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Obesity Risk Factors Among Preschool California Children

by

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DISSERTATION

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Obesity Risk Factors Among Preschool California Children

Denise M. Wall Parilo

Abstract

The increasing pervasiveness of pediatric obesity is cause for concern, because of its known association with life-long obesity and associated health problems. Nonetheless, there is little information about the important predictors of preschool obesity, which is a critical period for the development of emotional and behavioral self-regulation. This descriptive, cross-sectional analysis of 1510 preschoolers aged three to five years, utilized data from the 2009 Child version of the California Health Interview Survey (CHIS), in order to examine preschool obesity prevalence in this population and its associations with gender, ethnicity, and poverty level, as well as measures of negative emotion, developmental risk, physical activity, sedentary activity, diet, park factors, and maternal English ability. This research produced significant findings: well over a third of the preschoolers in the study were classified as obese; obesity was significantly associated with Hispanic ethnicity, poverty, and recent fast food intake; negative emotion was associated with normal, rather than overweight status; and inadequate physical activity was associated with Hispanic ethnicity and poor maternal English proficiency, a proxy for decreased maternal acculturation. The identification of maternal English ability as a significant, independent risk factor for physical activity is an important step in further understanding of demographic variables that may influence obesity rates in minority children. Study findings also present beginning evidence that negative mood may be associated with normal weight in young children, which is contrary to previous

research that suggests correlations between depression and overweight. Further research is needed to investigate negative emotion in the context of pediatric weight status, and to inquire further into the interplay among preschool obesity, limited English proficiency, Hispanic ethnicity, poverty, and physical activity.

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Chapter One: The Study Problem

The increasing pervasiveness of obesity in children from the United States (U.S.) is cause for concern. Data collected by the Centers for Disease Control and Prevention (CDC) over the last four decades indicate that the prevalence of overweight has risen in school-age children and adolescents such that these two age groups now have comparable rates (Centers for Disease Control and Prevention (CDC), 1999; Hedley et al., 2004). Similarly, research suggests that the obesity risk is growing among young children and infants (Bundred, Kitchiner, & Buchan, 2001; Hu et al., 2007; Kim et al., 2006) with the obesity rate for U.S. preschool children more than doubling in the past 30 years (Ogden, Flegal, Carroll, & Johnson, 2002). Childhood obesity prevalence and severity have continued to climb in developed and developing countries as well (Flynn et al., 2006; Jolliffe, 2004; World Health Organization (WHO), 2000) and pediatric weight gain is being pushed to a greater extreme than ever before (Jolliffe, 2004). The international health community recognizes obesity and childhood overweight as a global epidemic worthy of substantial study and attention (WHO, 2000).

Statement of the Problem

The upward trend in pediatric obesity among increasingly younger age groups in the U.S. and abroad has implications for both current and future health outcomes in children and adults. Yet, obesity research in the preschool age group is limited. Failure to understand the etiology for this emergent health problem in young children may lead to further increases in childhood and adult obesity and associated health effects.

The literature presents a compelling case for early efforts against pediatric obesity to avert a multitude of known health concerns. Research findings suggest that the earlier the onset of overweight in childhood, the more likely an individual will be obese as an older child and ultimately as an adult (Dietz, 1998; Lake, Power, & Cole, 1997; Nader et al., 2006; Ritchie et al., 2001). Longitudinal data also show that childhood obesity bodes poorly for future health with diabetes, depression, and cardiovascular complications such as dyslipidemia, hypertension, and heart disease but a few of many known consequences for obesity in children and adults alike (Ernst & Obarzanek, 1994; Flynn, et al., 2006; Frankel, Elwood, Sweetnam, Yarnell, & Smith, 1996; Haney et al., 2007; Morgan et al., 2002). Further, these health problems are thought to have greater severity for individuals who become overweight in their youth (Dietz, 1998; Frankel, Gunnell, Peters, Maynard, & Davey Smith, 1998; Gunnell, Frankel, Nanchahal, Peters, & Davey Smith, 1998). Adults are more likely to be weight stable in later years, in contrast, if they were lean in childhood, thereby preventing health complications (Davison & Birch, 2004). The increasing incidence of childhood overweight may result in a population of adults whose obesity-related health problems overwhelm the healthcare system. It is clear that early intervention is necessary in order to stop these trends.

When examining the child obesity problem from a developmental perspective, the case for intervention at the preschool level is made even stronger. One of the main developmental tasks of this age group is to become more autonomous in self-care habits such as feeding (Sturner & Howard, 1997) and to gain control over the external environment as well as one’s emotions (Berhman, Kliegman, & Jenson, 2004). Several key factors in childhood weight gain concern specific family factors that are established in early childhood, such as dietary patterns, parental feeding practices, and physical activity norms (Davison & Birch, 2001). By virtue of their position in the family, their developmental need for increased control and autonomy, and their continued reliance on caregivers, preschoolers are highly susceptible to these influences. The problem of childhood obesity should be addressed by research to better illuminate factors thought to impact this threat to child health, particularly in the preschool years.

The causes of pediatric obesity are multifaceted and complex and must be examined in the context of the child's family and social environment. The knowledge learned from study findings may prove useful as a basis for targeted obesity prevention efforts in an era of enhanced food availability, advancing modern technology, and improved ease of living.

Purpose of the Study

The purpose of this descriptive, cross-sectional research study is to examine factors thought to contribute to obesity and decreased physical activity in preschool California children. As the review of the literature in the next chapter shows, there are numerous unanswered research questions on this topic. Childhood activity levels, particularly sedentary behavior and physical activity will be investigated. The study also examines whether negative emotion is related to preschoolers' weight status. This research study attempts to fill some of the gaps in knowledge and provide direction for future study so that improved strategies may be developed to reduce pediatric obesity risk in this population of children.

Significance

The impact of study findings may be at many levels. Of greatest interest to this researcher is the potential to improve the health and well-being of preschool children. Obesity and overweight carry significant negative health consequences for children such as type 2 diabetes. Unfortunately, few studies have been identified which target prevention efforts for children between the ages of three and five years (Fitzgibbon et al., 2005, 2006; Flynn, et al., 2006; Hendy & Raudenbush, 2000; Reilly et al., 2006). Results from this study may serve to guide obesity prevention efforts and treatment interventions as a means to reverse the increasing trend of obesity prevalence. Long-term effects may be demonstrated as these children grow and mature into adulthood and avoid the health-related impacts of a lifetime of overweight. Further, the direct and indirect economic impacts of obesity on society are estimated in the billions of dollars for the U.S. population alone (G. Wang & Dietz, 2002; Wolf & Colditz, 1998); therefore, it is expected that successful prevention and treatment of this problem would provide substantial financial benefit for individuals and society at large. Study results may generate possibilities for obesity prevention efforts not previously identified for this age group.

Chapter Two: Review of Literature and Theoretical Framework

The problem of pediatric obesity poses significant personal and societal implications and has been deemed a global health priority by the World Health Organization (WHO, 2009). Understanding the etiology for this emergent health problem is a challenge due to the multiple factors that influence progressive, excessive weight gain. This chapter begins with a review of relevant research on childhood overweight, focusing on factors thought to be associated with obesity in the preschool age group. First, definitions of overweight and obesity are presented, followed by a discussion of the main study variables of physical activity and negative emotion. Then, the chapter provides a brief review of additional variables of interest for added context, specifically dietary intake, ethnicity, and maternal acculturation. Studies are presented in terms of their characteristics, significant research findings, and gaps for future research. The final pages of the chapter describe the theoretical framework for the study and the research assumptions, questions, and definition of terms.

Definitions of Overweight and Obesity

It is important to consider the definitions of overweight when referencing the pediatric population. Body mass index (BMI) measurement is a common tool used to identify adults as obese or overweight, according to linkages with obesity-related disease incidence in the adult population (Ritchie, et al., 2001). Similarly, research has demonstrated elevated childhood BMI is highly predictive of adult dyslipidemia, a major risk factor for coronary heart disease (Haney, et al., 2007). The CDC presents simplified classifications for pediatric obesity that take into account gender and age differences in child BMI measures. Although the CDC (1999) previously utilized classifications of “overweight” and “at risk for overweight” for children, these classifications have been revised. Strictly defined, a child is now considered obese if the BMI is at or exceeds the 95^{th} percentile and is considered overweight with a BMI that falls between the 85^{th} and 94^{th} percentile (Barlow, 2007). References throughout the paper adhere to the current definitions of weight status.

Overview of Relevant Research

This section presents an overview of the pediatric obesity literature specific to the dissertation research. Key variables of interest are presented first, followed by associated variables thought to have potential implications for study findings.

Physical Activity. Numerous studies have linked a sedentary lifestyle and limited physical play or exercise in day care with increased risk for overweight in young children. Two studies of preschoolers from diverse, lower socioeconomic backgrounds showed that overweight children spend significantly less time engaging in vigorous physical activity than their normal weight peers whether measured briefly at day care (Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003) or during all waking hours throughout the week (Metallinos-Katsaras, Freedson, Fulton, & Sherry, 2007). Similar findings were noted among overweight children attending preschool day care centers in Chile, where overweight children participated in less physical activity than recommended and routinely chose low rather than vigorous intensity activities when engaged in play (Vasquez, Salazar, Andrade, Vasquez, & Diaz, 2006). Janz et al. (2002) found that preschoolers who spent 17 minutes or less in vigorous daily activity had 4% more body fat than preschoolers whose vigorous physical activity lasted more than 35 minutes each day. It is important to note that in each of these studies decreased vigorous activity showed the greatest correlation with overweight. Research indicates that aerobic fitness, rather than simply total energy expenditure, is most closely associated with decreased risk for childhood adiposity (Johnson et al., 2000). The literature suggests a correlation between activity and overweight, yet descriptive studies like these do not elucidate causal relationships between the variables. However, longitudinal studies such as the Framingham Children's Study have noted that when preschool children's physical activity increases over time, levels of body fat decrease (Moore, Nguyen, Rothman, Cupples, & Ellison, 1995). These research findings are noteworthy for their consistency across varied demographic milieus.

At least two studies by Reilly and colleagues offer a divergent view of the effects of physical activity on overweight in the preschool population. In their first study, the researchers examined whether rising levels of physical activity correlate with an overall increase in total physical activity and energy expenditure (Montgomery et al., 2004). Among 104 Scottish preschoolers enrolled in the study, amounts of moderate to vigorous activity did not influence overall physical activity; rather, sedentary activity was most closely linked with physical activity totals. Reilly et al. conducted a follow-up study in Scotland with 545 children enrolled in nursery school (Reilly, et al., 2006). In this intervention study, the team provided an experimental group with parental education and added physical activity time of 30 minutes, three days a week, over a 24-week period. The group reported that at 6 and 12 months post intervention, the treatment was not sufficient to reduce preschoolers' BMI measures. The authors conclude that increased physical activity has little to no influence over adiposity in young children and suggest that interventions seeking to reduce sedentary time might be more effective, a recommendation supported by at least one other longitudinal study of overweight school children (Epstein et al., 1995).

At first glance the studies by Reilly and colleagues appear to seriously undermine the assumption that increased physical activity in young children may be a protective factor against overweight. However, the studies are not without limitations. In the first study, fewer than 10 children met the criteria for moderate activity which may have reduced the likelihood of discovering relationships between activity and total energy expenditure. The second study has several methodological flaws. Not only is it unclear what type of physical activity was performed by the children, critics have also noted that the authors may not have fully reported the children's adherence to the intervention (Michell, 2006). Another critique surrounds the BMI measure used, the BMI z-score, since this is not a direct measure of adiposity in children (Green & Cable, 2006). Future research must be mindful of how BMI and physical activity variables are measured and manipulated so that findings may be evaluated more fully. Additional work is needed to determine the fat and weight loss effectiveness of moderate to high intensity activity in young children both at home and in community settings.

Recreational availability and neighborhood safety may play a role in limiting or enhancing child activity levels. In one study of children ages four to seven years of age, increased physical activity correlated with increased housing density and greater park area relative to residential area (Roemmich et al., 2006). The authors posit that parents are more likely to permit children to play outside when neighbors and playmates are nearby and more likely to visit parks that offer play alternatives. A national CDC survey on physical activity in school-age children found that a significantly high percentage

(41.2%) of Hispanic parents reported neighborhood safety concerns while black and Hispanic parents reported significantly less involvement in organized sports (CDC, 2003). Parent perceptions of the child's environment may influence the kinds of activities in which the preschool child is permitted to participate and should be measured in studies of this age group.

If children are not participating in much physical activity, their sedentary behaviors also pose an obesity risk. The most studied sedentary behavior in young children is that of television viewing. Research conducted with 470 Midwest preschool children showed that children who watch more than three hours of TV per day have 3% more body fat than those who view an hour or less (Janz, et al., 2002) while research conducted in China revealed that preschool children who view TV more than two hours per day are at increased risk for overweight (Jiang et al., 2006). Additional studies of preschoolers found that increased TV viewing and decreased physical activity were the greatest predictors of overweight in a multiethnic population (Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005; Nelson, Carpenter, & Chiasson, 2006). The Framingham Children's Study followed the TV viewing habits of 106 children from preschool to early adolescence and determined that those spending the most time in front of the television set experienced the greatest increase in adiposity levels even when controlling for dietary intake, physical activity, and parental adiposity (Proctor et al., 2003). A study of ethnically diverse preschoolers from low income families discovered that 40% of these children had a TV in their bedroom and that the risk for overweight increased with every extra hour of daily TV viewing (Dennison, Erb, & Jenkins, 2002). These findings enhance those of an earlier study which found that among a national sample of children ages 12 to 17, every hour of TV watching above the average led to a 2% increase in obesity prevalence (Dietz & Gortmaker, 1985). Interestingly, studies of middle school children have found that eating while watching television increases the likelihood of overweight (McNutt et al., 1997) and TV viewing decreases the metabolic rate below that of rest (Klesges, Shelton, & Klesges, 1993). A critique of these studies is that all share a common data gathering methodology of parental report, which may affect accuracy. However, one could make the case that any inaccuracies would be expected to underestimate child TV viewing since up to a third of children have a television set in their own rooms, away from parental supervision.

Although the studies listed all demonstrate a link between TV use and pediatric overweight, others have refuted this finding by suggesting that the real culprit includes additional sedentary behavior patterns rather than TV viewing itself (Vandewater, Shim, & Caplovitz, 2004). Yet, when interventions have been applied to reduce TV viewing by middle school children, significant reductions in BMI occurred even when physical activity levels did not change (Robinson, 1999). This would appear to indicate that even small reductions in television time may be beneficial since TV viewing is a major activity for many preschool children. Furthermore, research on young girls has shown that the earlier the increase in TV viewing, the greater the risk of overweight (Davison, Francis, & Birch, 2005). As noted by Davison and Birch (2001), there are several factors that may influence overweight in young children relative to activity. In order for the child’s sedentary behaviors to decrease, perhaps the best strategy is for the family to get involved in monitoring TV viewing in early childhood while also encouraging appropriate physical activity. More investigation is needed to determine what prove the best tools in increasing physical activity in young children and decreasing TV viewing as a predominant sedentary activity.

Negative Emotion. The pediatric obesity literature suggests a link between children's psychological characteristics and weight gain. Primary lines of inquiry center on the relationship between negative emotion (frequently depression) and obesity as well as the association between negative emotion and dietary intake.

An association between negative emotion and obesity has been suggested in pediatric research. Overweight adolescents have reported higher scores of depression than normal weight peers (Erermis et al., 2004) and have been more likely to report psychological suffering and poor health behaviors (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002). Additionally, longitudinal research has implicated depressed mood in obesity. One study of boys from school-age through adolescence linked chronic obesity with depression scores (Mustillo et al., 2003) while another found that teenage depressed mood predicts adult obesity (E. Goodman & Whitaker, 2002; Richardson et al., 2003). A recent study of elementary school children in Taiwan reported an interaction effect between depression and socioeconomic status on overweight and underweight (<5th percentile BMI) (Lin, Hsieh, & Tung, 2012). The Taiwanese children in the underweight and overweight categories were more than five times as likely to be depressed if they came from low socioeconomic status while children in the normal weight category did not differ in their depression scores based on socioeconomic conditions. A meta-review by Liem and colleagues (Liem, Sauer, Oldehinkel, & Stolk, 2008) concluded that research evidence supports the association between childhood depressive symptoms and adult overweight. It should be noted that the vast majority of research in this area involves adolescents rather than young children. However, negative emotion appears to have an influence on weight status in childhood and may be complicated by factors such as poverty.

Negative mood has also been demonstrated as a correlate with abnormal dietary intake in children. Braet and Van Strien (1997) noted that overweight school-age children were more likely than non-overweight children to eat in response to negative emotions (e.g. loneliness, anxiety, irritation), to engage in restrictive dieting, and to eat as a response to external stimuli rather than actual hunger. The children who ate for emotional reasons or due to external stimuli had greater negative feelings of self and tended to eat more. In a similar study by Fryer, Waller, and Kroese (1997), the authors reported that teenage girls under increased stress were more likely to have troubled attitudes about food intake. When the teenage girls' stress and coping focused on emotion, it led to low self-esteem and subsequent poor eating attitudes. Studies have also shown that children self-report the utilization of eating and drinking as coping mechanisms, in populations of young children (Chen, Yeh, & Kennedy, 2007) and adolescents (Martyn-Nemeth, Penckofer, Gulanick, Velsor-Friedrich, & Bryant, 2008). Questions arise regarding whether the young child's ability to self-regulate feeding behaviors, for example, is more closely associated with family or environmental factors or with individual psychological functioning. Yet, research suggests that both brain development and social environment play important and interrelated roles (Eisenberg, Fabes, & Guthrie, 1997; Kochanska, Philibert, & Barry, 2009; Kopp, 1982; Sokol & Muller, 2007) and early childhood is a critical time period for the development of self-regulation (Feldman, 2009). Further investigation should explore the hypothesis that pediatric weight gain results from overeating as a coping mechanism for negative mood.

Studies support a relationship between negative emotion and obesity in children. The literature lacks examples of these relationships in preschoolers, which may be partially attributed to the age limitation of available survey instruments. Research is needed to explore whether negative emotions influences obesity in the preschool population and whether other factors may be interrelated.

Dietary Patterns. A comprehensive review of the literature published in 2007 by Davis and colleagues (2007) suggests that decreased risk of overweight is linked to increased intake of fruits and vegetables, while increased risk of overweight is associated with juice, soda, or soft drink consumption as well as intake of fried foods, fast food, cookies, and candy. Each of these diet variables will be explored further in this section.

Research has examined the fruit and vegetable intake of preschool children. A nationwide survey completed in 2002 found that French fries are the most common source of vegetables in the diets of two-year-old children while a third of their diets contain no fruit at all (Fox, Pac, Devaney, & Jankowski, 2004). These findings are alarming when compared to the recommendation of a minimum of five servings of fruits and vegetables per day (USDA, 2005). One study found a significant decrease in the fruits and vegetables consumed by overweight compared to normal weight five and six-year-old children, although fruit and vegetable intake was not by itself a significant predictor of overweight status (Miller, Moore, & Kral, 2011). However, these results should be taken with caution due to the low numbers of study participants (n = 39). A longitudinal study of 1379 low income preschool children identified no significant relationship between fruit and vegetable intake and weight change over a 6 to 12 month period (Newby et al., 2003). It is possible that the duration of the aforementioned study did not allow sufficient time for relationships to appear. Future investigation should more closely examine the relationship between fruit and vegetable consumption and weight status of young children because the literature provides inadequate support for an inverse relationship.

A number of studies show a positive relationship between childhood overweight and the intake of sweetened beverages. An extensive review of the data from the National Health and Nutrition Examination Survey (NHANES), which benefits from a representative national U.S. sample, shows that a substantial percentage of daily caloric intake for children ages 2 to 19 years comes from sugary drinks such as soda and fruit juices (Troiano, Briefel, Carroll, & Bialostosky, 2000). The review also demonstrates a relationship between increased sweetened beverage intake and pediatric overweight. A study of low income preschool children in Missouri found that as little as one to two servings of sweet beverages per day increased the overall risk for overweight in these children (Welsh et al., 2005). A longitudinal study of non-Hispanic white girls found that non-milk, non-fruit juice sweetened beverage intake at age five years demonstrated a positive correlation with adiposity at 5 and 15 years of age (Fiorito, Marini, Francis, Smiciklas-Wright, & Birch, 2009). In another review of the NHANES data, children ages two to five years with increased intake of beverages such as milk and fruit juice exhibited an increase in total energy intake without a concomitant increase in BMI (O'Connor, Yang, & Nicklas, 2006). Researchers note that the consumption of non-diet soft drinks in childhood significantly increases daily calorie consumption and diminishes the ingestion of healthier alternatives such as milk (Harnack, Stang, & Story, 1999) which may lead to overweight. Future research should attempt to separate out the soda, sweetened beverage, and fruit juice intake to provide better information regarding the obesity risk associated with each of these liquids in the diets of young children.

Fast and fried foods have been associated with childhood obesity. A study of school-age children demonstrated an increase in gender and age-adjusted BMI by 0.02 for each additional day per week of fast food intake over the course of a year (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006). Similarly, adolescents have shown increased BMI scores with increasing fast food consumption over a one-year period (Taveras et al., 2005). Among preschoolers, fried food has been associated with increased adiposity in longitudinal research even when adjusted for overall caloric intake (Wosje et al., 2010). These findings regarding fast and fried foods are of special interest given that French fries appear to be prevalent in toddler diets (Fox, et al., 2004) and because it has been estimated that up to 30% of children ages 4 to 19 years of age consume fast food on a given day (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). The substantial consumption of fast and fried foods by U.S. children requires that research include these variables in predictive models.

Despite the results of the studies listed above, the relationship between high calorie food intake and childhood obesity is not straightforward. The Missouri study noted that lean children who consumed sweet beverages did not experience statistically significant gains in BMI as compared to their overweight and obese peers (Welsh, et al., 2005). A study of adolescents noted that lean children exposed to above normal fast food diets did not eat as many calories as their overweight peers and appeared to compensate for the extra energy intake (Ebbeling et al., 2004). These results suggest that children with normal BMI are better able to tolerate such assaults on a healthy diet for reasons as yet unknown. Future research studies should seek participants from all weight classifications and from younger age groups to help identify whether protective factors against obesity exist in lean children such as greater ability for energy self-regulation.

Food availability and dietary practices in modern day culture play a significant role in pediatric overweight. If young children's primary source of vegetables comes from fried potatoes, increased fat in the diet is a probable result. Likewise, association between sweetened beverage intake and overweight should be expected due to the high caloric density of these drinks. Children from overweight families are subject to a combination of genetic and behavioral influences on food preference and research shows that high fat diets, for example, are more prevalent in these families (Davison, et al., 2005). Research is needed to parse out the distinct dietary factors thought to contribute to overweight in young children and to discern whether protective factors are present in lean children so that interventions will be targeted appropriately.

Ethnicity and Maternal Acculturation

Ethnicity has been repeatedly associated with pediatric obesity across multiple national studies of children, with African American, Native American, and Hispanic children experiencing higher obesity rates than non-Hispanic whites and Asians (Anderson & Whitaker, 2009; Ogden, Carroll, Kit, & Flegal, 2012; Y. Wang, 2011). These ethnic differences have been found as early as the preschool period (Sherry, Mei, Scanlon, Mokdad, & Grummer-Strawn, 2004). Interestingly, associations between increased BMI and socioeconomic status or gender have demonstrated variations among and within ethnic groups (Ogden, et al., 2012; Y. Wang, 2011). For example, a 2005 national study of preschoolers reported an obesity prevalence of 37% for male Native Americans compared to an obesity rate of nearly 16% for male Asians. In the same study, obesity prevalence in Native American girls was 26% compared to 10% in Asian girls. Among Hispanics in the study, the obesity prevalence was similar for boys and girls at approximately 22%. In a separate study of low-income preschoolers, obesity prevalence was highest among Native American children although the prevalence of obesity in African American children was below that of non-Hispanic whites (CDC, 2009). These findings indicate that future research studies should provide comparative analysis of multiethnic populations.

A component of ethnicity involves cultural practices of the family. If the focus of pediatric obesity prevention programs should be the young child, it is imperative that one consider that the primary caregiver is predominantly the mother. The ethnicity and acculturation status of the mother may affect the development of children's behavior patterns, such as dietary intake and physical activity. One study of Chinese American school-age children found that low parental acculturation was associated with increased BMI (Chen & Wu, 2008). A national, longitudinal study of children from kindergarten through fifth grade utilized parental English language proficiency as a proxy for acculturation status in its investigation of pediatric obesity (Van Hook & Baker, 2010). The study, which included a multiethnic sample, found that poor English proficiency may serve as a protective factor for excessive weight gain in children of immigrant parents because these parents remain socially isolated from an obesity-prone environment. Conversely, a study of Hispanic toddlers in the northeastern U.S. demonstrated elevated

BMI risk for children whose mothers spoke no English at all (Sussner, Lindsay, & Peterson, 2009). It would seem that the relationship between pediatric weight status and acculturation is unclear and warrants further study.

Summary. As a review of the literature shows, numerous avenues for investigation are available and may yield beneficial findings in the prevention and treatment of overweight in preschool children. Research suggests physical inactivity, poor diet, and negative mood may negatively affect the child's ability to maintain a healthy weight. Ethnic variations in pediatric obesity prevalence have been identified but appear to vary according to the age group, socioeconomic status, and population studied. Very limited research exists regarding the influence of maternal acculturation on preschool overweight and whether this characteristic exacerbates or lessens obesity risk. Overall, much more research has been conducted in these areas among school-age or adolescent children than in the preschool-age group. Future research should be conducted with young children to identify factors which are most strongly correlated with obesity.

Theoretical Framework

Utilizing a holistic perspective, researchers have identified myriad factors thought to contribute to childhood weight gain and obesity. A useful framework for examining the problem can be found in the model by Davison and Birch (Davison & Birch, 2001). The *Ecological Model of Childhood Obesity* (see Figure 1) names key factors extant in the child's environment, ranging from behavioral norms to family and community variables. The model depicts the child's behaviors as central with successive rings representing added layers of contextual influence on the child's weight status.

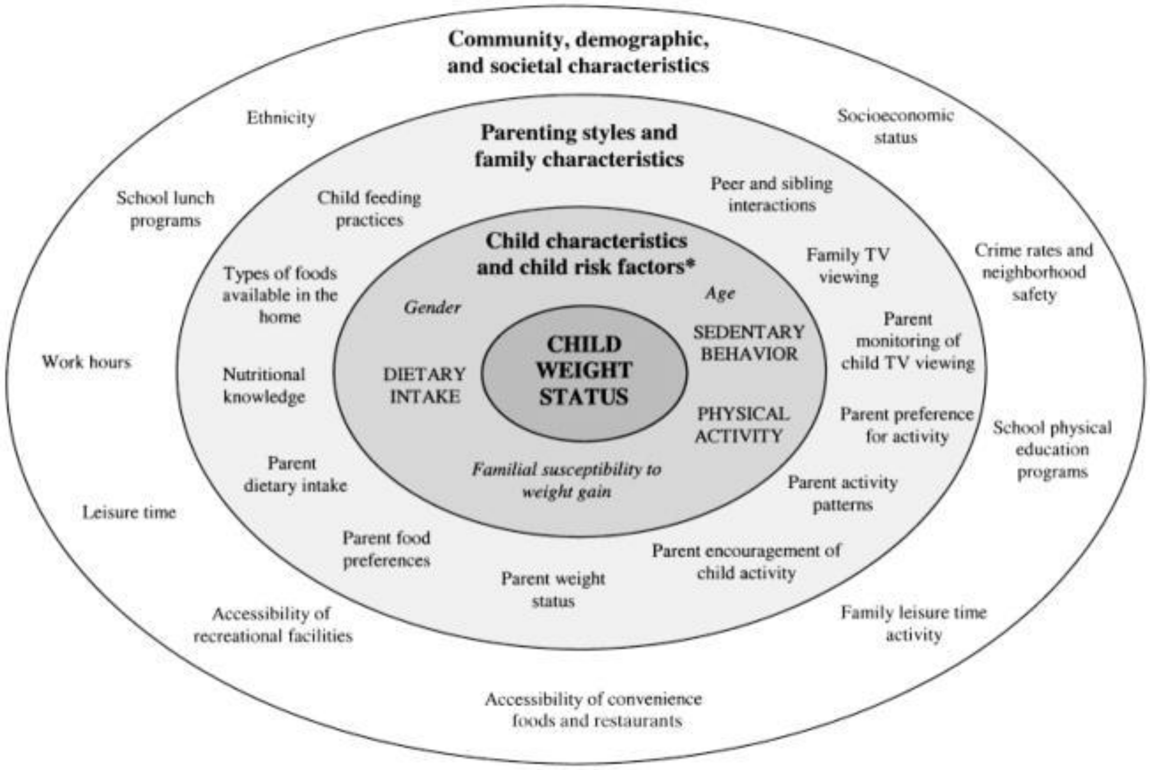

Figure 1. Ecological Model of Childhood Obesity (Davison & Birch, 2001)

Of primary interest in this study is an investigation of the fundamental child behaviors presented in the ecological model: dietary intake, physical activity, and sedentary behavior. Another component of child behaviors would seem to be negative emotion, which is also explored for its contribution to weight gain. The study also examines select community and demographic factors, including ethnicity, socioeconomic status (poverty, maternal acculturation) and accessibility of recreational facilities (park factors). Each factor is examined for influence on obesity and physical activity in the preschool child. The parent and family factors presented in the ecological model will not be investigated in this study of preschool children due to access limitations for family and parent data.

Assumptions

The study has several assumptions. It is assumed that the data selected for the research project from the 2009 Child version of the California Health Interview Survey (CHIS) will provide varied, reliable information from a socioeconomically diverse group of California children and that CHIS items will represent key variables of interest embedded in the Davidson and Birch ecological theory model. There is also an assumption that current understanding of child BMI and the use of BMI as a way to categorize weight status provides meaningful and clinically significant differences. The literature makes a strong case for the expectation of overweight among children of all ages; therefore, it is also assumed that the study sample will yield sufficient numbers of overweight and obese preschoolers with which to perform comparative analyses. Assuming a small effect size (Cohen's $f^2 = 0.02$), in order to obtain the sufficient desired power of 0.80 at a level of significance of $p < .05$ for multiple regression analysis with eight variables, a sample size of at least 757 is required (Cohen, 1992). The 2009 CHIS child public use data file has reported heights and weights (for BMI calculation) on 1,580 preschoolers which meets this minimum participant standard for at least eight variables in a multiple regression model.

Research Questions

The specific aim of this cross-sectional descriptive study is to examine factors related to increased BMI in the preschool California population. A secondary aim is to determine factors associated with physical activity for this population. To this end, the well-established CHIS will be the source of data for secondary analysis pertaining to the following research questions:

1. What are the factors related to increased BMI in preschoolers age three to five years of age in the CHIS study?
    a. What is the relationship between age, gender, ethnicity, poverty level, diet, physical activity, sedentary behavior, park factors, maternal acculturation, and BMI in preschoolers?
    b. What factors contribute to increased BMI in preschoolers?
2. Is child negative emotion associated with overweight in preschoolers age three to five years of age in the CHIS study?
    a. What is the relationship between negative emotion and BMI in preschoolers?
3. What are the factors related to physical activity in preschoolers five years of age in the CHIS study?
    a. What is the relationship between age, gender, ethnicity, poverty level, sedentary behavior, park proximity, park use, park safety, maternal acculturation, and physical activity in preschoolers?
    b. What factors contribute to meeting the physical activity recommendation of at least 60 minutes of physical activity per day in preschool children?

Definition of Terms

The purpose of the study is to factors thought to influence obesity in preschoolers. Utilizing the Davison and Birch model, questions were identified within the 2009 CHIS that relate to the following variables: age, gender, poverty, ethnicity, maternal acculturation, BMI, diet, physical activity, sedentary activity, park factors, and negative emotion. Operational definitions for the variables will be presented next.

Demographic variables. The study will consider demographic variables as part of the analysis. These include age, gender, poverty, ethnicity, and level of maternal acculturation. Each of these variables will be defined separately.

Age and gender. Children are identified as preschoolers and included in the study if they are three, four, or five years of age. Each child's gender is reported in the data file as male or female.

Poverty. Poverty level is defined according to the proxy adult respondent's answer to the CHIS question on household income. This value is converted in the CHIS data file to represent a percent of federal poverty level (FPL). The FPL is widely used among researchers and governmental agencies as a delimiter of socioeconomic strata; an FPL of less than 100% is classified as below the federal poverty threshold (U.S. Census Bureau, 2011). This study utilizes both the actual percentage FPL and four categories of FPL in the analysis, representing less than 100% FPL, 100% to 199% FPL, 200% to 299% FPL, and over 300% FPL.

Ethnicity. The ethnicity of preschoolers in the study sample is determined by the proxy adult respondent's self-report of the child's ethnic status. Since the 2007 version of the CHIS, if a child is reported to be part of more than one ethnic group, surveyors have inquired further to see if the child most identifies with one ethnic group and if so, the child receives the ethnicity designation for this primary ethnic category (CHIS, 2008). Children who do not identify with one ethnic group over another are categorized as "multiple race." For purposes of comparative analysis, preschoolers in the study are classified as a member of one of four categories: white, Hispanic, Asian, and other (to represent African American, American Indian, and multiple/other race).

Maternal acculturation. Maternal acculturation is determined by CHIS responses to items which solicit total number of years the index child's mother has lived in the U.S. and how well the mother speaks English. Each of these criteria has been implemented in research of acculturation (Arcia, Skinner, Bailey, & Correa, 2001; Cruz, Marshall, Bowling, & Villaveces, 2008) including studies of child overweight (Ahn, Juon, & Gittelsohn, 2008; Sussner, et al., 2009; Van Hook & Baker, 2010). Respondents were asked, "About how many years has his/her mother lived in the United States" and responses were placed into one of eight categories of increasing residence length, as follows: less than 1 year, 2 to 4 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 29 years, or over 30 years. The maternal English proficiency variable was created from the index child's mother's response to the question, "Compared to other languages spoken in (child)'s home, would you say you speak English… very well, fairly well, not well, or not at all well?"

BMI and weight status. Each CHIS survey respondent was asked to report the index child's height and weight. These measures were used to calculate the raw BMI and subsequently categorize the child's weight status based on current CDC definitions for age and gender. In this study, the BMI is analyzed as a categorical variable with categories of *underweight* and *normal weight*, *overweight*, and *obese* further dichotomized into *overweight* and *not overweight*.

Diet. Dietary analysis is based on responses to six food-related questions from the CHIS. These diet variables were converted to binary variables based on the established guidelines related to intake for preschool children. For example, the American Academy of Pediatrics (AAP) Committee on Nutrition (2001) recommends no more than six ounces (one glass) of juice intake per day; therefore, survey responses to the juice intake question, “Yesterday, how many glasses or boxes of 100% fruit juice, such as orange or apple juice, did (child) drink?” were dichotomized according to whether the index child’s intake meets these guidelines. The United States Department of Agriculture (USDA) has recommended against foods with added sugar and sugar-sweetened beverages since 2005 for suspected links to obesity (USDA, 2005). The AAP also discourages the consumption of sweetened beverages and soda for young children (Gidding et al., 2006) and recommends that energy-dense and fast food intake is limited (Davis, et al., 2007). Survey items asking “Yesterday, how many servings of…” high sugar foods, soda or sweetened beverages, and fried foods were assessed and dichotomized into categories of no servings or one or more servings to reflect these recommendations. As well, the response to the question “In the past 7 days, how many times did (he/she) eat fast food?” was similarly transformed into a binary independent variable of no servings per week and one or more servings per week.

Physical activity. The physical activity variable will provide information regarding frequency of preschool children’s activity. The CHIS solicits information regarding children’s physical activity according to the AAP, the National Association for Sport and Physical Education (NASPE), and other advocacy groups’ recommendations of 60 minutes of moderate physical activity per day (Council on Sports Medicine and Fitness, 2006; National Association for Sport and Physical Education, 2009). From the preschool study sample, only information regarding five-year-old children was solicited.

Survey respondents were asked, “Not including school PE, on how many days of the past seven days was (child) physically active for at least 60 minutes total?” This continuous variable was converted to a dichotomous variable to represent children meeting physical activity guidelines (≥ 60 minutes/day) and those who do not (<60 minutes/day).

Sedentary activity. The primary sedentary behavior variable of interest for this study is the amount of daily screen time. Screen time is defined as use of entertainment media such as television or computers (Strasburger, 2011). The AAP recommends that children over the age of two years limit the amount of screen time to no more than two hours per day (Strasburger, 2011). The CHIS has two items related to screen time; both ask respondents to consider the index child’s use of entertainment media on the weekends only. The first item asks, “Thinking about just Saturdays and Sundays, about how many hours does (child) usually watch TV or play video games (such as Playstation)?” and the other item asks “About how many hours per day on a typical Saturday or Sunday does (child) use a computer for fun, not schoolwork?” Responses for these two items were collapsed into a single continuous variable representing total hours of screen time. The screen time variable was further dichotomized for the purpose of analysis into two categories representing preschoolers who meet the AAP screen time guidelines of no more than two hours per day and those who exceed these guidelines.

Park factors. In this study, three key park factors of park availability, park use, and park safety are represented by three questions on the CHIS. The survey asks whether a play area is within walking distance of home, the number of days the child has been to the park in the past 30 days, and whether the nearest park is considered safe. These three variables of play area availability, amount of park play, and park safety have been positively associated with children's actual physical activity in research studies (Sallis, Prochaska, & Taylor, 2000). Each park factor variable was transformed into a dichotomous variable for analysis based on a "yes" or "no" response to the first two questions and by combining responses on the park safety question so "agree" and "strongly agree" become a single affirmative response and "disagree" and "strongly disagree" become the negative response to that item.

Negative Emotion. Preschooler's negative emotion is ascertained via three response items that were in two separate subsections of the 2009 CHIS. These items were from standardized measures of perceived developmental delay and parent concerns about mental health development. The measure of mental health development was a short, 7-item version of the 25-item Strengths and Difficulties Questionnaire (SDQ) created for use in children ages 3 to 16 years (R. Goodman, 2001). The second measure was the Parents' Evaluation of Developmental Status (PEDS) survey, a 10-item questionnaire for children from birth through eight years of age (Glascoe, 2000). Three specific items were selected from the SDQ and PEDS to evaluate the presence of negative emotion in study participants.

Two items came from the SDQ, an instrument used to collect data only from 4 and 5 year old children. The measure asks the proxy adult to state whether, in the past six months, each survey item is "not true, somewhat true, or certainly true" of the child. The child receives an overall behavioral and emotional difficulty score which is interpreted as *normal, borderline,* or *abnormal*. The two negative emotion items selected from the SDQ are found within the *Emotional Symptoms* subscale. The first individual item asks if "the child is often unhappy, depressed, or tearful." The second item asks if the child "has many worries or often seems worried." These two items were transformed into binary variables prior to analysis by combining "somewhat true" and "certainly true" into one response type and "not true" into the other.

The third item used to measure negative emotion came from the PEDS survey, an instrument that assesses parents' concerns about their child's perceived risk of developmental delay (Glascoe, 2000). In the CHIS, the proxy adult who completes the survey is asked "are you concerned a lot, a little, or not at all" regarding the index child's development in areas such as language ability, motor skills, and social interactions. The sum of individual item responses on the PEDS was used by the 2009 CHIS personnel to assign children to developmental risk levels of *no risk, low risk*, *moderate risk,* and *high risk*; numeric scores are not provided within the CHIS public use data file. The specific item on the PEDS chosen to represent negative emotion in the present study asks the proxy adult about "your child's feelings and moods." For the purposes of later analysis, responses to this item were dichotomized by collapsing the answer options of "concerned a little" and "concerned a lot" to represent an affirmative response with "not at all" representing the negative response to the item.

Chapter Three: Risk Factors for Obesity in California Preschoolers

Abstract

Aim: The aim of this study was to examine factors associated with obesity in preschool California children.
Subjects and Methods: Data from the 2009 Child version of the California Health Interview Survey (CHIS) were included in the analysis of 1510 preschoolers aged three to five years with values for height, weight, and ethnicity. Survey responses were obtained via randomized telephone survey of households whereby a parent or guardian provided information about a child in the household. CHIS data were analyzed for the following variables of interest: gender, socioeconomic status, physical activity, sedentary activity, diet, neighborhood park factors, and maternal acculturation.
Results: Approximately 36% of preschoolers were categorized as obese ($\geq 95^{th}$ percentile BMI for gender and age). More boys (41%) than girls (31%) were classified as obese and approximately 46% of Hispanics and 32% of whites and Asians fell in this category. The combined multinomial logistic regression model identified poverty, ethnicity, and fast food intake as predictors of obese status. Hispanics were 1.73 times as likely to be obese as whites. Preschoolers whose family household income exceeded 300% of the federal poverty level (FPL) were 63% less likely to be obese than children whose families earned less than 99% of FPL. Children avoiding fast food intake the previous week were 30% less likely to be classified as obese.
Conclusion: This study of preschool California children supports previous research findings regarding risk factors for obesity, including low socioeconomic status, Hispanic ethnicity, and fast food intake. Efforts to prevent child obesity must begin as early as risk factors are identified and must include culturally relevant interventions to assist families in raising healthy children.

Keywords: Preschool, obesity, ethnicity, CHIS

Introduction

The problem of pediatric obesity is a growing phenomenon in the United States (U.S.) and worldwide. Data collected by the Centers for Disease Control and Prevention (CDC) via the 2009-2010 National Health and Nutrition Examination Survey (NHANES) found the prevalence of obesity at 12% among children aged two to five years (Ogden, et al., 2012), an increase from a rate of 10% reported in the same age group two years prior (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Up to a third of U.S. children meet the criteria for overweight or obese with rates of overweight among preschoolers more than doubling since the 1970s to a current prevalence estimate of over 23% (Ogden & Carroll, 2010; Ogden, et al., 2012). This upward trend in pediatric overweight and obesity among increasingly younger age groups has implications for both current and future health outcomes in children and adults alike.

Research suggests that the earlier the onset of obesity in childhood, the more likely an individual will be obese as an older child and ultimately as an adult (Dietz, 1998; Lake, et al., 1997; Nader, et al., 2006; Ritchie, et al., 2001; Serdula et al., 1993). Longitudinal data show that obesity begun in childhood bodes poorly for future health. Diabetes, depression, and cardiovascular complications such as dyslipidemia, hypertension, and heart disease are but a few of many known consequences for obesity in both children and adults (Ernst & Obarzanek, 1994; Flynn, et al., 2006; Frankel, et al., 1996; Haney, et al., 2007; Morgan, et al., 2002). Further, these health problems are thought to have greater severity for individuals who become overweight in their youth (Dietz; Frankel, et al., 1998; Gunnell, et al., 1998). Adults are more likely to be weight stable in later years, in contrast, if they were lean in childhood, thereby preventing health complications (Davison & Birch, 2004). The increasing prevalence of childhood obesity may result in a population of adults whose weight-related health problems overwhelm the healthcare system.

Gender and ethnic differences have been found in U.S. child obesity rates. Ethnic disparities exist among racial minorities, with higher obesity prevalence reported among Hispanic, African American, and American Indian children and lower prevalence among Asian and non-Hispanic white children (Anderson & Whitaker, 2009; Ogden, et al., 2012; Y. Wang, 2011). These ethnic differences have been found as early as the preschool period (Anderson & Whitaker, 2009; Sherry, et al., 2004). Boys have also experienced greater aggregate increases in obesity prevalence than girls, although gender variations have been demonstrated among and within ethnic groups in some studies (Ogden, et al., 2012; Y. Wang, 2011) which suggests a need for further investigation.

Previous research findings emphasize that children's physical activity and sedentary behavior can affect the child's ability to maintain a healthy weight or prevent further weight gain (Epstein, et al., 1995; Johnson, et al., 2000). Preschool children identified as overweight have been shown to spend significantly less time engaging in vigorous physical activity than their normal weight peers when at day care (Trost, et al., 2003), when engaged in play activities (Vasquez, et al., 2006), and during all waking hours throughout the week (Metallinos-Katsaras, et al., 2007). Preschoolers who spend less time in vigorous daily activity have greater body fat (Janz, et al., 2002) and are at greater risk for overweight (Nelson, et al., 2006). Recreational facility or park availability and amount of outdoor play have been positively associated with children's actual physical activity in some research studies (Dunton, Kaplan, Wolch, Jerrett, & Reynolds, 2009; Sallis, et al., 2000) and may be a contributing factor to obesity rates. In terms of sedentary behavior, studies suggest that preschool children who watch more than three hours of television per day have 3% more body fat than those who view an hour or less (Janz, et al., 2002). Additional studies have found increased TV viewing and decreased physical activity to be the greatest predictors of overweight in multiethnic preschool populations (Jago, et al., 2005; Nelson, et al., 2006) with an odds ratio for overweight at 1.06 for every extra hour of daily TV use among low-income preschoolers (Dennison, et al., 2002).

Dietary correlates of preschool obesity have been identified. An extensive review of the NHANES data demonstrates a relationship between increased sweetened beverage intake and pediatric overweight (Troiano, et al., 2000), a finding that has also been demonstrated in low income preschool children (Lim et al., 2009; Welsh, et al., 2005). Excessive juice intake has been linked to preschool obesity in some studies (Dennison, Rockwell, & Baker, 1997; Welsh, et al., 2005) but not others (Alexy, Sichert-Hellert, Kersting, Manz, & Schoch, 1999; Nicklas, O'Neil, & Kleinman, 2008). Researchers have found that the consumption of non-diet soft drinks in childhood significantly increases daily calorie consumption and diminishes the ingestion of healthier alternatives such as milk (Harnack, et al., 1999), which may lead to obesity. Among solid foods, fast food and fried foods have been implicated as contributors to pediatric obesity, mostly in studies of school-age and adolescent children. School-age children demonstrated an increase in gender and age-adjusted BMI by 0.02 for each additional day per week of fast food intake after one year follow-up (Niemeier, et al., 2006). These results are similar to findings in a study of adolescents who experienced increased BMI scores with increasing fast food consumption over a one year period (Taveras, et al., 2005). Among preschoolers, fried food has been associated with increased adiposity in longitudinal research (Wosje, et al., 2010). Clearly, additional research in preschoolers' dietary intake is warranted to better define the type and amount of foods and beverages that place the child at highest risk for obesity.

Obesity in the preschool period has also been associated with familial factors such as socioeconomic status and maternal acculturation. Obesity has been shown to be more prevalent among preschool children from poorer households both in the United Kingdom (Armstrong, Dorosty, Reilly, & Emmett, 2003) and the U.S. (Y. Wang & Beydoun, 2007), although the degree of socioeconomic influence appears to be waning and seems to vary depending on individual factors such as ethnicity and geographic location (Y. Wang, 2011). Maternal acculturation has also been shown to influence overweight in children of varied age and ethnic groups (Chen, Weiss, Heyman, & Lustig, 2009; Chen & Wu, 2008; Sussner, et al., 2009) and deserves special scrutiny given that mothers of young children have great influence during this critical period of socialization and development.

The aim of this study was to examine demographic, dietary, and behavioral factors associated with obesity in preschoolers aged three to five years old living in California. Limited research has been conducted on large, diverse populations of children from the preschool age group and what research does exist has produced contradictory findings in several areas. Exploring the factors thought to contribute to obesity in this age group may help focus prevention and treatment efforts where they will be most effective in California or in other diverse communities across the country.

Study Sample

Data from the California Health Interview Survey (CHIS) 2009 Child public use data file was utilized for this analysis. The CHIS is a health survey of adults and children conducted biannually by researchers at the University of California, Los Angeles, Center for Health Policy Research in concert with the California Department of Health Services and the Public Health Institute (CHIS, 2011a).

The CHIS is recognized as the largest state-based public health survey in the U.S. (Holtby et al., 2008). The CHIS utilizes weighting and imputing of data in an effort to provide valid population estimates for health risk factors and behaviors of Californians (CHIS, 2011a). Questions on the child CHIS range from demographic information such as age, gender, height, weight, and immigration status to health-related topics such as medical diagnoses, school attendance, developmental status, diet, and physical activity.

The 2009 CHIS methodology report describes a sample design method intended to provide a representative sample of California's ethnic and population diversity (CHIS, 2011a). Data for the child version of the CHIS survey were obtained primarily through a randomized telephone survey of households whereby a parent or legal guardian provided information about a randomly selected child within the household. The telephone solicitation was designed according to geographic area (county) and utilized both landline and cellular phone numbers. Purposeful oversampling was also used to improve participation from Korean and Vietnamese residents. These groups were oversampled by focusing calls to geographic areas with high concentrations of these subgroups and also by drawing telephone numbers from a pool with identifiable Korean or Vietnamese ethnic surnames. In order to participate in the CHIS phone survey, respondents were required to speak one of five languages well enough to answer questions, including English, Spanish, Chinese (Mandarin or Cantonese), Vietnamese, or Korean. Approximately 24% of the 2009 CHIS child surveys were reportedly completed in a language other than English (CHIS, 2011c).

According to the CHIS 2009 report on response rates (CHIS, 2011c), a total of 8,945 interviews were completed with proxy adult responders for the survey of children aged infant through 11 years. The report utilized a weighted methodology to determine an overall completion rate, which accounts for both ineligible households (such as invalid phone numbers) and also population oversampling and undersampling. Nearly 16% of households contacted via landline phone and approximately 7% of those contacted via cell phone participated in the child survey, yielding an overall weighted response rate of nearly 14%. Of those, 73% of landline respondents and 76% of cell phone respondents successfully completed at least 80% of the child survey. The report notes that child survey completion rates benefited from a “child-first” sample methodology which required interviewers for the landline sample to complete the child survey first before continuing on to the adolescent and/or adult survey. The CHIS team sent introductory letters to homes where addresses could be matched to selected landline phone numbers. Each letter included two dollars as incentive for participation prior to the survey attempt; interviewers also called numbers repeatedly to increase participation. Cell phone respondents did not receive pre-assessment letters but were offered nominal payment for interview completion.

This study of preschool children was limited to children in the 2009 CHIS child sample who were between three and five years of age. In order to be included in the analysis, the children were required to have values for height and weight as needed to compute BMI. The CHIS 2009 Child public use data file contained these data for a total of 1580 children aged three to five years.

Study Variables

BMI and Weight Status

A weight status variable was created as a measure of the dependent variable. CHIS survey respondents were asked to report the index child's height and weight without shoes. These measures were used to calculate the raw body mass index (BMI) and subsequently categorize the child's weight status based on current CDC definitions for age and gender. The CDC (2012) considers a child *obese* if the BMI is at or exceeds the 95^{th} percentile and *overweight* with a BMI that falls between the 85^{th} and 94^{th} percentile. Conversely, a child is identified as *normal weight* if the BMI falls between the 5^{th} and 84^{th} percentile and *underweight* with a BMI below the 5^{th} percentile. For this study, BMI values were categorized three ways: *obese, overweight,* and *underweight* or *normal weight.*

The CHIS 2009 child public use data file did not contain the child's BMI value. Therefore, children's BMI classifications were made in a stepwise fashion. First, the reported weight in kilograms was divided by the height in meters squared to obtain the raw BMI according to the formula prescribed by the CDC (2011). Then a simple frequency analysis was conducted to see if any BMI values fell far outside the normal range. Tukey boxplot distributions of BMI values were analyzed using PASW Statistics Version 18 (IBM, 2010). The first and third quartile findings were incorporated into cut point calculations to eliminate outliers with either extremely high or low BMI values.

Next, each BMI was compared to the CDC's BMI-for-age reference tables (CDC, 2001) for children aged 66.5 months (approximately 5 ½ years old), 54.5 months (approximately 4 ½ years old), and 42.5 months (approximately 3 ½ years old). Finally, each child's BMI value was used to assign the child to the appropriate BMI category, leaving a total of 1510 children in the study for remaining analysis.

Demographic Variables

The study considered demographic variables as part of the analysis. These variables include gender, ethnicity, socioeconomic status, and maternal acculturation.

The CHIS asks respondents to identify the child's gender and also the child's ethnicity. Since the 2007 version of the CHIS, if a child is reported to be part of more than one ethnic group, surveyors have inquired further to see if the child most identifies with one ethnic group and if so, the child receives the ethnicity designation for this primary ethnic category (CHIS, 2008). Children who do not identify with one ethnic group over another are categorized as "multiple race." Of the children included in this study, the three major ethnic groups of Hispanic, Asian, and white were represented in sufficient number to yield reliable statistical estimates. Children from all other ethnic groups (African American, American Indian, multiple, and other race) were consolidated into a category titled "other" for comparative analysis due to small sample size.

The index child's socioeconomic status is evaluated in the CHIS via the respondent's report of household income. This value is then recoded within the database in terms of percent of federal poverty level (FPL). The FPL is widely used among researchers and governmental agencies as a delimiter of socioeconomic strata; an FPL of less than 100% is classified as below the federal poverty threshold (U.S. Census Bureau, 2011).

Maternal acculturation was assessed by reviewing CHIS responses regarding years lived in the U.S. and degree of English proficiency. Respondents were asked, "About how many years has his/her mother lived in the United States" and responses were placed into one of eight categories of increasing residence length. The maternal English proficiency variable was created from the index child's mother's response to the question, "Compared to other languages spoken in (child)'s home, would you say you speak English… very well, fairly well, not well, or not at all well?" Both the maternal years of residence and English proficiency criteria have been implemented in research of acculturation (Arcia, et al., 2001; Cruz, et al., 2008) and language use has been shown to be one of the strongest indicators of acculturation (Arcia, et al.; Marin & Gamba, 1996). Some research findings suggest that for Hispanic children, increasing length of U.S. residence is a risk factor for overweight in adolescents (Ahn, et al., 2008) and lack of maternal English proficiency is a risk for overweight in children as young as two years old (Sussner, et al., 2009). Conversely, at least one study of ethnically diverse, early school-age children has found that poor English proficiency may serve as a protective factor for excessive weight gain in children of immigrant parents (Van Hook & Baker, 2010) so the relationship between weight status and acculturation is unclear.

Park Factors

Access to parks was measured via three questions on the CHIS. The survey asks, "Is there a park, playground, or open space within walking distance of your home?" and "Has the child been to a park in the past 30 days?" The survey also asks whether the respondent agrees that “The park or playground closest to where I live is safe during the day.” These three variables of play area availability, amount of park play, and park safety have been positively associated with children’s actual physical activity in research studies (Sallis, et al., 2000). Each park factor variable was transformed into a dichotomous variable for analysis based on a “yes” or “no” response to the first two questions and by combining responses on the park safety question so “agree” and “strongly agree” become a single affirmative response and “disagree” and “strongly disagree” become the negative response to that item.

Physical Activity

The CHIS solicits information regarding 5-year-old children’s physical activity according to the American Academy of Pediatrics (AAP), the National Association for Sport and Physical Education (NASPE), and other advocacy groups’ recommendations of a minimum of 60 minutes of PA per day, every day (Council on Sports Medicine and Fitness, 2006; National Association for Sport and Physical Education, 2009). CHIS survey respondents were asked, “Not including school PE, on how many days of the past 7 days was (child) physically active for at least 60 minutes total?” This continuous variable was converted to a dichotomous categorical variable for analysis to represent whether the child meets the minimum physical activity guidelines (≥ 60 minutes/day) or not (< 60 minutes/day).

Sedentary Behavior

The primary sedentary behavior variable of interest for this study is the amount of daily screen time. Screen time is defined as use of entertainment media such as television or computers (Strasburger, 2011). The AAP recommends that children over the age of two years limit the amount of screen time to no more than two hours per day (Strasburger). The CHIS has two items related to screen time; both ask respondents to consider the index child's use of entertainment media on the weekends only. The first item asks, "Thinking about just Saturdays and Sundays, about how many hours does (child) usually watch TV or play video games (such as Playstation)?" and the other item asks "About how many hours per day on a typical Saturday or Sunday does (child) use a computer for fun, not schoolwork?" Responses for these two items were collapsed into a single continuous variable representing total hours of screen time. The screen time variable was further dichotomized for the purpose of analysis into two categories representing preschoolers who meet the AAP screen time guidelines of no more than two hours per day and those who exceed these guidelines.

Diet Factors

Dietary analysis is based on responses to six food-related questions from the CHIS. These diet variables were converted to binary variables based on the established guidelines related to intake for preschool children. For example, the AAP Committee on Nutrition (2001) recommends no more than six ounces (one glass) of juice intake per day; therefore, survey responses to the juice intake question, "Yesterday, how many glasses or boxes of 100% fruit juice, such as orange or apple juice, did (child) drink?" were dichotomized according to whether the index child's intake meets these guidelines. The United States Department of Agriculture (USDA) has recommended against foods with added sugar and sugar-sweetened beverages since 2005 for suspected links to obesity (USDA, 2005). The AAP also discourages the consumption of sweetened beverages and soda for young children (Gidding, et al., 2006) and recommends that energy-dense and fast food intake is limited (Davis, et al., 2007). Survey items asking “Yesterday, how many servings of…” high sugar foods, soda or sweetened beverages, and fried foods were assessed and dichotomized into categories of no servings or one or more servings to reflect these recommendations. As well, the response to the question “In the past 7 days, how many times did (he/she) eat fast food?” was similarly transformed into a binary independent variable of no servings per week and one or more servings per week.

Statistical Analysis

Stata Statistical Software (Release 12) (StataCorp, 2011) was used to examine the data and generate statistics using weighted results to project population estimates. Initial analysis of the data yielded descriptive statistics of the major study variables (BMI status, gender, ethnicity, socioeconomic status, physical activity, sedentary activity, diet factors, neighborhood park factors, and maternal acculturation). Cross tabulation statistics utilized a design-based F-test to account for complex unequal probability sampling; the cross tabulations revealed relationships between the three-category dependent variable of weight status (*obese*, *overweight*, and *underweight* or *normal weight*) and variables of interest as well as relationships between the ethnic categories and these variables. The final analysis included multinomial logistic regression to explore interrelationships between the three categories of weight status and independent variables identified as significant in the preliminary stages of analysis. Statistical significance for the analyses was identified by a p value equal or below 0.05.

Results

As shown in Table 3.1, approximately 36% of the preschoolers in this study met the criteria for *obese* status (BMI $\geq 95^{th}$ percentile), 11% were classified as *overweight*, and 53% of children in the study were categorized as *underweight* or *normal weight*. Approximately 46% of Hispanics and 32% of whites and Asians were obese. The ages of children in the preschool study sample were distributed fairly evenly with four-year-old children comprising the greatest percentage overall (37%). Children were also equally divided along gender lines (49.5% female; 50.5% male) with more boys (41%) than girls (31%) meeting the *obese* criterion. A majority of the children were white (44%), with Hispanic (29%), those categorized as “other” race (15%), and Asian (12%) children comprising the remainder of the ethnic distributions in decreasing proportions. Just over half of families in the study (52%) reported household income at or above 300% of FPL while a third (33%) reported low socioeconomic status with an income below 200% of FPL. Approximately 20% of mothers had limited English speaking ability and about 27% of mothers reported having lived in the U.S. for less than 10 years.

A large majority of survey respondents reported that there was a neighborhood park or playground located within walking distance of the child’s home (79%), that the nearest park was safe (91%), and that the index child had visited a park within the past 30 days (90%). A low percentage (33%) of five-year-old children in the study met the recommendations for physical activity of at least 60 minutes per day, every day. A little more than half of all preschool children (54%) in the study met daily screen time guidelines during their weekends by spending two or fewer hours per weekend day watching TV, playing video games, or using the computer.

Results of children’s dietary analysis based on the previous day’s intake are also presented in Table 3.1. Just over half (54%) of the preschoolers in the study met recommendations to consume at least five fruits or vegetables daily. About two-thirds

(65%) of children met juice intake guidelines of no more than one glass per day, while a large majority (85%) adhered to recommendations for no daily soda intake. Fried foods were consumed by only 15% of children the previous day although sugary foods were eaten by at least 71% of children in households surveyed. Consumption of fast food was common, with at least 68% reporting at least one serving during the week prior to the survey.

Weight Status Differences

Placement in a weight status category was found to differ across multiple demographic variables as shown in the cross tabulations presented in Table 3.2. Weight status varied by age and gender (both $p \leq 0.02$) with a greater proportion of three-year-old children (42%) and boys (41%) in the *obese* category. Hispanic children had the greatest proportion classified as *obese* (53%) while Asian children had the greatest share of children (63%) in the *underweight* or *normal weight* category ($p = 0.0000$). Preschoolers from the lowest socioeconomic stratum (less than 99% FPL) had the greatest proportion (56%) in the *obese* category compared to children with incomes over 300% FPL (26%; $p = 0.0000$). Among children whose mothers spoke no English, 71% were categorized as *obese* while children whose mothers had good English ability had the largest share (57%) of children in the *underweight* or *normal weight* category ($p = 0.0016$).

Weight status also differed by diet and park factors. Of the preschool children meeting daily juice intake guidelines for the previous day's intake, the greatest proportion came from those in the *underweight* or *normal weight* category (56%; $p = 0.04$). Among children exceeding juice intake guidelines, 42% were classified as *obese* and 48% were placed in the *underweight* or *normal weight* group. Of preschoolers failing to meet fast food guidelines of no intake in the past week, 39% were in the *obese* category compared to 29% classified as *obese* among children reporting no fast food intake (p = 0.01). Preschoolers' weight status differed with the presence of a park (p = 0.05). Of children with a park nearby, 33% were classified as *obese* compared to the 47% classified as *obese* among children without a nearby park.

Cross tabulations were not significant for the remaining park variables. Somewhat surprisingly, no significant relationship was identified between weight status and physical activity or sedentary activity. Other diet factors that did not yield significance during this stage of the analysis were the previous day's intake of fruits and vegetables, soda, fried food, and high sugar foods.

Ethnic Differences

By examining the cross tabulations for ethnicity in Table 3.3, it appears that differences exist among ethnic groups in the study sample. Of Hispanic children, 53% (p = 0.0003) were designated as *obese* in contrast to the proportions classified as *obese* among whites (29%), Asians (27%), and children in the "other" group (29%). There were proportionately more girls (63%) represented among Asian children and more boys (61%) represented among Hispanic children (p = 0.007). Of Hispanic children, 35% (p = 0.0000) were from households with less than 100% FPL, which is nearly double the proportion of the next closest ethnic group, those classified as "other" race (20%). Hispanic preschoolers also had the highest proportion of children failing to meet physical activity guidelines (84%; p = 0.008) and failing to meet dietary guidelines for juice intake (48%; p = 0.0000), soda consumption (27%; p = 0.0000), and fast food intake (76%; p =

0.05). The greatest proportion of children failing to meet the high sugar food intake guidelines was among Asian children at 81% ($p = 0.04$). Age, meeting screen time guidelines, and meeting the guidelines for fruit and vegetable or fried food intake did not demonstrate significant differences among the four ethnic groups.

Factors Associated with Obesity

Presented in Table 3.4, multinomial logistic regression was utilized to explore relationships between the categories of *obese*, *overweight*, and *underweight* or *normal weight* and those variables identified as significant in the cross tabulations. A regression analysis was performed separately for each variable of interest to determine whether any were predictive of weight status on their own. No factors significantly predicted *overweight* status in preschool children; however, several factors were found to increase the risk for obesity when examined independently. These risk factors include gender, poverty, ethnicity, and ability to meet fast food intake guidelines. Preschool boys were 1.42 times as likely to be obese compared to girls ($p = 0.05$) and Hispanic preschoolers were 2.75 times as likely to be obese as white preschool children ($p = 0.000$). Socioeconomic status was also a significant predictor of weight status in an independent regression model ($p = 0.0000$). Children from families with household incomes over 300% FPL were 72% less likely to be obese compared to children whose families earn less than 100% FPL ($p = 0.0004$). Preschool children who met fast food guidelines were 27% less likely to be obese as those who did not meet the guidelines ($p = 0.01$), when examined in the independent analysis.

In the final stage of analysis, a multinomial logistic regression model was created to incorporate each of the significant predictors identified during initial independent analyses. The combined predictor model was completed in a stepwise fashion by adding the most significant predictors first, poverty and ethnicity, followed by fast food intake and gender so that all variables were included in the model at the last step. The model achieved significance (p = 0.000) in each step. The combined, final model data are presented in Table 3.5. Again, no factors were predictive of *overweight* status, but three variables were predictive of obesity risk: poverty, ethnicity, and fast food intake. In the combined model, children from families with household income over 300% FPL were 63% less likely to be obese compared to children from families with income below the federal poverty threshold (p = 0.002). This relative risk is diminished by nearly 10% from when poverty was examined as a single, independent predictor. The combined model also showed that Hispanic preschoolers were 1.72 times as likely to be obese as white children (p = 0.01), which is a one-point drop in relative risk from the independent model. Preschool children who met fast food guidelines had similar risk for obesity in the combined model as in the independent analysis, with those children 31% less likely to be obese as children who did not meet the guidelines (p = 0.05). Gender was added to the model at the final step and was not a significant predictor of *obese* status.

Discussion

Study findings indicated that children from low social economic background, with Hispanic ethnicity, and children who ate fast food in the last seven days are at higher risk for obesity. Low socioeconomic status is a primary risk factor for obesity in preschool California children. Poverty has been implicated previously as an obesity risk factor in international research (Armstrong, et al., 2003). However, the nature of the relationship between an impoverished environment, ethnicity, and obesity appears to be complex with the predictive risk for obesity from ethnicity and poverty diminishing when both were in the regression model. This is consistent with other study findings. For instance, Wang (2011) found that poor, white children had higher incidence of obesity than affluent, white children while Mexican American children did not share this finding. Further investigation into these variables is needed to better identify the independent contribution of ethnicity and poverty to obesity risk in young children so that resources can be properly directed.

Hispanic ethnicity increased the risk for obesity in our study. Nearly 46% of Hispanic preschool California children met the *obese* criteria with an obesity prevalence of 53% among Hispanic boys, exceeding all other comparison groups for race and gender. Hispanic preschoolers were at greatest risk for obesity-associated factors as well. Greater proportions of Hispanic children in our study were represented among categories of low socioeconomic status and fast food intake on both descriptive analyses and cross tabulations by ethnicity. These findings mirror previous studies that have identified racial differences among risk factors for obesity in infants (Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2010) and children (Anderson & Whitaker, 2009; Y. Wang, 2011). Given the high prevalence and risk associated with obesity in Hispanic preschool-age children, studies which identify mechanisms to reduce and decrease obesity in this population are warranted.

Previous research on school-age children and adolescents suggests that fast food intake is correlated with obesity (Niemeier, et al., 2006; Taveras, et al., 2005). These findings were confirmed in our study of California preschoolers who had an increased risk for obesity by consuming one or more servings of fast food during the week. The high overall prevalence of fast food intake was not unexpected. It has been reported that among U.S. children ages 4 to 19 years, about 30% eat fast food on a given day (Bowman, et al., 2004). National surveys show that among children ages 2 to 18 years, overall fast food intake has risen with the increase explained mainly by a concomitant surge in the proportion of fast food eaten at home as take-out (Poti & Popkin, 2011). Further, a nationwide survey completed in 2002 found that French fries are the most common source of vegetables in the diets of two-year-old children while a third of their diets contain no fruit at all (Fox, et al., 2004). These findings are disquieting when compared to the recommendation of a minimum of five servings of fruits and vegetables per day (USDA, 2005).

Although several studies across varied demographic milieus have linked limited physical activity with increased risk for overweight in young children, this study did not find preschoolers' physical activity associated with obesity. This may be due in part because of the varied methods for defining and measuring physical activity in the literature. One of the limitations of the study involves the survey question about physical activity since it does not ask the respondent to identify the type of activity (such as vigorous vs. moderate). It would be helpful to know the type of physical activity since aerobic fitness, rather than simply total energy expenditure, is most closely associated with decreased risk for childhood adiposity (Johnson, et al., 2000). Yet, limited studies have also shown that among preschool children, interventions targeting sedentary behavior may be more effective at decreasing overweight than simply adding to total daily physical activity time (Montgomery, et al., 2004; Reilly, et al., 2006).

Screen time and park factors were not identified as predictors of obesity in this study. This is particularly interesting because nearly half of the preschoolers exceeded guidelines of two hours of screen time per day during weekends. A linear relationship between hours of screen time and overweight has been demonstrated in adolescents (Dietz & Gortmaker, 1985) and young children with research indicating that nearly 40% of preschoolers have a television in their bedroom and these children are more likely than those without a television to be overweight (Dennison, et al., 2002). Due to these factors, the lack of an association between screen time and obesity in our study was unexpected. Park availability, park safety, and park usage were not associated with obesity. Nearly 80% of the children in the study had a park nearby and more than 90% of the proxy adults reported that the child had recently visited the park and that the closest park was safe. The overwhelmingly positive responses on these park survey items may have contributed to a lack of identified differences. As well, the park items did not provide sufficient detail for analysis. Study findings would have benefited from quantifying the number of days in the past month the child had been to the park and also categorizing the type of physical activity the child enjoyed during park visits. Research suggests that overall park acreage rather than total number of neighborhood parks is positively associated with increased physical activity in young children (Roemmich, et al., 2006) and that open park or playground spaces with equipment that fosters movement (e.g., tricycles) improve the likelihood of moderate to vigorous activity in preschoolers (Nicaise, Kahan, & Sallis, 2011). Further research should seek to gather data that will provide improved context regarding children's park and playground usage and their association with weight status.

The majority of dietary factors were not found to predict obesity among preschoolers in the study sample. This is contrary to a comprehensive review of the literature published by Davis and colleagues (2007) which suggests increased risk of overweight is associated with increased juice intake, and consumption of soda or soft drinks, fried foods, cookies, and candy. Despite the lack of predictive significance, it was concerning to discover that one in five Hispanic preschoolers in our study were found to have consumed a soda beverage the previous day. Soda and sweetened beverage intake has frequently been linked with pediatric overweight (Troiano, et al., 2000; Welsh, et al., 2005) and provides empty calories with no nutritional value. One possibility for the lack of demonstrated association between these dietary factors and obesity may be the unit of analysis. Respondents may have had varying interpretations of what constitutes a food serving and it appears that the CHIS surveyor's prompt is of limited usefulness by telling the respondent that servings are "self-defined" and according to the child's "regular portion" of each food. Additionally, our study dichotomized each diet variable according to whether or not the child's intake adhered to dietary guidelines rather than utilizing the child's total intake for analysis. Improved definitions of age-appropriate serving sizes for dietary intake in preschoolers would increase the reliability of data collection. As well, future research should investigate differences in total servings and their association with elevated BMI in the preschool age group.

A total of 36% of preschool children in our study were classified as *obese* which is much higher than other population-based studies of young children. In fact, the obesity prevalence in our study was about three times the estimated national prevalence for children ages two to five years from the 2009-2010 NHANES data (Ogden, et al., 2012) and double that of the national estimate for four-year-old children in the 2009-2010 Early Childhood Longitudinal Study, Birth Cohort (Anderson & Whitaker, 2009). Obesity prevalence in our study even exceeds the findings from a 2008 national survey which found 17.3% of low-income California children aged two to four years were obese (CDC, 2009). In light of these contradictory findings and because recent research implies child obesity rates have begun to level off (Olds et al., 2011), study findings should be interpreted with caution until confirmed by additional research.

Limitations

Self-report measures of child height and weight are susceptible to error. Given that the CHIS is a rather lengthy phone interview, it would be expected for the proxy adult to estimate the index child's height and weight instead of taking measurements. Parents of preschoolers have been shown to overestimate weight (Dubois & Girad, 2007) yet research has also demonstrated that children's BMI values derived from parental report may be underestimated (Huybrechts, De Bacquer, Van Trimpont, De Backer, & De Henauw, 2006) or overestimated (Akinbami & Ogden, 2009). This study attempted to reduce the error rate in BMI data by eliminating outliers through standardized processes; however, it is possible that height-weight reporting errors may have contributed to the elevated obesity rates for this study sample.

Additional limitations involve physical activity and diet data collection. The CHIS only collects physical activity data on children five years or older, yet there were at least 450 five-year-old children in the study sample which was a sufficient number with which to run analyses. Physical activity determinations would have also benefited from improved clarity regarding the intensity and daily duration of the activity as well as park utilization. The dietary intake questions are limited by a reliance on respondents' recollection of what the child ate or drank yesterday for five of the six diet questions. Research has shown that three-day diet recalls and diet logs have better reliability in determining preschool children's typical intake than 24-hour parent recall (Serdula, Alexander, Scanlon, & Bowman, 2001; Thompson & Byers, 1994). The 24-hour recall method has demonstrated high levels of agreement between parent report and actual intake (Klesges, Klesges, Brown, & Frank, 1987), although other studies have found more moderate discrepancies (Pearson's *r* 0.56 to 0.86) (Baranowski, Sprague, Baranowski, & Harrison, 1991; Basch et al., 1990; Eck, Klesges, & Hanson, 1989).

The study was based on a purposeful sampling method which may limit generalization to the larger preschool population. However, by soliciting participants from groups represented by the most prevalent languages Spoken in California, there is an increased ability to analyze ethnic differences. The fact that the CHIS employs imputing methods to replace missing variables is another limitation but these methods are clearly reported and in accordance with established procedures (i.e. relational and hot-deck imputation) (CHIS, 2011b). Aspects of the child data that contribute to the credibility and external validity of potential findings are its data currency and its representation of the three major ethnic groups of interest. The CHIS 2009 Child Questionnaire completion rate was also quite high (73-76%), reducing non-response bias (CHIS, 2011c).

Clinical and Research Implications

The prevalence of obesity among this sample of preschool children is of concern. The literature consistently describes a lifetime of adverse weight-related health problems for individuals who become overweight or obese in childhood. Study findings suggest that clinicians should not wait until the child becomes obese to intervene. Intervention should begin prior to age three if a child is found to have identified risk factors. Obesity prevention information should be provided in a way that is sensitive to the cultural background of the family while being mindful of socioeconomic barriers to treatment efforts.

Diet is the most modifiable risk factor implicated in this study. It would seem appropriate, then, to focus clinical efforts on mothers who are most often the primary caregiver in charge of the type and timing of food offerings. Perhaps targeted community efforts in low socioeconomic neighborhoods, such as weekly farmers' markets, could lead to significant decreases in preschool obesity rates and would be worthy of investigation as a way to decrease the use of convenience or fast foods. Another practice consideration should be an assessment of mothers' nutrition knowledge and food preparation skill. A stall of fresh produce in an area of high child obesity is of little use if children's primary caregivers lack the ability to create fast, nutritious meals from the ingredients.

Although physical activity was not identified as a predictor for obesity in our study, clinicians should continue to promote moderate to vigorous physical activity in young children since longitudinal studies such as the Framingham Children's Study have found that when preschool children increase physical activity over time, their levels of body fat decrease (Moore, et al., 1995). Future research studies should attempt to gather more specific data regarding the type and intensity of preschoolers' physical activity to ascertain whether the lack of association between physical activity and obesity in this study is a true representation of this relationship. Research is also needed to identify best practices for health diet promotion in families with young children.

Conclusion

This study of preschool California children supports previous research findings regarding causes of obesity, including low socioeconomic status, Hispanic ethnicity, and fast food intake. Hispanic preschoolers had the highest rates of obesity and also were overrepresented among children of low socioeconomic status and among those failing to meet dietary guidelines for fast food intake. Efforts to improve child obesity rates must begin as early in childhood as risk factors are identified and must include culturally relevant interventions to assist families in raising healthy children.

Table 3.1

Descriptive Data for Preschool Children (3-5 Years of Age) in CHIS 2009 Sample

% of Respondents

Variable	**Total**	**Males**	**Females**	**White**	**Hispanic**	**Asian**
Age						
3 years	33.5	33.8	33.2	32.0	32.1	30.3
4 years	36.8	35.7	37.0	36.9	38.4	43.1
5 years	29.7	30.5	28.8	31.1	29.4	26.6
Gender						
Male	50.5			49.4	56.1	39.4
Female	49.5			50.6	43.9	60.6
BMI Status, three categories						
Normal/ Underweight	53.4	51.2	55.8	56.7	43.9	57.6
Overweight	10.6	8.3	13.0	11.0	10.6	9.9
Obese	35.9	40.5	31.2	32.3	45.5	32.6
Household Income, % of Federal Poverty Level						
0-99	16.2	19.7	12.7	9.8	28.7	8.2
100-199	16.6	14.3	18.9	15.2	22.8	13.3
200-299	14.8	17.2	12.3	13.9	16.1	8.7
>=300	52.4	48.8	56.2	61.1	32.3	69.9
Physical Activity, per guidelines (5-year-old children only; 503 observations)						
≥60 mins/day	32.9	31.8	34.1	37.4	22.3	40.2
<60 mins/day	67.1	68.2	65.9	62.6	77.7	59.8
Screen Time, per guidelines						
≤ 2 hrs/day	53.9	52.1	55.7	58.1	52.7	45.8
> 2 hrs/day	46.1	47.9	44.3	41.9	47.3	54.2
Fruit/Vegetable Intake Servings, per guidelines						
5 or more/day	53.5	53.1	53.9	54.4	56.7	47.8
Less than 5/day	46.5	46.9	46.1	45.6	43.3	52.2

% of Respondents

Variable	Total	Males	Females	White	Hispanic	Asian
Juice Intake Servings, per guidelines						
≤ 1 svg/day	65.4	62.4	68.4	69.8	55.0	73.4
> 1 svg/day	34.6	37.6	31.6	30.2	45.0	26.6
Soda Intake Servings, per guidelines						
No svg/day	85.1	84.4	85.8	87.6	77.8	91.7
≥ 1 svg/day	14.9	15.6	14.2	12.4	22.2	8.3
Fried Food Intake Servings, per guidelines						
No svg/day	85.1	84.5	85.6	85.4	82.7	82.9
≥ 1 svg/day	14.9	15.6	14.4	14.6	17.3	17.1
Sugar Intake Servings, per guidelines						
No svg/day	28.8	31.2	26.4	28.7	34.3	17.5
≥ 1 svg/day	71.2	68.8	73.6	71.3	65.7	82.5
Fast Food Intake Servings, per guidelines						
No svg/week	31.6	26.7	36.6	32.7	23.8	33.8
≥ 1 svg/week	68.4	73.3	63.4	67.3	76.2	66.2
Park Nearby						
Yes	78.8	79.9	77.7	78.3	77.7	73.5
No	21.2	20.1	22.3	21.7	22.3	26.5
Visited Park Past 30 Days						
Yes	89.6	88.7	90.4	92.3	85.4	94.3
No	10.4	11.3	9.6	7.7	14.6	5.7
Closest Park Safe During Day						
Strongly Agree	52.7	50.8	54.7	60.5	40.1	58.5
Agree	39.8	42.0	37.6	33.6	50.0	27.3
Disagree	6.3	6.2	6.5	5.0	8.9	10.6
Strongly Disagree	1.1	1.0	1.2	1.0	1.0	3.6

	% of Respondents					
Variable	**Total**	**Males**	**Females**	**White**	**Hispanic**	**Asian**
Mother's Years in U.S. (460 observations)						
< 1year	0.9	0.1	1.8	0.6	6.8e-04	2.4
2-4 years	2.6	2.5	2.8	2.2	1.4	3.6
5-9 years	24.2	23.4	25.0	20.8	23.6	24.2
10-14 years	24.1	28.3	19.4	27.0	27.8	23.3
15-19 years	12.5	9.5	15.8	12.0	13.1	9.8
20-24 years	11.9	1.2	12.2	6.9	15.9	7.8
25-29 years	9.6	11.8	7.0	9.1	8.9	11.6
> 30 years	14.3	12.7	16.0	21.5	9.3	17.4
Mother's Ability to Speak English (625 observations)						
Very well	59	53.6	65.5	61.4	48.8	69.6
Fairly Well	19.1	21.5	16.2	17.3	20.6	22.7
Not well	14.1	14.5	13.6	15.9	18.8	7.7
Not at all	7.8	10.4	4.7	5.3	11.8	0

Note: Values are weighted population estimates.

Table 3.2

Cross Tabulations: Weight Status Differences for Preschool Children in CHIS 2009 Sample

	Dependent Variable		
Independent Variable	**Normal or Underweight**	**Overweight**	**Obese**
Age			
F(3.16, 246.76) = 3.32, *p* = 0.019*			
3 years	48% (0.41-0.54)	10% (0.07-0.15)	42% (0.35-0.49)
4 years	50% (0.44-0.49)	11% (0.08-0.16)	39% (0.32-0.46)
5 years	64% (0.54-0.73)	11% (0.08-0.14)	26% (0.18-0.36)
Gender			
F(1.96, 153.24) = 4.04, *p* = 0.02*			
Male	51% (0.45-0.57)	8% (0.06-0.11)	41% (0.34-0.47)
Female	53% (0.49-0.58)	11% (0.09-0.13)	36% (0.31-0.41)
Ethnicity			
F(4.97, 387.90) = 5.9, *p* = 0.0000**			
White	60% (0.54-0.65)	11% (0.08-0.14)	29% (0.24-0.35)
Hispanic	39% (0.31-0.48)	8% (0.05-0.13)	53% (0.43-0.63)
Asian	63% (0.52-0.73)	10% (0.06-0.17)	27% (0.17-0.39)
Other	54% (0.43-0.65)	15% (0.10-0.23)	30% (0.22-0.41)
Percent Federal Poverty Level			
F(4.77, 371.77) = 6.76, *p*=0.0000**			
0-99%	38% (0.28-0.48)	7% (0.03-0.14)	56% (0.44-0.67)
100-199%	38% (0.31-0.47)	15% (0.1-0.23)	46% (0.36-0.57)
200-299%	50% (0.37-0.63)	13% (0.08-0.21)	37% (0.24-0.52)
>300%	64% (0.59-0.69)	10% (0.07-0.13)	26% (0.21-0.32)
Meets Physical Activity Guidelines			
F(1.81, 141.00) = 1.32, *p* = 0.27			
Yes (≥ 60 mins/day)	64% (0.55-0.73)	15% (0.09-0.23)	21% (0.15-0.29)
No (< 60 mins/day)	64% (0.50-0.75)	9% (0.06-0.13)	28% (0.17-0.42)
Meets Screen Time Guidelines			
F(1.62, 126.18) = 0.05, *p* = 0.93			
Yes (≤ 2 hours/day)	54% (0.49-0.59)	10% (0.08-0.13)	46% (0.36-0.57)
No (> 2 hours/day)	53% (0.45-0.6)	11% (0.08-0.15)	56% (0.44-0.67)
Meets Fruit, Vegetable Guidelines			
F(1.62, 126.70) = 0.08, *p* = 0.89			
Yes (≥ 5 svgs/day)	53% (0.46-0.61)	11% (0.08-0.15)	35% (0.28-0.44)
No (< 5 svgs/day)	53% (0.48-0.59)	10% (0.08-0.13)	36% (0.31-0.42)
Meets Juice Guidelines			
F(1.75, 136.48) = 3.54, *p* = 0.04*			
Yes (≤ 1 svg/day)	56% (0.51-0.61)	11% (0.09-0.14)	33% (0.27-0.39)
No (> 1 svg/day)	48% (0.41-0.54)	10% (0.07-0.14)	42% (0.35-0.49)

Independent Variable	Dependent Variable: Normal or Underweight	Overweight	Obese
Meets Soda Guidelines *F*(1.73, 135.25) = 2.63, *p* = 0.08			
Yes (no svg/day)	55% (0.50-0.60)	11% (0.09-0.13)	34% (0.29-0.40)
No (≥ 1 svg/day)	44% (0.35-0.54)	9% (0.05-0.16)	47% (0.36-0.58)
Meets Fried Food Guidelines *F*(1.42, 110.40) = 0.08, *p* = 0.86			
Yes (no svg/day)	54% (0.50-0.58)	11% (0.09-0.13)	35% (0.31-0.40)
No (≥ 1 svg/day)	51% (0.34-0.68)	10% (0.05-0.19)	39% (0.20-0.61)
Meets Sugar Guidelines *F*(1.73, 134.82) = 0.49, *p* = 0.59			
Yes (no svg/day)	51% (0.42-0.60)	10% (0.07-0.14)	39% (0.30-0.49)
No (≥ 1 svg/day)	54% (0.50-0.59)	11% (0.09-0.14)	35% (0.30-0.40)
Meets Fast Food Guidelines *F*(1.86, 145.15) = 4.78, *p* = 0.01*			
Yes (no svg/week)	59% (0.54-0.65)	12% (0.09-0.16)	29% (0.24-0.35)
No (≥ 1 svg/week)	51% (0.45-0.56)	10% (0.08-0.13)	39% (0.33-0.46)
Park Nearby *F*(1.69, 131.69) = 3.18, *p* = 0.05*			
No	44% (0.32-0.56)	9% (0.05-0.16)	47% (0.34-0.61)
Yes	56% (0.52-0.6)	11% (0.09-0.14)	33% (0.29-0.38)
Visited Park Past 30 Days *F*(1.44, 112.64) = 0.92, *p* = 0.37			
No	48% (0.33-0.64)	7% (0.04-0.14)	44% (0.28-0.62)
Yes	54% (0.50-0.58)	11% (0.09-0.14)	35% (0.30-0.40)
Closest Park Safe During Day *F*(3.96, 309.22) = 2.21, *p* = 0.07			
Strongly Agree	57% (0.51-0.62)	11% (0.09-0.15)	32% (0.26-0.38)
Agree	49% (0.41-0.56)	11% (0.02, 0.08-0.15)	40% (0.32-0.49)
Disagree	48% (0.32-0.64)	6% (0.02-0.17)	46% (0.3-0.64)
Strongly Disagree	91% (0.71-0.97)	2% (0.0-0.19)	7% (0.02-0.24)
Maternal English Speaking Ability *F*(4.83, 376.61) = 2.87, *p* = 0.016*			
Very Well	57% (0.48-0.66)	9% (0.6-0.13)	34% (0.24-0.45)
Fairly Well	39% (0.28-0.51)	10% (0.06-0.19)	51% (0.39-0.63)
Not Well	40% (0.28-0.53)	12% (0.06-0.25)	48% (0.32-0.64)
Not at All	17% (0.06-0.38)	12% (0.03-0.34)	71% (0.45-0.88)

Note: Values are weighted population estimates presented as percentage of respondents, with jackknife standard error and 95% confidence interval in parentheses.
*$p \leq 0.05$. **$p \leq 0.0005$.

Table 3.3

Cross Tabulations: Ethnic Differences for Preschool Children in CHIS 2009 Sample

	Ethnicity			
Variable	**White**	**Hispanic**	**Asian**	**Other**
Age				
$F(5.07, 395.63) = 0.63$, $p = 0.68$				
3 years	33% (0.30-0.39)	35% (0.27-0.43)	35% (0.24-0.47)	28% (0.19-0.38)
4 years	35% (0.30-0.41)	39% (0.27-0.43)	40% (0.29-0.52)	35% (0.26-0.45)
5 years	30% (0.26-0.35)	27% (0.18-0.37)	26% (0.16-0.39)	38% (0.27-0.49)
Gender				
$F(2.73, 212.68) = 4.39$, $p = 0.0066$*				
Male	46% (0.42-0.51)	61% (0.52-0.70)	37% (0.28-0.48)	53% (0.40-0.64)
Female	54% (0.49-0.58)	39% (0.30-0.48)	63% (0.52-0.72)	47% (0.36-0.60)
Percent of Federal Poverty Level				
$F(6.98, 544.68) = 12.1$, $p = 0.0000$***				
0-99%	5% (0.03-0.08)	35% (0.26-0.45)	6% (0.02-0.13)	20% (0.11-0.33)
100-199%	11% (0.08-0.15)	23% (0.16-0.32)	15% (0.08-0.32)	20% (0.13-0.30)
200-299%	13% (0.12-0.19)	17% (0.10-0.29)	8% (0.04-0.13)	19% (0.12-0.29)
>300%	70% (0.49-0.56)	24% (0.19-0.31)	71% (0.58-0.82)	41% (0.30-0.53)
Overweight Status				
$F(4.97, 387.90) = 5.90$, $p = 0.0000$***				
Normal or Underweight	60% (0.54-0.65)	39% (0.31-0.48)	63% (0.52-0.73)	54% (0.43-0.65)
Overweight	11% (0.08-0.14)	8% (0.05-0.13)	10% (0.06-0.17)	11% (0.08-0.14)
Obese	29% (0.24-0.35)	53% (0.43-0.63)	27% (0.17-0.39)	29% (0.24-0.35)
Meets Physical Activity Guidelines				
$F(2.9, 226.22) = 4.09$, $p = 0.008$*				
Yes (≥ 60 mins/day)	43% (0.36-0.51)	16% (0.09-0.29)	43% (0.22-0.67)	26% (0.13-0.45)
No (< 60 mins/day)	57% (0.49-0.64)	84% (0.71-0.91)	57% (0.33-0.78)	74% (0.55-0.87)

Variable	Ethnicity White	 Hispanic	 Asian	 Other
Meets Screen Time Guidelines *F*(2.8, 218.52) = 2.22, *p* = 0.09				
Yes (≤ 2 hours/day)	60% (0.55-0.65)	50% (0.41-0.60)	49% (0.37-0.61)	46% (0.35-0.57)
No (> 2 hours/day)	40% (0.35-0.45)	50% (0.40-0.59)	51% (0.39-0.63)	54% (0.43-0.65)
Meets Fruit and Vegetable Guidelines *F*(2.48, 193.54) = 1.44, *p* = 0.24				
Yes (≥ 5 svgs/day)	56% (0.51-0.61)	55% (0.44-0.65)	40% (0.30-0.51)	55% (0.43-0.67)
No (< 5 svgs/day)	44% (0.39-0.49)	45% (0.35-0.56)	60% (0.49-0.69)	45% (0.33-0.57)
Meets Juice Guidelines *F*(2.65, 206.56) = 9,76, *p* = 0.0000***				
Yes (≤ 1 svg/day)	73% (0.68-0.77)	52% (0.42-0.61)	83% (0.74-0.89)	57% (0.45-0.68)
No (> 1 svg/day)	27% (0.23-0.32)	48% (0.39-0.58)	17% (0.11-0.26)	43% (0.32-0.55)
Meets Soda Guidelines *F*(2.36, 184.00) = 11.22, *p* = 0.0000***				
Yes (no svg/day)	92% (0.89-0.94)	73% (0.62-0.81)	90% (0.80-0.96)	84% (0.77-0.89)
No (≥ 1 svg/day)	8% (0.06-0.11)	27% (0.19-0.38)	10% (0.04-0.20)	16% (0.11-0.23)
Meets Fried Food Guidelines *F*(2.62, 204.29) = 2.05, *p* = 0.12				
Yes (no svg/day)	86% (0.81-0.90)	80% (0.69-0.87)	88% (0.75-0.94)	90% (0.83-0.94)
No (≥ 1 svg/day)	14% (0.10-0.19)	20% (0.13-0.31)	12% (0.06-0.25)	10% (0.06-0.17)
Meets Sugar Guidelines *F*(2.56, 199.30) = 3.06, *p* = 0.04*				
Yes (no svg/day)	25% (0.22-0.29)	34% (0.25-0.44)	19% (0.12-0.27)	37% (0.26-0.50)
No (≥ 1 svg/day)	75% (0.71-0.78)	66% (0.56-0.74)	81% (0.73-0.88)	63% (0.50-0.74)
Meets Fast Food Guidelines *F*(2.84, 221.65) = 2.74, *p* = 0.05*				
Yes (no svg/week)	35% (0.31-0.41)	24% (0.18-0.31)	37% (0.28-0.47)	31% (0.22-0.43)
No (≥ 1 svg/week)	65% (0.59-0.69)	76% (0.69-0.82)	63% (0.53-0.72)	69% (0.57-0.78)

	Ethnicity			
Variable	**White**	**Hispanic**	**Asian**	**Other**
Mother's English Ability *F*(5.2, 405.73) = 7.64, *p* = 0.0000***				
Very Well	91% (0.84-0.95)	47% (0.38-0.57)	66% (0.38-0.57)	57% (0.35-0.77)
Fairly Well	5% (0.03-0.08)	18% (0.12-0.24)	25% (0.18-0.34)	34% (0.16-0.57)
Not Well	4% (0.01-0.11)	20% (0.14-0.29)	9% (0.04-0.18)	9% (0.03-0.20)
Not at All	0.39% (4.8e-04-0.03)	14% (0.08-0.24)	0	0.38% (7.7e-04-0.02)

Note: Values are weighted population estimates presented as percentage of respondents, with jackknife standard error and 95% confidence interval in parentheses.
$*p < 0.05$. $**p < 0.005$. $***p = 0.000$.

Table 3.4

Multinomial Logistic Regression: Independent Analyses Predicting BMI Status by Individual Variables

Independent Variable	**Odds Ratio**	**SE**	***t***	***p***	**95% CI**
Age (model $p = 0.16$)					
Overweight					
4 vs. 3 years	1.06	0.30	0.21	0.84	0.61-1.85
5 vs. 3 years	0.79	0.22	-0.84	0.41	0.45-1.39
Obese					
4 vs. 3 years	0.88	0.18	-0.64	0.53	0.59-1.31
5 vs. 3 years	0.46	0.14	-2.57	0.01	0.25-0.84
Gender (model $p = 0.03$*)					
Overweight					
Males vs. Females	0.70	0.17	-1.45	0.15	0.42-1.14
Obese					
Males vs. Females	1.42	0.25	1.96	0.05*	0.99-2.01
Percent of FPL (model $p = 0.0000$***)					
Overweight					
100-199% vs. 0-99%	2.24	1	1.82	0.07	0.93-5.43
200-299% vs. 0-99%	1.48	0.68	0.86	0.40	0.59-3.69
>300% vs. 0-99%	0.85	0.33	-0.42	0.67	0.39-1.85
Obese					
100-199% vs. 0-99%	0.81	0.24	-0.72	0.47	0.45-1.45
200-299% vs. 0-99%	0.49	0.21	-1.66	0.10	0.21-1.15
>300% vs. 0-99%	0.28	0.08	-4.41	0.000***	0.15-0.49
Ethnicity (model $p = 0.0004$**)					
Overweight					
Other vs. White	1.50	0.50	1.23	0.22	0.77-2.94
Hispanic vs. White	1.10	0.32	0.33	0.74	0.62-1.96
Asian vs. White	0.87	0.29	-0.41	0.68	0.45-1.69
Obese					
Other vs. White	1.14	0.33	0.46	0.64	0.65-2.02
Hispanic vs. White	2.75	0.59	4.76	0.000***	1.8-4.2
Asian vs. White	0.86	0.28	-0.46	0.65	0.46-1.63
Physical Activity Guidelines (Y/N) (model $p = 0.32$)					
Overweight	1.66	0.63	1.35	0.18	0.79-3.53
Obese	0.75	0.29	-0.76	0.45	0.35-1.61

Independent Variable	**Odds Ratio**	**SE**	***t***	***p***	**95% CI**
Screen Hours Guidelines (Y/N) (model p = 0.09)					
Overweight	0.92	0.20	-0.38	0.70	0.59-1.43
Obese	0.96	0.23	-0.16	0.87	0.6-1.55
Juice Guidelines (Y/N) (model p = 0.08)					
Overweight	0.90	0.18	-0.53	0.60	0.61-1.33
Obese	0.66	0.12	-2.28	0.03	0.46-0.95
Soda Guidelines (Y/N) (model p = 0.17)					
Overweight	0.96	0.31	-0.12	0.90	0.51-1.81
Obese	0.59	0.16	-1.92	0.06	0.34-1.02
Fried Food Guidelines (Y/N) (model p = 0.96)					
Overweight	1.00	0.32	-0.01	1.00	0.53-1.89
Obese	0.88	0.42	-0.28	0.78	0.34-2.27
Sugar Guidelines (Y/N) (model p = 0.7)					
Overweight	0.96	0.24	-0.15	0.88	0.58-1.59
Obese	1.20	0.29	0.78	0.44	0.75-1.93
Fast Food Guidelines (Y/N) (model p = 0.03)*					
Overweight	1.02	0.20	0.10	0.92	0.69-1.51
Obese	0.63	0.11	-2.62	0.01*	0.44-0.90
Mother's English Ability (model p = 0.11)					
Overweight					
Fairly Well vs. Very Well	1.74	0.69	1.39	0.17	0.79-3.82
Not Well vs. Very Well	2.09	0.98	1.58	0.12	0.82-5.29
Not at All vs. Very Well	4.64	4.05	1.76	0.83	0.82-26.34
Obese					
Fairly Well vs. Very Well	2.18	0.83	2.04	0.05	1.02-4.66
Not Well vs. Very Well	2.04	0.85	1.72	0.09	0.89-4.67
Not at All vs. Very Well	7.05	4.88	2.83	0.01	1.78-27.93

Note: Weighted population estimates; jackknife standard errors.
*$p \leq 0.05$. **$p < 0.005$. ***$p \leq 0.000$.

Table 3.5

Multinomial Logistic Regression Predicting BMI Status

Independent Variable	Odds Ratio	SE	*t*	*p*	95% CI
Overweight					
Percent of FPL					
100-199% vs. 0-99%	2.17	1.01	1.67	0.10	0.86-5.47
200-299% vs. 0-99%	1.48	0.68	0.84	0.40	0.59-3.71
>300% vs. 0-99%	0.85	0.34	-0.41	0.68	0.39-1.88
Ethnicity					
Other vs. White	1.34	0.44	0.87	0.39	0.69-2.59
Hispanic vs. White	0.95	0.28	-0.16	0.87	0.53-1.71
Asian vs. White	0.83	0.30	-0.52	0.61	0.41-1.69
Fast Food Guidelines (Y/N)	1.01	0.21	0.05	0.96	0.67-1.51
Gender (Males vs. Females)	0.69	0.18	-1.41	0.16	0.41-1.17
Obese					
Percent of FPL					
100-199% vs. 0-99%	0.95	0.26	-0.19	0.85	0.56-1.62
200-299% vs. 0-99%	0.55	0.22	-1.49	0.14	0.25-1.22
>300% vs. 0-99%	0.37	0.11	-3.25	0.002**	0.20-0.68
Ethnicity					
Other vs. White	0.86	0.25	-0.53	0.60	0.49-1.52
Hispanic vs. White	1.73	0.36	2.63	0.01*	1.14-2.61
Asian vs. White	0.87	0.30	-0.41	0.68	0.43-1.73
Fast Food Guidelines (Y/N)	0.70	0.12	-2.04	0.05*	0.49-0.99
Gender (Males vs. Females)	1.23	0.21	1.18	0.24	0.87-1.72

Note: Weighted population estimates; jackknife standard errors.
Overall model significance = 0.0000.
*$p \leq 0.05$. **$p < 0.005$.

Chapter Four: Negative Mood as a Risk Factor for Overweight in California Preschoolers

Abstract

Purpose: The aim of this study was to examine whether negative emotion is associated with overweight in California preschoolers.
Methods: Data from the 2009 California Health Interview Survey (CHIS) were included in the analysis of 1510 preschoolers aged three to five years with values for height and weight. Data were analyzed for the following variables of interest: age, gender, ethnicity, poverty level, BMI status, negative emotion, mental health development, and risk of developmental delay.
Results: Approximately 36% of the children in the study were categorized as obese, 11% as overweight, and 53% as underweight or normal weight. In the cross tabulations, overweight status differed across age, gender, ethnicity, and poverty level. Children's overall scores for the mental health development and risk for developmental delay did not vary by weight status. However, when specific items pertaining to the negative emotion were examined separately, overweight status differed based on a child's perceived degree of unhappiness. Children identified *as often unhappy, depressed, or tearful* comprised the greatest proportion of children in the normal or underweight category (83%). Conversely, obese children were the largest proportion of children who were not reported as being unhappy, depressed or tearful (35%). Multinomial logistic regression demonstrated that children who were reported to be unhappy were 59% less likely to be overweight and 82% less likely to be obese than those who were not perceived as unhappy, even when adjusting for poverty level, ethnicity, and gender. The analysis also found that compared to Whites, Hispanic preschoolers were 2.24 times as likely to be obese as normal or overweight when adjusting for the other variables in the model. Poverty level and gender were not significant predictors of being overweight or obese in the combined regression analysis.
Conclusion: This study provides preliminary evidence that feelings of depression and unhappiness may be associated with normal weight or underweight in preschool children rather than overweight or obesity.

Keywords: Preschool, overweight, emotion, CHIS

Negative Mood as a Risk Factor for Overweight in California Preschoolers

Childhood overweight has become a major concern in the United States. Although there is general agreement regarding how diet and physical activity influence this health condition, there is little consensus regarding the potential influence of psychological factors, particularly negative emotion, in young children. Exploring the relationship between pediatric obesity and mental health concepts such as depression, worry, and negative mood may lead to improved or more effective obesity prevention strategies at an early age.

A primary line of psychological inquiry in the pediatric overweight literature centers on the relationship between obesity and depression. Studies have found that overweight teens in obesity treatment have an increased prevalence of depression compared to overweight teens not receiving treatment (Britz et al., 2000; Goossens, Braet, Van Vlierberghe, & Mels, 2008). Overweight adolescents have also been shown to experience higher depression scores than their normal weight peers (Erermis, et al., 2004), yet other research failed to identify a correlation between these two variables or found only small differences in depressive scores between normal and obese children when controlling for socioeconomic factors (Sawyer et al., 2006). Chronic childhood obesity has been associated with boys' depression in one study of rural children who were followed from school age through adolescence (Mustillo, et al., 2003). Longitudinal pediatric research has found that measures of depressed mood in adolescence predict the development and persistence of overweight while obesity at baseline was not predictive of later depression (Goodman & Whitaker, 2002). One longitudinal study found that both presence and frequency of adolescent depression was predictive of the severity of adult obesity, at least in female study subjects (Richardson, et al., 2003). A recent review concluded that evidence supports the association between childhood depressive symptoms and adult overweight, although the vast majority of this research has been conducted with adolescents rather than young children (Liem, et al., 2008).

In addition, a link has been found between overweight and other emotional or behavioral problems. In a study of children age 5 to 17 years, psychiatric disorders were more common among obese children than expected in the general population, with anxiety disorder most prevalent (Vila et al., 2004). Behavioral problems have been shown to be more frequent among school-age children who were obese at the start of the study or those who became obese during the study period (Lumeng, Gannon, Cabral, Frank, & Zuckerman, 2003). Overweight adolescents have also reported greater emotional distress than normal weight peers (Mellin, et al., 2002). However, consistent examples of these relationships in younger children have not been demonstrated which may be partially attributed to the age limitation of available survey instruments. Research is needed to explore whether emotional factors exist in preschool children that are associated with overweight in this population.

A related path of analysis in the childhood overweight literature has investigated child food intake and negative emotions. Specifically, research has tested the theory that a child's negative emotional state becomes an external driver of eating behavior which overrides internal satiety cues. Overweight school-age children have been shown to be more likely than non-overweight children to eat in response to negative emotions (e.g. loneliness, anxiety, irritation) and to eat as a response to external stimuli rather than actual hunger (Braet & Van Strien, 1997). Eating and drinking have been reported as a common strategy for coping by both young children (Chen, et al., 2007) and adolescents (Martyn-Nemeth, et al., 2008). Further, school-age children who indicate they eat in response to stress have been shown to prefer salty and high-sugar foods in their coping efforts (Jenkins, Rew, & Sternglanz, 2005) which may promote weight gain. Some research suggests that overweight children use food as a coping mechanism for depression (Goossens, et al., 2008), although the directional nature of the relationship between depression and obesity is unclear. It would appear that negative emotions, disordered eating, and weight gain in the pediatric population are interrelated and warrant further exploration to understand their association.

Scientists have grappled for many years within this chicken-egg conundrum over whether negative emotion or obesity comes first. An early research review by Ganley (1989) advocated strongly for the position that emotional eating leads to obesity. More recent scholarship has called into question this pathway and speculated that the relationship may be, in fact, bidirectional or mediated by concepts such as self-esteem, social desirability, family functioning, and body image (Allison & Heshka, 1993; Martyn-Nemeth, et al., 2008; Nguyen-Rodriguez, Chou, Unger, & Spruijt-Metz, 2008; Puder & Munsch, 2010). Research suggests early childhood is a critical time period for the development of self-regulation (Feldman, 2009) which may influence how a child copes with negative emotion. Clinicians must attend to the apparent interrelatedness of psychology and weight status, even among young children.

Research on how negative emotion may affect the development of overweight in young children is not understood and deserves additional attention, particularly when a relationship between overweight and disordered eating has been identified in children as young as three years of age (Martin et al., 2000). The aim of this study was to determine whether children's negative emotion is associated with overweight in preschoolers aged three to five years old living in California. It was hypothesized that children's negative emotion, as reported by parents or other adult caregivers, would increase the likelihood of overweight and obesity among preschoolers.

Study Sample and Design

This study was a secondary analysis of cross-sectional data from the 2009 California Health Interview Survey (CHIS) Child public use data file. The CHIS is a health survey of adults and children conducted biannually by researchers at the University of California, Los Angeles, Center for Health Policy Research in concert with the California Department of Health Services and the Public Health Institute (CHIS, 2011a).

The CHIS is recognized as the largest state-based public health survey in the U.S. (Holtby, et al., 2008). The CHIS utilizes weighting and imputing of data in an effort to provide valid population estimates for health risk factors and behaviors of Californians (CHIS, 2011a). Questions on the child version of the survey range from demographic information such as age, gender, height, weight, and immigration status to health-related topics such as medical diagnoses, school attendance, mental health, developmental status, diet, and physical activity.

The 2009 CHIS methodology report describes a sample design method intended to provide adequate representation of California's ethnic and population diversity (CHIS, 2011a). Data for the child version of the CHIS survey were obtained primarily through a randomized telephone survey of households whereby a parent or legal guardian provided information about a randomly selected child within the household. The telephone solicitation was designed according to geographic area (county) and utilized both landline and cellular phone numbers. Purposeful oversampling was also used to improve participation from Korean and Vietnamese residents. These groups were oversampled by focusing calls to geographic areas with high concentrations of these subgroups and also by drawing telephone numbers from a pool with identifiable Korean or Vietnamese ethnic surnames. In order to participate in the CHIS phone survey, respondents were required to speak one of five languages well enough to answer questions, including English, Spanish, Chinese (Mandarin or Cantonese), Vietnamese, or Korean. Approximately 24% of the child surveys were reportedly completed in a language other than English (CHIS, 2011c).

According to the CHIS 2009 report on response rates (CHIS, 2011c), a total of 8,945 interviews were completed with proxy adult responders for the survey of children aged infant through 11 years. The report utilized a weighted methodology to determine an overall completion rate, which accounts for both ineligible households (such as invalid phone numbers) and also population oversampling or undersampling. Approximately 15.7% of households contacted via landline phone and 7.4% of those contacted via cell phone participated in the child survey, yielding an overall weighted response rate of 13.9%. Of those, 73% of landline respondents and 76% of cell phone respondents successfully completed at least 80% of the child survey. The report notes that child survey completion rates benefited from a “child-first” sample methodology which required interviewers for the landline sample to complete the child survey first before continuing on to the adolescent and/or adult survey. The CHIS team sent introductory letters to homes where addresses could be matched to selected landline phone numbers. Each letter included two dollars as an incentive for participation prior to the survey attempt; interviewers also called numbers repeatedly to increase participation rates. Cell phone respondents did not receive pre-assessment letters but were offered nominal payment for interview completion.

This study of preschool children was limited to children in the 2009 CHIS child sample who were between three and five years of age. In order to be included in the analysis, the children were required to have values for height and weight as needed to compute body mass index (BMI). The analysis was conducted on a total of 1510 children who met the study criteria.

Study Variables and Measures

BMI and Weight Status

A weight status variable was created as a measure of the dependent variable; this process involved two separate steps. First, a value for BMI was determined for each child. CHIS survey respondents were asked to report the index child's height and weight. These values were used to calculate the raw BMI because the CHIS 2009 child public use data file did not contain the child's BMI value. Children's reported weight in kilograms was divided by the height in meters squared to obtain the raw BMI. Then a simple frequency analysis was conducted to see if any BMI values fell far outside the normal range. Tukey boxplot distributions of BMI values were analyzed using PASW Statistics Version 18 (IBM, 2010). The first and third quartile findings were incorporated into cut point calculations to eliminate outliers with either extremely high or low BMI values.

At a second step, each BMI was compared to the CDC's BMI for age reference tables (www.cdc.gov/growthcharts/html_charts/bmiagerev.htm) for children aged 66.5 months (approximately 5 ½ years old), 54.5 months (approximately 4 ½ years old), and 42.5 months (approximately 3 ½ years old). Each child's BMI value was used to assign the child to a weight status category. The CDC considers a child *obese* if the BMI is at or exceeds the 95th percentile and *overweight* with a BMI that falls between the 85th and 95th percentile (www.cdc.gov/obesity/childhood/defining.html). Conversely, a child is identified as *normal weight* if the BMI falls between the 5th and 84th percentile and *underweight* for a BMI below the 5th percentile. For this study, BMI values were categorized three ways: *obese, overweight,* and *not overweight* (incorporating *normal weight* and *underweight*).

Negative Emotion

Preschooler's negative emotion was assessed via three response items that were in two separate subsections of the 2009 CHIS. These items were from standardized measures of perceived developmental delay and concerns about mental health development. The measure of mental health development was a short, 7-item version of the 25-item Strengths and Difficulties Questionnaire (SDQ) created for use in children ages 3 to 16 years (R. Goodman, 2001). The second measure was the Parents' Evaluation of Developmental Status (PEDS) survey, a 10-item questionnaire for children from birth through eight years of age (Glascoe, 2000). Three specific items were selected from the SDQ and PEDS to evaluate the presence of negative emotion in study participants.

Two items came from the SDQ, an instrument used to collect data only from 4 and 5 year old children. The measure asks the proxy adult to state whether, in the past six months, each survey item is "not true, somewhat true, or certainly true" of the child. The child receives an overall behavioral and emotional difficulty score which is interpreted as *normal*, *borderline*, or *abnormal*. The full version of the SDQ has demonstrated high sensitivity (0.81-0.90) and low to moderate specificity (0.47-0.82) in international studies of child psychology (Goodman, Renfrew, & Mullick, 2000) with the majority of research supporting the structure of its five subscales as well as significant correlation with another measure of child psychology, the respected and popular Child Behavior Checklist (CBCL) (Stone, Otten, Engels, Vermulst, & Janssens, 2010). The 7-item version found in the CHIS has also been utilized in the 2002, 2005-2007, and 2010 editions of the CDC's National Health Interview Survey (NHIS) with the authors reporting correlations ranging from 0.64 to 0.72 between each item on the short form SDQ and its associated subscale (NCHS, 2011).

Two items from the *Emotional Symptoms* subscale of the SDQ were used to measure negative emotion. The *Emotional Symptoms* subscale has been shown to correlate well with a general measure of child depression, the Child Depression Inventory (r = 0.67), and the *Internalizing* domain on the CBCL (r = 0.64) (Stone, et al., 2010). The first individual item, labeled for analysis as DEPRESS, asks if "the child is often unhappy, depressed, or tearful." The second item, labeled WORRY, asks if the child "has many worries or often seems worried." The DEPRESS (r = 0.64) and WORRY (r = 0.71) items have shown moderate correlation with the entire SDQ *Emotional Symptoms* subscale (NCHS, 2011). The DEPRESS and WORRY items were transformed into binary variables prior to analysis by combining "somewhat true" and "certainly true" into one response type and "not true" into the other.

The third item used to measure negative emotion came from the PEDS survey, an instrument that assesses parents' concerns about their child's perceived risk of developmental delay (Glascoe, 2000). The PEDS has good reported reliability and has demonstrated moderate sensitivity (0.74-0.79) and specificity (0.70-0.80) for identifying overall developmental risk (Glascoe, 2000). In the CHIS, the proxy adult who completes the survey is asked "are you concerned a lot, a little, or not at all" regarding the index child's development in areas such as language ability, motor skills, and social interactions. The sum of individual item responses on the PEDS was used by the 2009 CHIS personnel to assign children to developmental risk levels of *no risk*, *low risk*, *moderate risk,* and *high risk*; numeric scores are not provided within the CHIS public use data file. The item on the PEDS chosen to represent negative emotion in the present study asks the proxy adult about "your child's feelings and moods." This item was labeled as MOOD. Information regarding the validity and reliability of individual items within the PEDS has not been provided by the CHIS investigators. For the purposes of later analysis, the MOOD item was dichotomized by collapsing the answer options of "concerned a little" and "concerned a lot" to represent an affirmative response with "not at all" representing the negative response to the item.

Demographic Variables

Demographic variables were also examined for descriptive purposes and for their potential role as confounds in the analysis. These variables include gender, ethnicity, and federal poverty level.

The CHIS asks respondents to identify the child's gender and also the child's ethnicity. Since the 2007 version of the CHIS, if a child is reported to be part of more than one ethnic group, surveyors have inquired further to see if the child most identifies with one ethnic group and if so, the child receives the ethnicity designation for this primary ethnic category (CHIS, 2008). Children who do not identify with one ethnic group over another are categorized as “multiple race.” Of the children included in this study, the three major ethnic groups of Hispanic, Asian, and white were represented in sufficient number to yield reliable statistical estimates. Children from all other ethnic groups (African American, American Indian, multiple/other race) were consolidated into a category titled “other” for comparative analysis.

The child’s federal poverty level is evaluated in the CHIS via the adult respondent’s report of household income. This value is then recoded within the database in terms of percent of federal poverty level (FPL). The FPL is widely used among researchers and governmental agencies as a delimiter of socioeconomic strata; an FPL of less than 100% is classified as below the federal poverty threshold (U.S. Census Bureau, 2011).

Statistical Analysis

Stata Statistical Software (Release 12) (StataCorp, 2011) was used to examine the data and generate statistics using weighted results to project population estimates. Initial analysis of the data yielded descriptive statistics of the major study variables (age, gender, ethnicity, federal poverty level, BMI status, mental health development, risk of developmental delay, and the specific negative emotion variables termed DEPRESS, WORRY, and MOOD). Cross tabulation statistics utilized a design-based F-test to account for complex unequal probability sampling; the cross tabulations revealed relationships between the three-category dependent variable of weight status (*obese*, *overweight*, and *not overweight*) and all other variables as well as relationships between the ethnic categories and these variables. Multinomial logistic regression analysis was subsequently conducted to investigate selected independent variables' abilities to predict weight status. The final analysis included multiple independent variables in the multinomial logistic regression to explore interrelationships between the variables identified as significant in the previous logistic regression results. Statistical significance for the analyses was identified by a *p* value equal or below 0.05.

Results

As shown in the descriptive analyses in Table 4.1, approximately 36% of the children in the study were categorized as obese, 11% as overweight, and 53% as not overweight. The children in the preschool study sample were equally divided along gender lines (49.5% female; 50.5% male) and evenly distributed among the age categories (33% age three; 37% age four; 30% age five). Approximately 44% of the children were white, 29% Hispanic, 12% Asian, and 15% of the sample were classified as "other" race. The majority of children (52%) were living in households with incomes of at least 300% FPL and approximately 23% were classified as having household incomes below 200% FPL.

Concern about *moderate* or *high risk* for developmental delay, labeled for analysis as PEDS, was prevalent among at least 40% of those surveyed while 24% reported perceptions of *low risk* and 34% *no risk*. Children's mental health development, labeled as SDQ, was deemed *normal* for 92% of four and five-year-old children in the sample, *borderline* for 4%, and *abnormal* for 5%. When isolating the item on the actual PEDS survey which asks whether the respondent has concern about the *child's feelings and moods* (MOOD), at least 34% answered in the affirmative. Additionally, analysis of the two SDQ items which assess the adult's perception about the child's negative emotions showed that at least 18% of those surveyed agreed that the child *has many worries or often seems worried* (WORRY) while 9% of children were perceived as *often unhappy, depressed, or tearful* (DEPRESS).

Cross tabulations based on weight status are presented in Table 4.2. Overweight status differed across age (p = 0.019), gender (p = 0.02), ethnicity (p = 0.0000), and poverty level (p = .0000). The proportion of obese ($\geq 95^{th}$ percentile BMI) children decreased with age so that the greatest proportion of these children was found among those age three (42%) and the lowest proportion among five-year-olds (26%). A greater share of male preschoolers was categorized as obese (41%) when compared to females (36%). Of the children who were classified as obese, 29% were white, 27% Asian, 53% Hispanic, and 30% in the other category. Additionally, children in the normal or underweight category ($<85^{th}$ percentile BMI) were least represented by Hispanics (39%) as compared to whites (60%), Asians (63%), and those classified as other race (54%). The highest percentage of obese children (56%) was found among children whose household incomes were 99% FPL or below, while among children with household incomes above 300% FPL, the majority were classified as normal or underweight (64%). Table 4.2 shows that children's overall scores for the PEDS and SDQ did not vary by weight status. However, when specific items pertaining to the negative emotion were examined separately, overweight status differed on the DEPRESS criterion (p = 0.0002). Children identified *as often unhappy, depressed, or tearful* comprised the greatest proportion of children in the normal or underweight category (83%). Conversely, obese children were the largest proportion of children who were not reported as being unhappy, depressed or tearful (35%). The negative emotion variables of WORRY and MOOD did not demonstrate significant differences in the cross tabulations. An additional cross tabulation analysis of the three negative emotion variables was performed across all four categories of weight status (*underweight*, *normal weight*, *overweight*, *obese*). Again, WORRY and MOOD did not differ by weight status but DEPRESS varied significantly (p = 0.0005) with the highest percentage of children meeting the DEPRESS criterion (15%) found among normal weight children, followed by underweight children (9%). The lowest percentage of children identified with this aspect of negative emotion was among the overweight (6%) and obese (3%) children.

Multinomial logistic regression was utilized to explore factors associated with the three categories of weight status. The multinomial logit model yielded an odds ratio of a child being in one weight category relative to the baseline category of *normal weight* or *underweight*. Predictor variables were selected from those independent variables identified as significant in the cross tabulations based on weight status. These significant predictors were included along with the negative emotion variable DEPRESS in the multinomial model in order to determine whether important relationships exist among the variables.

The next phase of analysis combined the variables predictive of weight status in a stepwise fashion based on level of significance in the independent models. First, a multinomial logit model was computed with the main variable of interest, DEPRESS, along with poverty level as predictor variables. Next, ethnicity and then gender were added to the model to ascertain whether the coefficients changed with the addition of each variable. Lastly, a final multinomial logistic regression analysis was completed by entering all of the identified predictor variables at once into the model.

The final model demonstrated overall significance (p = 0.0001) as presented in Table 4.3. Children who met the DEPRESS criterion were 59% less likely (p = 0.04) to be overweight and 82% less likely to be obese (p = 0.000) than those who did not meet the DEPRESS criterion, even when adjusting for poverty level, ethnicity, and gender. As compared to the single predictor model, the odds of being in a particular weight status if the child was depressed or unhappy (DEPRESS criterion) were only slightly changed when other predictors were added. The DEPRESS coefficients ranged from 0.39 to 0.41 for overweight and 0.18 to 0.19 for obese across all steps of the regression model. The analysis also found that compared to whites, Hispanic preschoolers were 2.24 times as likely to be obese as normal or overweight when adjusting for the other variables (p = 0.003). This risk for Hispanic versus white children was less than demonstrated when ethnicity was considered alone in the multinomial logit analysis. Poverty level and gender were not significant predictors of being overweight or obese in the combined model.

Discussion

The hypothesis that negative emotion would predict overweight and obesity in preschool children was supported to a limited extent and in an unexpected way. Of the three items measuring negative emotion, only one of the items showed a significant relationship to weight status. Preschoolers identified as *often unhappy, depressed, or tearful,* were <u>less likely</u> to be overweight or obese as opposed to normal or underweight. Adjusting for poverty level, ethnicity, and gender in the combined predictor model did not significantly affect the relationship between unhappiness/depression and weight status when compared to the model which examined this variable separately.

As discussed in the introduction to this paper, higher levels of negative emotion such as depression have been shown to correlate with elevated BMI in children and adolescents, with the suggestion that overeating accompanies or follows negative affect. The opposite was found for preschoolers in this study, with lower BMI values being associated with an unhappy, depressed state. This finding could suggest that unhappier preschoolers use eating as a way to achieve some control over their environment. The choice to refuse food may be one of the only decision points remaining for the toilet-trained preschooler at this developmental stage. The simple act of eating can become a powerful mechanism of emotional self-regulation early in life.

Study results are potentially supported by Wardle and colleagues who, during the development of the Child Eating Behavior Questionnaire (CEBQ), found that parents reported preschoolers as more likely to undereat as to overeat in the face of negative emotion (Wardle, Guthrie, Sanderson, & Rapoport, 2001). Further, a longitudinal study of the CEBQ demonstrated that emotional undereating diminishes and emotional overeating increases from the preschool to the school-age years (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008). It may be that young children experience diminished appetite during negative emotional states but this behavior is changed over time if caregivers provide food as comfort and children learn to increase food intake as a way to regulate their emotions. One need look no further than the neonatal intensive care unit for evidence of the comfort potential of sugar as sucrose therapy is increasingly adopted as a standard practice during painful procedures in infants.

Although the data in this study were combined for normal and underweight children, the association between depression and undereating has been evidenced in early childhood. In preschool children, a key symptom of depression is lack of interest in favorite foods (Weiss & Quides, 2012). Similarly, in school aged children, a common symptom of depression is the failure to make expected weight gains (American Psychiatric Association, 2000). Depression in adolescents and adults has been linked with both overweight and underweight (Cortese et al., 2009; Puder & Munsch, 2010; Richardson, et al., 2003). Emotional overeating and emotional undereating have both been demonstrated in children (Braet & Van Strien, 1997; Nguyen-Rodriguez, et al., 2008; Stice, Hayward, Cameron, Killen, & Taylor, 2000). Individual differences among children can impact the relationship between negative emotional states and dietary intake. Further research may help elucidate these differences among preschool children so that interventions may be developed to avoid potentially harmful patterns of nutrition that are associated with depressed mood.

An alternate interpretation of the findings should also be considered. Overweight children may have learned to regulate their emotions somewhat successfully through overeating during the first few years of life. In this case, their negative emotions would either be reduced through eating or effectively hidden from parental perception. Use of a more detailed, comprehensive measure of preschool depression is needed in future studies to better understand the association between specific negative emotional states and weight status of preschool children. It may be that the nature of negative emotion, whether acute or chronic, yields different weight-influencing behaviors of varying degree and consequence.

It is less clear why the normal and underweight preschoolers in this study were more likely to meet the DEPRESS criterion than their overweight and obese peers. Previous research on Taiwanese school-age children found an interactive effect between depression risk and socioeconomic status so that levels of depression in underweight and overweight children were highest if the children were from lower socioeconomic conditions; the depression risk was unchanged for normal weight children regardless of socioeconomic condition (Lin, et al., 2012). Our study did not demonstrate changes in the level of DEPRESS when poverty was added to the regression model. Perhaps the underweight and normal weight children in our study were more likely to be rated as often unhappy, depressed, or tearful because they were more active than the children in the overweight and obese groups. Expressed emotion may have been perceived as depressed emotion when the preschooler's negative expressions or emotional outbursts may be a symptom of adaptive, rather than maladaptive behavior at this young age.

A final consideration concerns the possible relationship between physical activity and negative emotion. If diminished physical activity is a logical antecedent to weight gain, the developmental stage of the preschooler may be protective of the effects of negative emotion on obesity. It is socially acceptable for a preschool child to run around and participate in very active play while the school-age child is increasingly required to sit still for school lessons, for example. With age there may be diminished opportunities for the child to manage negative emotions in physical ways so that the relationship between weight gain and negative emotion becomes evident only in later childhood or adolescence.

Limitations

Primary limitations of the research study involve the measurement of negative emotion. First, responses for the SDQ items were obtained only for children ages four and five years (*n* = 1026) and not for the three-year-old children in the sample. In addition, fewer than 10% of the preschoolers in the study were classified as *borderline* or *abnormal* by their overall SDQ score, although the overall percentages of children meeting the individual DEPRESS (9.2%) and WORRY (19.9%) criteria are adequate for analysis. Another limitation is the lack of specific data regarding the reliability and validity of the individual items that were used in the analysis. However, as noted earlier, the variables have shown a significant relationship to other items in the *Emotional Symptoms* subscale of the SDQ and this subscale has shown concurrent validity with other measures of negative emotion. Similarly, the individual MOOD item from the PEDS survey has not been tested for validity or reliability and there is less evidence for its overall criterion validity.

Another study limitation concerns the matter of parent or proxy adult report. Parent report of children’s negative mood states is often open to criticism since it relies on an interpretation of the child’s internally experienced feelings and thoughts. However, it is difficult to measure the emotional states of preschoolers. Play-based interview methods that are typically used with preschool children were not employed in the CHIS survey because of their impracticality for such a large survey study.

Self-report measures of child height and weight are also susceptible to error. Given that the CHIS is a rather lengthy phone interview, adult respondents were asked only to estimate the child’s height and weight instead of taking actual measurements.

There is evidence that parents of preschoolers may both overestimate weight and BMI (Akinbami & Ogden, 2009; Dubois & Girad, 2007) as well as underestimate children's BMI values (Huybrechts, et al., 2006). This study attempted to reduce the error rate in BMI data by eliminating outliers through standardized processes.

Conclusion

This study provides preliminary evidence that feelings of depression and unhappiness may be associated with normal weight or underweight in preschool children rather than overweight or obesity. These results suggest that children's psychological distress in early childhood may contribute to undereating or certain effects on metabolism that yield lower body weight. Alternatively, overweight may contribute to greater feelings of contentment and happiness if overeating serves as an emotional coping mechanism for the child. Further research is necessary to understand these potential effects. Little research has been conducted with the preschool population and this study is unique for its use of broadly collected statewide data from representative ethnic groups. By elucidating psychological characteristics that may impact the development of either underweight or overweight in the preschool population, it may be possible to improve prevention and treatment of unhealthy weight. Future research should seek to employ more specific, independently observed measures of negative emotion in preschoolers to parse out the individual differences at play. As well, it is recommended that researchers investigate whether acute episodes of negative emotion vary from those experienced over a sustained period in the context of weight gain.

Table 4.1

Descriptive Data

% of Respondents

Variable	**Total**	**Males**	**Females**	**White Males**	**White Females**	**Hispanic Males**	**Hispanic Females**	**Asian Males**	**Asian Females**
Age, years									
3	33.49	33.75	33.23	31.46	32.53	31.64	32.80	28.62	31.36
4	36.83	35.73	37.95	38.50	35.38	39.94	36.53	36.65	47.32
5	29.68	30.53	28.82	30.04	32.08	28.43	30.67	34.73	21.32
Gender									
Male	50.50								
Female	49.50								
Ethnicity									
White	43.74								
Hispanic	29								
Asian	11.88								
Other	15.38								
BMI Status									
Normal/ Underweight	53.44	51.16	55.76	57.05	56.35	39.51	49.58	51.76	61.35
Overweight	10.64	8.31	13.01	8.85	13.08	7.05	15.19	12.85	7.92
Obese	35.93	40.53	31.23	34.11	30.58	53.44	35.23	35.39	30.73
Household income, % of Federal Poverty Level									
0-99	16.24	19.72	12.68	10.56	9.02	33.24	22.96	1.49	3.84
100-199	16.56	14.29	18.87	15.58	14.86	17.75	29.29	8.06	16.65
200-299	14.78	17.22	12.29	15.06	12.81	20.12	11.05	12.36	6.24
≥300	52.43	48.77	56.16	58.81	6.33	28.89	36.7	64.68	73.27
Risk of Developmental Delay (PEDS)									
No Risk	34.48	33.94	35.03	35.99	38.72	32.66	38.0	34.38	23.51
Low Risk	24.78	20.32	29.32	24.28	29.52	17.06	18.84	18.93	35.69
Moderate Risk	18.20	17.97	18.43	17.63	17.47	16.86	20.89	22.08	20.47
High Risk	22.54	27.77	17.22	22.11	14.29	33.43	22.26	24.61	20.33

	% of Respondents								
Variable	**Total**	**Males**	**Females**	**White Males**	**White Females**	**Hispanic Males**	**Hispanic Females**	**Asian Males**	**Asian Females**
Mental Health Development (SDQ) (of those 4-5 years old, 1026 observations)									
Normal	91.64	88.7	94.62	92.27	95.36	82.29	94.8	99.44	93.97
Borderline	3.55	4.82	2.27	5.82	3.32	6.16	0.44	0.18	0
Abnormal	4.81	6.49	3.11	1.91	1.32	11.55	4.76	0.38	6.03

Note. Values are weighted population estimates.

Table 4.2

Cross Tabulations Based on Weight Status

	Weight Status		
Variable	**Normal/Underweight**	**Overweight**	**Obese**
Age			
$F(3.16, 246.76) = 3.32$, $p = 0.019$*			
3 years	48% (0.03, 0.41-0.54)	10% (0.02, 0.07-0.15)	42% (0.04, 0.35-0.49)
4 years	50% (0.03, 0.44-0.49)	11% (0.02, 0.08-0.16)	39% (0.04, 0.32-0.46)
5 years	64% (0.05, 0.54-0.73)	11% (0.02, 0.08-0.14)	26% (0.05, 0.18-0.36)
Gender			
$F(1.96, 153.24) = 4.04$, $p = 0.02$*			
Male	51% (0.03, 0.45-0.57)	8% (0.01, 0.06-0.11)	41% (0.03, 0.34-0.47)
Female	53% (0.02, 0.49-0.58)	11% (0.01, 0.09-0.13)	36% (0.02, 0.31-0.41)
Ethnicity			
$F(4.97, 387.90) = 5.9$, $p = 0.0000$**			
White	60% (0.03, 0.54-0.65)	11% (0.01, 0.08-0.14)	29% (0.03, 0.24-0.35)
Hispanic	39% (0.04, 0.31-0.48)	8% (0.02,0.05-0.13)	53% (0.05, 0.43-0.63)
Asian	63% (0.05, 0.52-0.73)	10% (0.03, 0.06-0.17)	27% (0.05, 0.17-0.39)
Other	54% (0.06, 0.43-0.65)	15% (0.03, 0.1-0.23)	30% (0.05, 0.22-0.41)
Percent of Federal Poverty Level			
$F(4.77, 371.77) = 6.76$, $p = 0.0000$**			
0-99%	38% (0.05, 0.28-0.48)	7% (0.03, 0.03-0.14)	56% (0.06, 0.44-0.67)
100-199%	38% (0.04, 0.31-0.47)	15% (0.03, 0.1-0.23)	46% (0.05, 0.36-0.57)
200-299%	50% (0.07, 0.37-0.63)	13% (0.03, 0.08-0.21)	37% (0.07, 0.24-0.52)
≥300%	64% (0.03, 0.59-0.69)	10% (0.01, 0.07-0.13)	26% (0.03, 0.21-0.32)
Risk of Developmental Delay (PEDS)			
$F(4.83, 376.71) = 1.53$, $p = 0.18$			
No Risk	52% (0.03, 0.45-0.58)	10% (0.02, 0.07-0.15)	38% (0.04, 0.31-0.46)
Low Risk	60% (0.04, 0.52-0.67)	13% (0.02, 0.09-0.18)	27% (0.03, 0.21-0.34)
Moderate Risk	50% (0.04, 0.42-0.59)	12% (0.03, 0.07-0.19)	38% (0.05, 0.28-0.49)
High Risk	52% (0.05, 0.42-0.62)	7% (0.01,0.05-0.11)	41% (0.05, 0.31-0.51)
Mental Health Development (SDQ) (only ages 4-5)			
$F(2.64, 205.72) = 0.75$, $p = 0.51$			
Normal	56% (0.03, 0.5-0.62)	11% (0.01, 0.09-0.14)	32% (0.03, 0.26-0.39)
Borderline	67% (0.12, 0.41-0.85)	9% (0.06, 0.02-0.31)	25% (0.12, 0.09-0.53)
Abnormal	46% (0.18, 0.17-0.79)	5% (0.03, 0.01-0.17)	48% (0.2, 0.16-0.82)
DEPRESS (only ages 4-5)			
$F(1.78, 139.03) = 10.12$, $p = 0.0002$*			
Yes	83% (0.05, 0.7-0.91)	7% (0.02, 0.03-0.13)	10% (0.04, 0.04-0.23)
No	54% (0.03, 0.48-0.59)	11% (0.02, 0.09-0.15)	35% (0.03, 0.29-0.42)

	Weight Status		
Variable	**Normal/Underweight**	**Overweight**	**Obese**
WORRY (only ages 4-5)			
F(1.58, 123.39) = 1.55, *p* = 0.22			
Yes	66% (0.06, 0.52-0.76)	8% (0.02, 0.04-0.14)	26% (0.06, 0.15-0.41)
No	54% (0.03, 0.47-0.61)	12% (0.02, 0.09-0.15)	34% (0.04, 0.27-0.42)
MOOD			
F(1.77, 137.95) = 0.7, *p* = 0.48			
Yes	57% (0.04, 0.49-0.64)	10% (0.01, 0.07-0.13)	34% (0.04, 0.26-0.42)
No	52% (0.03, 0.47-0.57)	11% (0.02, 0.09-0.15)	37% (0.03, 0.31-0.43)

Note. Values are weighted population estimates presented as percentage of respondents, with jackknife standard error and 95% confidence interval in parentheses.
$^{*}p < 0.05$. $^{**}p = 0.0001$.

Table 4.3

Multinomial Logistic Regression Predicting Overweight Status

Independent Variable	**Odds Ratio**	**SE**	***t***	***p***	**95% CI**
Overall Model				0.0001**	
Overweight					
DEPRESS	0.41	0.18	-2.09	0.04*	0.17-0.96
Percent of Federal Poverty Level					
100-199% vs. 0-99%	1.57	0.90	0.79	0.43	0.51-4.90
200-299% vs. 0-99%	1.25	0.70	0.39	0.70	0.41-3.80
≥300% vs. 0-99%	0.89	0.42	-0.26	0.80	0.34-2.28
Ethnicity					
Other vs. White	0.91	0.37	-0.22	0.82	0.40-2.06
Hispanic vs. White	0.83	0.32	-0.47	0.64	0.39-1.80
Asian vs. White	1.03	0.40	0.09	0.93	0.48-2.22
Male	0.79	0.24	-0.80	0.43	0.43-1.43
Obese					
DEPRESS	0.18	0.08	-3.81	0.000**	0.07-0.44
Percent of Federal Poverty Level					
100-199% vs. 0-99%	1.10	0.37	0.27	0.79	0.56-2.16
200-299% vs. 0-99%	0.77	0.42	-0.49	0.63	0.26-2.26
≥300% vs. 0-99%	0.43	0.18	-1.97	0.053	0.19-1.01
Ethnicity					
Other vs. White	0.80	0.27	-0.67	0.50	0.40-1.56
Hispanic vs. White	2.25	0.58	3.11	0.003*	1.34-3.77
Asian vs. White	1.26	0.52	0.56	0.57	0.55-2.89
Male	1.20	0.27	0.81	0.42	0.77-1.87

Note. Weighted population estimates; jackknife standard errors.
*$p \leq 0.05$. **$p \leq 0.001$.

Chapter Five: Risk Factors for Decreased Physical Activity in California Preschoolers

Abstract

Purpose: The aim of this study was to examine factors associated with decreased physical activity in preschool California children.
Methods: Data from the 2009 California Health Interview Survey (CHIS) were included in the analysis of 503 preschoolers aged five years with values for physical activity, height, weight, and ethnicity. Data were analyzed for the following variables of interest: gender, socioeconomic status, BMI status, sedentary activity, maternal English proficiency, and neighborhood park availability.
Results: Approximately 67% of the five-year-old children in this study were categorized as not meeting the physical activity guidelines established by the American Academy of Pediatrics of at least 60 minutes of physical activity per day, each day. Of children meeting the physical activity guidelines, Hispanics represented the smallest proportion (16%) as compared to whites, Asians, and children of other ethnicity. Additionally, children who have mothers with limited or no English skills comprised the greatest proportion of preschoolers not meeting physical activity minimums. Maternal English ability predicted achievement of 60 minutes of daily physical activity with children of English proficient mothers nearly seven times more likely to meet these recommendations. When controlling for ethnicity, children whose mothers had limited English proficiency were still at least five times as likely to report inadequate physical activity as children who had mothers who spoke English well.
Conclusion: Findings suggest that decreased physical activity in this sample of five-year-old children was significantly associated with Hispanic ethnicity and low levels of maternal English proficiency, a correlate of decreased maternal acculturation.

Keywords: Preschool, physical activity, acculturation, overweight, CHIS

Risk Factors for Decreased Physical Activity in California Preschoolers

One byproduct of a technologically sophisticated society is diminished physical activity among its inhabitants. Young children are not immune to this trend and have demonstrated difficulty meeting physical activity recommendations. A recent review of nearly 40 international studies of preschoolers found that that just over half of study participants met the standard of 60 minutes of daily physical activity (Tucker, 2008).

Decreased physical activity has been independently associated with cardiovascular risk factors in children including elevations in blood pressure, fasting glucose, and triglyceride levels (Ekelund et al., 2006). However, much of the physical activity research has been focused on obesity prevention because correlations between diminished physical activity and overweight and adiposity have been well established. Preschoolers who spend less time in vigorous daily activity have greater body fat (Janz, et al., 2002) and are at greater risk for overweight (Nelson, et al., 2006). Longitudinal studies such as the Framingham Children's Study have found that when preschool children increase physical activity over time, their levels of body fat decrease (Moore, et al., 1995). As well, preschool children identified as overweight have been shown to spend significantly less time engaging in vigorous physical activity than their normal weight peers when at day care (Trost, et al., 2003), when engaged in play activities (Vasquez, et al., 2006), and during all waking hours throughout the week (Metallinos-Katsaras, et al., 2007).

Health consequences of overweight are significant and include depression, diabetes, and cardiovascular complications such as dyslipidemia, hypertension, and heart disease for children and adults alike (Ernst & Obarzanek, 1994; Flynn, et al., 2006;

Frankel, et al., 1996; Haney, et al., 2007; Morgan, et al., 2002). Further, these health problems are thought to have greater severity for individuals who become overweight in their youth (Dietz, 1998; Frankel, et al., 1998; Gunnell, et al., 1998). Weight status during the preschool period is especially significant for later overweight due to the phenomenon of adiposity rebound. As part of normal physical development, a child's body mass index (BMI) is expected to drop to its lowest point between five and six years of age before beginning an increase, or adiposity rebound, that extends slowly through adolescence and into adulthood (Rolland-Cachera et al., 1984). Research findings indicate that early adiposity rebound (occurring prior to age six) is associated with an increased risk for obesity in later childhood and adulthood in addition to the concomitant health problems (Rolland-Cachera, Deheeger, Maillot, & Bellisle, 2006; Taylor, Grant, Goulding, & Williams, 2005; Whitaker, Pepe, Wright, Seidel, & Dietz, 1998).

An important factor associated with children's physical activity levels concerns their sedentary behavior. Perhaps the most studied sedentary behavior in young children is television (TV) viewing. Studies have found that preschool children who watch more than three hours of television per day have 3% more body fat than those who view an hour or less (Janz, et al., 2002). Children spending the most time in front of the television set have the greatest increase in adiposity levels even when controlling for dietary intake, physical activity, and parental adiposity (Proctor, et al., 2003). Additional studies have found increased TV viewing and decreased physical activity to be the greatest predictors of overweight in multiethnic preschool populations (Jago, et al., 2005; Nelson, et al., 2006) with the risk for overweight increasing for every extra hour of daily TV viewing (Dennison, et al., 2002). Not surprisingly, a national survey of preschoolers found that children watching more than two hours per day of TV spent 30 minutes less in daily physical activity (Rideout, Vandewater, & Wartella, 2003).

Increasingly, researchers are examining children's computer and video game use in addition to their television habits as young children are becoming progressively more adept at using electronic media. Published reports state that nearly a third of children ages five and six use a computer daily (Vandewater et al., 2007) and up to 16% play video games each day (Rideout, et al., 2003). In addition, one study of low income preschool children found that time spent in front of the TV or computer during the day was more than double the amount of time spent in physical activities (Nelson, et al., 2006).

Another current trend in pediatric physical activity research is the examination of whether park/playground availability and perceived safety play a role in limiting or enhancing preschoolers' activity levels. A study of children ages four to seven years found that increased physical activity correlated with increased housing density and greater park area relative to residential area (Roemmich, et al., 2006). The authors posit that parents are more likely to permit children to play outside when neighbors and playmates are nearby and more likely to visit parks that offer play alternatives. The sheer "greenness," or density of neighborhood vegetation has been shown to be predictive of outdoor physical activity in preschoolers (Grigsby-Toussaint, Chi, & Fiese, 2011) and children ages 3 to 18 years (Liu, Wilson, Qi, & Ying, 2007). The child's physical environment appears to influence the kinds of activities in which the preschool child is interested and able to participate.

The literature has identified additional correlates of physical activity in children including gender, ethnicity, and acculturation. Preschool boys have been consistently shown as more active than girls, regardless of the method of physical activity measurement (Finn, Johannsen, & Specker, 2002; Janz et al., 2001; Montgomery, et al., 2004; Moore, et al., 1995). Ethnic differences have also emerged from the research on older, school-age children but these differences are less well-established among preschoolers. One analysis of over a hundred studies of physical activity in children aged 3 to 18 found ethnicity as a significant predictor for adolescent physical activity but not for younger children under age 12, in part because nearly two thirds of the studies were either from homogenous populations or failed to report the ethnic makeup of the study groups (Sallis, et al., 2000). In at least one study, physical activity differences were found between four-year-old Mexican American children and their Anglo-American counterparts, who were more active during home observation (Sallis et al., 1993). Factors associated with maternal acculturation have also been shown to influence overweight and physical activity in children from varied age and ethnic groups (Chen, et al., 2009; Chen & Wu, 2008; Sussner, et al., 2009). Maternal acculturation factors deserve special scrutiny related to the preschool period of primary maternal influence on socialization and development.

Methods

Study Design and Sample

The aim of this study was to examine factors associated with decreased physical activity in preschoolers aged five years and living in California. Data from the California Health Interview Survey (CHIS) 2009 Child public use data file was utilized for this analysis. The CHIS is a health survey of adults and children conducted biannually by researchers at the University of California, Los Angeles, Center for Health Policy

Research in concert with the California Department of Health Services and the Public Health Institute (CHIS, 2011a).

The CHIS is recognized as the largest state-based public health survey in the U.S. (Holtby, et al., 2008). The CHIS utilizes weighting and imputing of data in an effort to provide valid population estimates for health risk factors and behaviors of Californians (CHIS, 2011a). Questions on the child version of the survey range from demographic information such as age, gender, height, weight, and immigration status to health-related topics such as medical diagnoses, school attendance, developmental status, diet, and physical activity.

The 2009 CHIS methodology report describes a sample design method intended to provide adequate representation of California's ethnic and population diversity (CHIS, 2011a). Data for the child version of the CHIS were obtained primarily through a randomized telephone survey of households whereby a parent or legal guardian provided information about a randomly selected child within the household. The telephone solicitation was designed according to geographic area (county) and utilized both landline and cellular phone numbers. Purposeful oversampling was also used to improve participation from Korean and Vietnamese residents. These groups were oversampled by focusing calls to geographic areas with high concentrations of these subgroups and also by drawing telephone numbers from a pool with identifiable Korean or Vietnamese ethnic surnames. In order to participate in the CHIS phone survey, respondents were required to speak one of five languages well enough to answer questions, including English, Spanish, Chinese (Mandarin or Cantonese), Vietnamese, or Korean.

Approximately 24% of the child surveys were reportedly completed in a language other than English (CHIS, 2011c).

According to the CHIS 2009 report on response rates (CHIS, 2011c), a total of 8,945 interviews were completed with proxy adult responders for the survey of children aged infant through 11 years. The report utilized a weighted methodology to determine an overall completion rate, which accounts for both ineligible households (such as invalid phone numbers) and also population oversampling/undersampling. Approximately 15.7% of households contacted via landline phone and 7.4% of those contacted via cell phone participated in the child survey, yielding an overall weighted response rate of 13.9%. Of those, 73% of landline respondents and 76% of cell phone respondents successfully completed at least 80% of the child survey. The report notes that child survey completion rates benefited from a “child-first” sample methodology which required interviewers for the landline sample to complete the child survey first before continuing on to the adolescent and/or adult survey. The CHIS team sent introductory letters to homes where addresses could be matched to selected landline phone numbers. The letters included two dollars as incentive for participation prior to the survey attempt; interviewers also called numbers repeatedly to increase participation rates. Cell phone respondents did not receive pre-assessment letters but were offered nominal payment for interview completion.

The 2009 CHIS limited collection of physical activity data in preschoolers to children aged five years or older; therefore, the analysis was performed only using data from five-year-old children. In order to be included in the study, values for height and weight (needed to compute BMI) and physical activity were also required. A total of 503 children from the CHIS public use data file met the study inclusion criteria necessary for analysis.

Study Variables

Physical Activity

The purpose of the study was to investigate factors associated with physical activity (PA) in preschool children. The CHIS solicits information regarding children's PA according to the American Academy of Pediatrics (AAP), the National Association for Sport and Physical Education (NASPE), and other advocacy groups' recommendations of a minimum of 60 minutes of PA per day, every day (Council on Sports Medicine and Fitness, 2006; National Association for Sport and Physical Education, 2009). Respondents were asked to identify the number of days in the past week that the index child was active for at least 60 minutes total, not including school physical education. This continuous variable was converted to a dichotomous categorical variable for analysis to represent whether the child meets the minimum PA guidelines (≥ 60 minutes/day) or not (< 60 minutes/day).

Demographic Variables

The study considered demographic variables as part of the analysis. These variables include gender, ethnicity, socioeconomic status, and maternal acculturation.

The CHIS asks respondents to identify the child's gender and also the child's ethnicity. Since the 2007 version of the CHIS, if a child is reported to be part of more than one ethnic group, surveyors have inquired further to see if the child most identifies with one ethnic group and if so, the child receives the ethnicity designation for this primary ethnic category (CHIS, 2008). Children who do not identify with one ethnic group over another are categorized as “multiple race.” Of the children included in this study, the three major ethnic groups of Hispanic, Asian, and white were represented in sufficient number to yield reliable statistical estimates. Children from all other ethnic groups (African American, American Indian, multiple/other race) were consolidated into a category titled “other” for comparative analysis.

The index child’s socioeconomic status is evaluated in the CHIS via the respondent’s report of household income. This value is then recoded within the database in terms of percent of federal poverty level (FPL). The FPL is widely used among researchers and governmental agencies as a delimiter of socioeconomic strata; an FPL of less than 100% is classified as below the federal poverty threshold (U.S. Census Bureau, 2011,).

Maternal acculturation will be assessed by reviewing CHIS responses regarding years lived in the U.S. and degree of English proficiency. Each of these criteria has been implemented in research of acculturation (Arcia, et al., 2001; Cruz, et al., 2008) including studies of child overweight (Ahn, et al., 2008; Sussner, et al., 2009; Van Hook & Baker, 2010). Language use has been shown to be one of the strongest indicators of acculturation (Arcia, et al., 2001; Marin & Gamba, 1996).

BMI and Weight Status

CHIS respondents were asked to report the index child’s height and weight. These measures were used to calculate the raw BMI and subsequently categorize the child’s weight status based on current Centers for Disease Control (CDC) definitions for age and gender. The CDC considers a child *obese* if the BMI is at or exceeds the 95th percentile and *overweight* with a BMI that falls between the 85th and 94th percentile (CDC, 2012).

Conversely, a child is identified as *normal weight* if the BMI falls between the 5th and 84th percentile and *underweight* for a BMI below the 5th percentile. For this study, BMI values were dichotomized for analysis into weight status categories of *overweight* (combining *obese* and *overweight*) and *not overweight* (combining *normal weight* and *underweight*).

Park Factors

As noted in the introduction, physical activity is thought to be associated with park availability. Three questions on the CHIS addressed park factors. The survey solicits information about whether a park or playground is within walking distance of home, whether the closest park is safe during the day, and the number of days the child has been to the park in the past 30 days. Each of these three variables of play area availability, park safety, and amount of park play have been positively associated with children's actual physical activity in research studies (Sallis, et al., 2000).

Sedentary Behavior

The primary sedentary behavior variable of interest for this study is the amount of daily screen time. Screen time is defined as use of entertainment media such as television or computers (Strasburger, 2011). The AAP recommends that children over the age of two years limit the amount of screen time to no more than two hours per day (Strasburger, 2011). The CHIS has two items related to screen time; both ask respondents to consider the index child's use of entertainment media on the weekends only. The first item solicits the hours of daily weekend television viewing or video game use and the other item queries the amount of time per weekend day spent using the computer. Responses for these two items were collapsed into a single continuous variable representing total hours of screen time. The screen time variable was further dichotomized for the purpose of analysis into two categories representing preschoolers who meet the AAP screen time guidelines of no more than two hours per day and those who exceed these guidelines.

Statistical Analysis

Stata Statistical Software (Release 11) (StataCorp, 2009) was used to examine the data and generate statistics using weighted results to project population estimates. Inclusion criteria for this study of five-year-old children were the provision of physical activity data as well as height, weight, and ethnicity data. The CHIS 2009 Child public use data file contained physical activity data and ethnicity data for a total of 747 children aged five years. The height and weight data required preliminary computation and analysis as described next.

The CHIS 2009 Child public use data file did not contain the date of birth for the index child or date of interview completion, nor the child's BMI value. Therefore, children's BMI classifications were made in a stepwise fashion. First, the reported weight in kilograms was divided by the height in meters squared to obtain the raw BMI. Then a simple frequency analysis was conducted to check to see if any BMI values fell far outside the normal range. Tukey boxplot distributions of BMI values were analyzed using PASW Statistics Version 18 (IBM, 2010). The first and third quartile findings were incorporated into cut point calculations to eliminate outliers with either extremely high or low BMI values. Next, each BMI was compared to the CDC's BMI for age reference tables (CDC, 2001) for a child aged 66.5 months (approximately 5 ½ years old). Finally, each child's BMI value was used to assign the child to the appropriate BMI category, leaving a total of 503 children in the study for remaining analysis.

Initial analysis of the data yielded descriptive statistics of the major study variables (gender, socioeconomic status, BMI status, sedentary activity, behavioral/developmental factors, maternal acculturation, and neighborhood park factors). Cross tabulation statistics utilizing a design-based F-test revealed relationships between the dependent variable of physical activity (meeting or not meeting PA guidelines) and variables of interest. Univariate logistic regression analysis was subsequently conducted to investigate selected independent variables' abilities to predict adherence to the physical activity guideline. The final analysis included multivariate logistic regression to explore interrelationships between the two independent variables identified as significant in the previous univariate logistic regression results. Statistical significance for the analyses was identified by a p value equal or below 0.05.

Results

A total of 503 California preschoolers aged five years were included in the analysis. The children in the study sample were nearly equally divided along gender lines with 48% female and 52% male. As shown in Table 5.1, 44% of the children were white, 26% Hispanic, 10% Asian, and 20% of the children were classified as "other" because their numbers were not sufficient to generate reliable statistical analyses if labeled separately by race.

Over half of families in the study (54%) reported income greater than 300% of FPL while nearly a third reported low socioeconomic status with incomes below 200% of FPL. Most mothers (89%) were reported to have lived in the U.S. for at least 10 years while almost 20% of mothers had limited English speaking ability. A large majority of survey respondents reported that there was a neighborhood park or playground located within walking distance of their home (79%), that the park was safe (94%), and that the index child had visited a park within the past 30 days (90%).

Approximately 67% of children in the study did not meet the recommendations for physical activity of at least 60 minutes of activity per day, every day. Nearly half of children (47%) met daily screen time guidelines and spent two or fewer hours per day watching TV, playing video games, or using the computer. Approximately 64% of children in the study were categorized as underweight or normal weight, while 36% were classified as overweight. Of those classified as overweight, 25% met the criteria for obese status (BMI $\geq 95^{th}$ percentile).

Factors Associated with Physical Activity

Children's ability to meet PA guidelines differed across ethnicities ($p = 0.008$). As noted in the cross tabulations presented in Table 5.2, it appears that the smallest proportion of five-year-old children meeting PA guidelines is of Hispanic ethnicity. Only 16% of Hispanic children met PA minimums while 43% of Asian and white children and 26% of children from other ethnic groups were reported to engage in at least 60 minutes of PA per day.

The cross tabulations also show that children whose mothers have limited English language ability represented the smallest proportion of children meeting PA guidelines. The first step in the analysis found that when utilizing the four-category scale of maternal English ability, physical activity differed significantly ($p = 0.04$). Of children meeting PA minimums, barely 1% came from the group with mothers who speak no English and only

8% were part of the group with mothers who speak English *not well*. When the maternal language ability variable is dichotomized (speaks English *very well/well* vs. *not well/not at all*), the proportion of children meeting the PA guidelines continued to vary significantly (p = 0.0001) with the smallest proportion representing children of mothers whose English ability was found in the *not well* category (6%). Interestingly, the proportion of children meeting (32%) or not meeting (68%) PA guidelines was similar for the "mother speaks English *very well/well*" category when compared to the overall proportion of children meeting PA guidelines (33% to 67%).

The preceding findings created concern that ethnicity and maternal English ability were confounded. Therefore, another cross tabulation was performed using the dichotomy of mother's language ability as the dependent variable and child ethnicity as the independent variable. This analysis showed maternal English ability differed significantly across ethnic groups (p = 0.0001). Of mothers with limited English ability, the greatest proportion was within the Hispanic category (35%) while the remaining three ethnic groups each had very small representation (4% to 9%).

None of the other cross tabulations proved statistically significant in their relationship with children meeting PA guidelines. Gender, socioeconomic status, sedentary activity, neighborhood park factors, and mother's years in the U.S. all appear unrelated to PA in this sample of five-year-old children. Achievement of PA minimums also did not vary significantly according to children's overweight status.

Linear regression analysis was performed to ascertain whether the variables of interest were predictive of the outcome variable of meeting the PA guidelines. Presented in Table 5.3, the findings are similar to the cross tabulations. The only variables shown to be significant for predicting the outcome were mother's English ability (p = 0.02) and child's ethnicity (p = 0.01). As both of these predictors are categorical variables, the interpretation is limited. The regression analysis demonstrates that PA levels differ between the ethnic classifications of white and other. Achievement of PA minimums also differs between children who have mothers with the highest and lowest English language skills.

Multinomial logistic regression was utilized to explore relationships between the PA outcome and those variables already identified as significant in the cross tabulations and linear models. These results are presented in Table 5.4. The previous analyses suggested that maternal English ability and child ethnicity are interrelated. In order to obtain a clearer picture of how these two variables predict PA, each was examined independently in the first step of the logistic regression analysis.

The regression model was significant (p = 0.004) in predicting achievement of meeting PA guidelines when utilizing ethnicity as the predictor variable. The odds of meeting PA guidelines for Hispanic was found to be 75% less than those for white children (p = 0.001). Post hoc pairwise comparisons of the different ethnic groups showed that whites differed from Hispanic ($p < 0.0001$) and from children categorized as other ethnicity (p = 0.04) in meeting PA guidelines.

Multinomial regression analysis conducted using maternal English ability as a predictor for PA was also significant (p = 0.006). Children of mothers who speak English well were found to have odds 6.9 times greater for meeting PA minimums than those of mothers with limited English skill ($p < 0.0001$). When the ethnicity variable was added to the model for multivariate logistic regression, the overall model was significant (p =

0.006) but no significant differences among the race categories remained. However, the odds of meeting the PA guidelines were shown to be at least five times greater for children whose mothers speak English well than for those who do not ($p = 0.002$) when adjusting for child's ethnicity. This decrease in odds ratio for achieving minimum PA levels reflects the interrelatedness of these variables. In addition, the post hoc pairwise comparisons resulted in no significance because all variables were adjusted for mother's English language ability. A further test of interaction between the maternal language and child ethnicity variables was significant ($p = 0.02$) but not meaningful due to insufficient observations among the categories and sparsely populated cells.

Discussion

Analysis of the CHIS data showed that an inadequate percentage of five-year-old California children are meeting guidelines for 60 minutes of daily physical activity. This is of concern because promotion of regular physical activity in childhood has been shown to reduce current and future individual health problems, especially related to overweight and obesity.

Although several studies across varied demographic milieus have linked limited physical activity with increased risk for overweight in young children, this study did not find overweight associated with preschoolers' PA. This may be due in part because of the varied methods for defining and measuring physical activity in the literature. One of the limitations of the study involves the survey question about PA since it does not ask the respondent to qualify the type of PA (such as vigorous vs. moderate). It would be helpful to know the type of PA since aerobic fitness, rather than simply total energy expenditure, is most closely associated with decreased risk for childhood adiposity (Johnson, et al., 2000).

The study results were surprising in that screen time was not significantly associated with PA despite the finding that over half of the children were exceeding TV, video game, and computer use limits of two hours per day. Given that the assessment method for determining hours of TV viewed was parental report, one could make the case that the TV time amounts may be an underestimation since up to a third of children in previous research have been shown to possess a television set in their own rooms, away from parental supervision.

The lack of an overall association between park factors and physical activity was less surprising. Simply increasing time spent outdoors has not been shown as effective in improving PA levels in at least one study of Hispanic preschool children (Alhassan, Sirard, & Robinson, 2007). It is also thought that PA is related to both the availability of open space and the type of play equipment rather than just one or the other (Nicaise, et al., 2011). Additionally, the vast majority of survey respondents identified their local park or playground as safe, nearby, and visited often by the index child, which leaves less variability with which to identify differences.

Ethnicity and maternal English ability were interrelated in their ability to predict preschool PA. The largest proportion of mothers in this study with limited English proficiency came from the Hispanic category for child's ethnicity. The fact that poor maternal English language skill remained a strong predictor of PA even after adjusting for ethnicity suggests that the family environment, in the context of the mother-child dyad, may have significant influence over socialization to and opportunities for PA in young children.

The body of literature in the area of parental influence on PA is narrow in its focus, with studies generally measuring children's movements rather than family influences on activity levels. It is unclear what kinds of parenting behaviors have the greatest effect on improving PA in preschoolers. A meta-analysis of children ages 2 to 18 years found that parental modeling may have limited to no effect while parents who provide encouragement and support may improve their children's activity levels (Pugliese & Tinsley, 2007). At least one other meta-review has demonstrated that parental influence on children's activity has been at best inconsistent in the research (Sallis, et al., 2000). The former meta-analysis noted that there was insufficient data to determine whether differences exist between mothers and fathers on measures of influence and the latter suggested that differences have simply not yet been identified. Both analyses failed to name effective parent behaviors specific to the preschool age group. In this study, it would appear that mother's level of acculturation may be a powerful factor over PA.

The association between Hispanic ethnicity and decreased PA in preschoolers must be considered. This PA correlate has been identified in previous child research yet has not been examined sufficiently in terms of acculturation. An especially elucidative qualitative study of Mexican American mothers of preschoolers found that PA was valued but that mothers were apt to restrict outdoor play during the summer months (Gallagher, 2010). Although this study took place in another state, it is possible that California Hispanic mothers share similar concerns and limit vigorous child play. The same study also found that mothers valued and promoted TV viewing because they believed it was educational and helped their children learn the English language since the mothers did not use English at home. Another recent qualitative study of parents in Mexico City found that parental reliability on childcare from grandparents and parents' concern for communicable disease were factors in decreased PA in their preschool children (Rodriguez-Oliveros et al., 2011). This study did not examine seasonal PA variations not parental beliefs about PA, but future investigations should explore these qualitative findings further.

Conclusion

Although previous research of preschoolers' physical activity levels has identified ethnicity as a correlate, less has been published in this age group regarding related factors such as English language ability, a correlate of maternal acculturation. Population-based data on physical activity in preschool U.S. children are also sparse in the literature. This study is unique for its use of broadly collected statewide data of young children which identified factors contributing to physical activity in this sample of preschoolers aged five years. Study findings suggest that ethnicity and limited maternal English ability are predictive of young children's achievement of PA guidelines. Efforts to improve preschool physical activity rates must consider cultural factors when attempting to assist families to raise active children.

Table 5.1

Descriptive Data for Preschool Children (5 Years of Age) in CHIS 2009 Sample

	% of Respondents								
				Male			Female		
Variable	**Total**	**Male**	**Female**	**White**	**Hisp-anic**	**Asian**	**White**	**Hisp-anic**	**Asian**
Gender									
Male	51.9								
Female	48.1								
Ethnicity									
White	44.3	34.5	54.9						
Hispanic	25.9	31.4	20.0						
Asian American	10.3	8.2	12.6						
Other	19.5	25.9	12.5						
Percent of Federal Poverty Level									
0-99%	18.3	22.7	13.6	12.3	36.5	30.6	8.1	24.5	9.3
100-199%	10.9	9.1	12.8	13.5	9.7	2.8	10.7	19.6	14.6
200-299%	17.3	19	15.4	20.4	23.1	14.4	16.6	9.7	6.1
>300%	53.6	49.3	58.2	53.8	30.7	52.3	64.6	46.2	70
Overweight Status									
BMI < 85th Percentile	63.8	59.6	68.4	62	46.2	59.8	68.8	66.2	71.2
BMI ≥ 85th Percentile	36.2	40.4	31.6	38	53.8	40.2	31.2	33.9	28.8
Meets PA Guidelines									
Yes (≥ 60 min/day)	32.9	31.8	34.1	37.3	23.7	32.4	37.6	20.5	48.5
No (< 60 min/day)	67.1	68.2	65.9	62.7	76.3	67.6	62.4	79.5	51.5
Meets Screen Time Guidelines									
Yes (≤ 2 hours/day)	47.3	42.9	52.0	43.2	41.7	49.8	58.0	47.9	26.9
No (> 2 hours/day)	52.7	57.1	48.0	56.8	58.3	50.2	42.0	52.1	73.1
Maternal English Speaking Ability									
Very Well	59.6	60.8	58	49.7	45.1	65.3	73.9	45.4	74.2
Well	21	27.5	12.9	37.5	37.1	27.3	9.6	12.6	17.9
Not Well	15.6	9.8	23	12.8	14.6	7.5	7.6	32.4	7.9
Not at All	3.8	1.9	6.1	0	3.2	0	8.9	9.5	0

Variable	Total	Male	Female	Male: White	Male: Hisp-anic	Male: Asian	Female: White	Female: Hisp-anic	Female: Asian
	% of Respondents								
Mother's Years in U.S.									
≤ 1 Year	3.9	0	6.0	0	0	0	5.3	0.7	11.2
2-4 Years	4.7	3.5	6.2	1.5	1.1	0.8	0	1.9	14.0
5-9 Years	2.4	13.2	34.8	3.7	10.8	13.5	9.8	34.9	41.9
10-14 Years	37.0	47.4	25.5	36.0	54.8	47.9	12.9	32.4	19.7
15-19 Years	11.4	13.4	9.3	10.9	11.6	13.1	4.9	9.9	6.5
20-24 Years	7.4	7.6	7.3	9.7	4.5	11.0	1.5	13.1	0
25-29 Years	6.6	11.7	0.9	31.0	16.0	8.7	1.0	0.6	1.5
≥ 30 Years	6.5	3.3	10.1	7.3	1.4	5.1	10.1	6.5	5.3
Park Nearby									
No	21.4	24.5	18.1	26.2	37.9	16.5	16.7	11.3	31.4
Yes	78.6	75.5	81.9	73.8	62.1	83.5	83.3	88.7	68.6
Visited Park Past 30 Days									
No	9.8	8.2	11.5	4.1	1.7	1.2	9.6	20.5	5.3
Yes	90.2	91.8	88.5	95.9	98.3	98.8	90.4	79.5	94.7
Closest Park Safe During Day									
Strongly Agree	46.3	40.3	52.7	49.9	28.9	62.1	61.7	37.8	43.7
Agree	47.6	53.9	40.8	46.7	63.5	29.6	32.9	54.9	42.6
Disagree	4.4	4.7	4.2	1.7	5.1	8.3	4.8	4.9	4.6
Strongly Disagree	1.7	1.2	2.3	1.7	2.7	0	0.7	2.4	9.1

Note. Values are weighted population estimates.

Table 5.2

Cross Tabulations Based on Physical Activity Guidelines

	Dependent Variable		
Independent Variable	**Does Not Meet PA Guidelines (< 60 minutes/day)**	**Meets PA Guidelines (≥ 60 minutes/day)**	**Statistics**
Gender			$F(1, 78) = 0.11$, $p = 0.74$
Male	68% (0.05, 0.57-0.77)	32% (0.05, 0.23-0.43)	
Female	66% (0.04, 0.57-0.74)	34% (0.04, 0.26-0.43)	
Ethnicity			$F(2.9, 226.22) = 4.09$, $p = 0.0081$*
White	57% (0.04, 0.49-0.65)	43% (0.04, 0.36-0.51)	
Hispanic	84% (0.05, 0.71-0.91)	16% (0.05, 0.09-0.29)	
Asian	57% (0.12, 0.33-0.78)	43% (0.12, 0.22-0.68)	
Other	74% (0.08, 0.55-0.87)	26% (0.08, 0.13-0.45)	
Percent of Federal Poverty Level			$F(2.71, 211.48) = 1.91$, $p = 0.13$
0-99%	78% (0.07, 0.67-0.88)	22% (0.07, 0.12-0.38)	
100-199%	52% (0.09, 0.34-0.69)	48% (0.09, 0.31-0.66)	
200-299%	74% (0.09, 0.52-0.88)	26% (0.09, 0.12-0.48)	
>300%	64% (0.04, 0.55-0.72)	36% (0.04, 0.28-0.45)	
Overweight Status			$F(1, 78) = 0.02$, $p = 0.90$
BMI < 85^{th} Percentile	67% (0.04, 0.59-0.74)	33% (0.04, 0.26-0.41)	
BMI ≥ 85^{th} Percentile	68% (0.06, 0.56-0.78)	32% (0.06, 0.22-0.45)	
Meets Screen Time Guidelines			$F(1, 78) = 1.47$, $p = 0.23$
Yes (≤ 2 hours/day)	63% (0.04, 0.54-0.71)	37% (0.04, 0.29-0.46)	
No (> 2 hours/day)	71% (0.05, 0.6-0.8)	29% (0.05, 0.2-0.4)	
Maternal English Speaking Ability			F(1.54, 120 = 3.6, $p = 0.0416$*
Very Well	66% (0.09, 0.47-0.81)	34% (0.09, 0.19-0.54)	
Well	72% (0.09, 0.51-0.86)	28% (0.09, 0.14-0.49)	
Not Well	92% (0.03, 0.82-0.97)	8% (0.03, 0.03-0.18)	
Not at All	99% (0.01, 0.91-100)	1% (0.01, 0-0.09)	

Independent Variable	Dependent Variable: Does Not Meet PA Guidelines (< 60 minutes/day)	Dependent Variable: Meets PA Guidelines (≥ 60 minutes/day)	Statistics
Maternal English Speaking Ability			*F*(1, 78) = 16.45, *p* = 0.0001**
Very Well/Well	94% (0.03, 0.85-0.97)	7% (0.07, 0.53-0.79)	
Not Well/Not at All	6% (0.03, 0.03-0.15)	32% (0.07, 0.21-0.47)	
Park Nearby			*F*(1, 78) = 0.09, *p* = 0.76
No	65% (0.12, 0.4-0.83)	36% (0.12, 0.17-0.6)	
Yes	68% (0.03, 0.61-0.74)	32% (0.03, 0.26-0.39)	
Visited Park Past 30 Days			*F*(1, 78) = 0.45, *p* = 0.5
No	74% (0.12, 0.46-0.9)	26% (0.12, 0.1-0.54)	
Yes	66% (0.03, 0.6-0.72)	34% (0.03, 0.28-0.4)	
Closest Park Safe During Day			*F*(2.72, 212.12) = 1.28, *p* = 0.28
Strongly Agree	63% (0.04, 0.54-0.71)	37% (0.04, 0.29-0.46)	
Agree	73% (0.6, 0.61-0.83)	27% (0.6, 0.17-0.39)	
Disagree	53% (0.12, 0.3-0.75)	47% (0.12, 0.25-0.7)	
Strongly Disagree	48% (0.29, 0.09-0.9)	52% (0.29, 0.1-0.91)	

Note. Values are weighted population estimates presented as percentage of respondents, with jackknife standard error and 95% confidence interval in parentheses.
* $p < 0.05$. ** $p = 0.0001$.

Table 5.3

Univariate Linear Regression Predicting Achievement of Physical Activity Guideline (at least 60 minutes per day)

Independent Variable	Coefficient	SE	*t*	*p*	95% CI
Overweight Status					
Overweight vs. Not	-0.45	0.38	-1.17	0.25	-1.21 – 0.32
Gender					
Male vs. Female	0.25	0.35	0.69	0.49	-0.46 – 0.95
Ethnicity					
White vs. Other	0.34	0.14	2.52	0.01*	0.07 – 0.61
Poverty (%FPL)					
Percent (continuous)	0.08	0.05	1.8	0.08	0 – 0.18
Categorical	0.42	0.21	1.95	0.054	0-0.84
Screen Time					
Hours (continuous)	-0.12	0.09	-1.3	0.2	-0.3 – 0.06
Meets Guidelines vs. Not	0.05	0.39	0.13	0.9	-0.73 – 0.83
Mother's English Language Ability					
Very Well/Well vs. Not Well/Not at All	-0.83	0.35	-2.37	0.02*	-1.53 - -0.13
Park Nearby (Y/N)	0.66	0.76	0.87	0.39	-0.85 – 2.17
Been to Park in Past Month (Y/N)	0.06	0.45	0.14	0.89	-0.83 – 0.96
Park Safe (Y/N)	-0.44	0.28	-1.59	0.12	-1 – 0.11

Note. Weighted population estimates; jackknife standard errors.
*$p \leq 0.05$.

Table 5.4

Multinomial Logistic Regression Predicting Achievement of Physical Activity Guideline (at least 60 minutes per day)

Independent Variable	**Odds Ratio**	**SE**	***t***	***p***	**95% CI**
Ethnicity				0.0038**	
White	0.76	0.12	-1.7	0.09	0.55 - 1.05
Hispanic	0.25	0.10	-3.45	0.001**	0.12 - 0.56
Asian	1	0.57	0	1	0.32 - 3.12
Other	0.46	0.2	-1.81	0.07	0.20 - 1.08
Mother's English Language Ability				0.0003**	
Very Well/Well	6.90	3.57	3.77	0.000***	2.50 – 19.31
Not Well/Not at All	0.07	0.03	-6.1	0.000***	0.03 – 0.17
Post-hoc Pairwise Comparisons of Ethnicity Variable			***z***		
Hispanic vs. Other		0.1	-1.03	0.30	-0.29 - 0.9
Asian vs. Other		0.15	1.15	0.25	-0.12 - 0.46
White vs. Other		0.08	2.02	0.04*	0.01 - 0.34
Asian vs. Hispanic		0.14	1.94	0.05*	0 - 0.54
White vs. Hispanic		0.06	4.23	0.000***	0.14 - 0.39
White vs. Asian		0.14	0	1	-0.27 - 0.28

Note. Weighted population estimates; jackknife standard errors
* $p \leq 0.05$. ** < 0.005. *** $p \leq 0.0001$.

Table 5.5

Multinomial Logistic Regression Predicting Achievement of Physical Activity Guideline (at least 60 minutes per day) by Ethnicity and Maternal English Language Ability

Independent Variable	**Odds Ratio**	**SE**	***t***	***p***	**95% CI**
Overall Model				0.006*	
Ethnicity					
Hispanic	0.50	0.35	-0.99	0.32	0.13 – 1.98
Asian	1.75	1.45	0.67	0.50	0.34 – 9.12
Other	0.78	0.71	-0.27	0.79	0.13 – 4.77
Mother's English Language Ability					
Very Well/Well	5.05	2.60	3.15	0.002**	1.81 – 14.08
Not Well/Not at All	0.11	0.07	-3.54	0.001***	0.03 – 0.38
Post-hoc Pairwise Comparisons of Ethnicity Variable		**SE**	***z***	***p***	**CI**
Hispanic vs. Other		0.15	-0.49	0.63	-0.37 – 0.22
Asian vs. Other		0.19	0.88	0.38	-0.2 – 0.55
White vs. Other		0.17	0.27	0.79	-0.29 – 0.39
Asian vs. Hispanic		0.16	1.51	0.13	-0.07 – 0.56
White vs. Hispanic		0.12	0.98	0.33	-0.12 – 0.36
White vs. Asian		0.18	0.50	0.50	-0.48 – 0.23

Note. Weighted population estimates; jackknife standard errors.
* $p \leq 0.05$. ** < 0.005. *** $p \leq 0.001$.

Chapter Six: Summary, Limitations, and Implications of the Study

This descriptive cross-sectional analysis of data from the 2009 California Health Interview Survey sought to identify risk factors for obesity and decreased physical activity in preschool California children. This closing chapter will present a summary of study findings, discuss study limitations and offer clinical and research implications.

Meaning of Findings in Relation to Theoretical Model and Research Questions

The Davison and Birch Ecological Model of Childhood Obesity (Davison & Birch, 2001) presented in Figure 1 was used as a framework for the investigation, focusing on behavioral and environmental contexts around the young child's weight status. The three main research objectives for this study were to: 1) identify factors related to increased BMI in preschoolers age three to five years of age in the CHIS study; 2) determine whether negative emotion is associated with overweight in preschoolers age three to five years of age in the CHIS study; and 3) identify factors related to physical activity in preschoolers five years of age in the CHIS study. Data were analyzed for the following variables of interest: age, gender, ethnicity, maternal acculturation, and poverty level, as well as measures of dietary intake, physical activity, sedentary activity, park factors, and negative emotion.

Community and demographic factors, in the outermost circle of the ecological model, were identified in this study as risk factors for obesity in preschoolers. These results are similar to the research findings presented in the literature review which suggest ethnicity, maternal acculturation, and poverty are associated with pediatric obesity. Approximately 36% of preschoolers were categorized as obese ($\geq 95^{th}$ percentile BMI) and Hispanics were 1.73 times as likely to be obese as whites. Preschoolers with family incomes over 300% of the federal poverty level (FPL) were 63% less likely to be obese than children whose families earned less than 100% of FPL. Park factors did not predict obesity or physical activity levels.

The study also explored the innermost circle of the ecological model pertaining to the child behaviors of dietary intake, sedentary activity, physical activity, and emotions. Preschool-age children's dietary intake of fast food was predictive of obesity so that those avoiding fast food intake the previous week were 30% less likely to be classified as obese. Sedentary activity, as represented by combined hours of TV, computer, and video game use, was not a significant predictor of obesity. Physical activity was also not implicated in obesity risk. One of three measures of negative emotion, which identified children as unhappy, depressed, or tearful, predicted underweight or normal weight. These children were 59% less likely to be overweight and 82% less likely to be obese than those who did not meet this criterion, even when adjusting for poverty level, ethnicity, and gender.

It should be noted that the investigation of negative emotion did not find poverty as a significant predictor in the combined multinomial logistic regression model. In that model, the risk for being obese as compared to normal or underweight had a level of significance of 0.053, which did not meet the $p \leq 0.05$ standard. It seems plausible that the negative emotion variables (DEPRESS, WORRY, MOOD) may be linked to the poverty measure, thereby reducing the independent influence of low household income on obesity. This possibility should be explored further because interrelationships have been identified in previous research among pediatric obesity, poverty, and depression scores (Lin, et al., 2012).

The study performed an in depth analysis of the physical activity variable to identify factors that predict preschoolers' adherence to the recommended physical activity guidelines of at least 60 minutes of daily activity. Findings from this investigation of five-year-old children in the study demonstrated that meeting physical activity guidelines was predicted by ethnicity and maternal English ability. Approximately 67% of five-year-old children were categorized as not meeting physical activity guidelines and only 16% of Hispanic children met PA recommendations. When controlling for ethnicity, children whose mothers had limited English proficiency were five times as likely to report inadequate PA as children whose mothers spoke English well.

This study did not examine the family environmental and parent characteristics presented within the middle ring of the ecological model. The CHIS Child survey did not contain items suitable for the analysis of those family and parent related variables, but future research should explore the adult version of the CHIS and utilize paired parent-child data to examine the results of the current study within a family context, especially since ethnic and acculturation factors would be expected to influence family norms.

Significance

This study offers new knowledge in the area of pediatric obesity research. It is unique in its examination of obesity and physical activity among diverse, statewide sample of children from the preschool age group. Results suggest that adherence to current professional diet and activity guidelines may not be sufficient alone to prevent obesity. Refinement in both data collection and clinical recommendations in these areas is warranted. Hispanic ethnicity demonstrated risk for unhealthy weight and poor physical activity, which augments findings from previous research. The identification of maternal English language ability as a significant, independent risk factor for physical activity is an important step in further understanding of demographic variables that may influence obesity rates in minority children. The study findings also present beginning evidence that negative mood may be associated with under or normal weight in young children, which is contrary to previous research that suggests correlations between depression and overweight.

Limitations

Critique of secondary analysis includes methodological problems related to the unit of analysis and definitions of the variables (McArt & McDougal, 1985). In terms of the unit of analysis, it may be problematic that interviews were limited to the languages of English, Spanish, Chinese, Vietnamese, and Korean (CHIS, 2011a) which, of necessity, excludes certain households. Yet, the study focuses upon the ethnic groups represented by these languages, which are the most prevalent second languages in this sample. The fact that the CHIS employs imputing methods to replace missing variables is another limitation but these methods are clearly reported and in accordance with established procedures (i.e. relational and hot-deck imputation) (CHIS, 2011b). Although secondary analysis has limitations, the number of participants in the child version of the CHIS is greater than would be possible for this researcher to obtain independently. Aspects of the child data that contribute to the credibility and external validity of findings are its data currency and its representation of the ethnic groups of interest. The results of this study may guide future researchers to ask new and perhaps more elucidative questions regarding child, family, and environmental factors associated with preschool obesity and physical activity.

For certain, some of the study variables of interest would be better represented by more detailed and specific questioning than available within the CHIS. The BMI calculation depended upon respondent estimations of child height and weight, which may have been incorrect parental estimates. A major limitation exists for the investigation of whether negative mood is associated with BMI. Reliability and validity data are lacking for the individual items and responses on two of three negative emotion items were provided by only four and five-year-old children in the study sample. The CHIS items representing sedentary activity were limited by questions which asked respondents to identify preschoolers' activity for weekends only rather than average daily screen time which may have provided clearer differences among children's activities. The solicitation of dietary intake suffers from problems with recall and serving size estimates. The aforementioned limitations should be taken into consideration when critiquing the study; however, it is believed that the data were sufficient for initial pursuit of the research aims.

Implications for Nursing

The study findings have implications for nursing, for clinicians, and for future research. The high prevalence of obesity (36%) and overweight (11%) among California preschoolers in this study is concerning, particularly when recent national studies have reported that among U.S. children aged two to five years the prevalence of a BMI greater than the 85^{th} percentile (overweight including obese) ranges between 17% and 23% (Ogden, et al., 2012; Olds, et al., 2011). Although the elevated prevalence rates in the present study should be viewed with caution, there is ample evidence to demonstrate that childhood obesity is linked to increased risk for adult obesity and morbidity. There are also indications that mothers have difficultly self-identifying their overweight preschool children as having weight issues (Campbell, Williams, Hampton, & Wake, 2006; Jain et al., 2001) which indicates that healthcare providers must give voice to this public health problem lest nationwide prevalence rates surge again. Nurses and other health professionals should conduct obesity child-find activities and intervene as soon as a child is identified as overweight, even as young as three years of age.

A common sense approach to the pediatric obesity problem is to improve both diet and physical activity. However, the present study did not find an association between adherence to physical activity guidelines and overweight, nor was there a risk identified for lack of adherence to dietary guidelines other than for fast food intake. At the same time, rates of preschooler compliance with dietary recommendations ranged from 85% (soda intake, fried food intake) to as low as 29% (sugary food intake). These findings suggest that clinicians should be more directive in prescribing interventions to avoid or treat overweight in preschoolers. Caregivers should be counseled on dietary and behavioral recommendations and also must be able to dialog with health providers about realistic ways to operationalize these guidelines in their daily life. As shown in the study, poverty poses risk for obesity and may impact the kinds of foods families are able to obtain. Similarly, clinicians should discuss types of physical activity that best offer the opportunity for young children from all cultural and socioeconomic backgrounds to participate in moderate to vigorous play.

Hispanic ethnicity predicted higher risk for obesity and reduced physical activity levels in preschool children. Poor maternal English ability was also associated with low levels of physical activity. Nurses and others should recognize that children of Hispanic ethnicity are at greater risk for elevated BMI and should work to develop culturally sensitive approaches. The fact that limited English speaking ability was identified as an independent risk factor indicates that healthcare providers must be vigilant in ensuring access to translators and health education materials for families from linguistically diverse households. Perhaps community-wide initiatives may be enacted to assist these families to address both cultural and language barriers to healthy lifestyles for their children.

The findings regarding negative emotion and its relationship with weight status are preliminary. There is insufficient support to make practice recommendations at this time. However, clinicians should be aware that evidence of depressed mood in young children may have different implications for weight status than for school-age or adolescent children.

In terms of the ecological model, only one of the three factors thought to central to the pediatric obesity problem demonstrated significance. Fast food intake increased the risk for obesity but activity levels did not. None of the other diet variables predicted obesity and negative emotion predicted normal and underweight, rather than overweight. On the contrary, three of the four community and demographic factors were predictive of obesity, including ethnicity, maternal English proficiency, and poverty level. Park factors (accessibility of recreational facilities) were the only community factors proved not significant. Limitations of the research study notwithstanding, these findings illustrate the unique influence of contextual factors on the development of personal behaviors which should be modifiable if successful treatment strategies can be identified.

Future Research

There are ample avenues for future research in the area of preschool obesity and physical activity. Additional investigation into dietary and physical activity recommendations and their association with weight status would help determine whether current guidelines are inadequate for the prevention of obesity in preschoolers. The relationship between negative emotion and weight status in children is not well understood and also requires further exploration better elucidate directional associations among preschoolers. Family environmental factors were not addressed in this study but research is still needed to identify family norms that may magnify or lessen the impact of demographic and community risk factors. Longitudinal studies of ethnically diverse samples of young children will help ascertain which obesity prevention efforts yield the best likelihood for success over the long term.

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