-morbidities affect quality of life and health outcomes

throughout the child's life. Furthermore, obesity is an economic burden on society, costing billions of dollars in annual public medical expenditure (MacEwan et al., 2014).

The life-long consequences of childhood overweight and obesity lead to lasting effects for both the individual and the population. Interventions targeted specifically toward Latino children have been shown to be effective in reducing BMI (Falbe et al., 2015; Barkin et al., 2014). These interventions highlight specific aspects of Hispanic/Latino children by appealing to culture and tradition. These types of population-specific interventions should be adapted to accommodate other groups that face similar health disparities. Another study suggested that parent involvement in the planning process may improve retention rate and success, and children in the study showed significant improvements in obesity rate, light physical activity levels, and dietary intake (Davison et al., 2013). In the future, studies should consider the long-term effects of these interventions. Though current literature has demonstrated short-term outcomes, future research should be dedicated to long-term outcomes and ways to improve program and healthy lifestyle adherence. Particularly with the recent indication of a plateau in overweight and obesity prevalence (Fryar, Carroll & Ogden, 2012), it is a crucial time to implement childhood obesity interventions and consider the implementations of preventative programs as well. This switch to emphasis on primary care will address the importance of healthy diet and exercise before the problem becomes exacerbated in early adolescence and lead to improved health outcomes for all.

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