THE POTENTIAL OF TELEVISIONS IN THE BEDROOM INCREASING A CHILD'S RISK FOR OBESITY THROUGH DECREASED SLEEP TIMES

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by
Brittany Nicole Mellen
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SAN DIEGO STATE UNIVERSITY

The Undersigned Faculty Committee Approves the

Thesis of Brittany Nicole Mellen:

The Potential of Televisions in the Bedroom Increasing a Child's Risk for Obesity

Through Decreased Sleep Times

Guadalupe X. Ayala, Chair
Graduate School of Public Health

Hector Lemus
Graduate School of Public Health

Mee Young Hong
School of Exercise & Nutritional Sciences

John P. Elder
Graduate School of Public Health

May 5, 2014
Approval Date
DEDICATION

To mom and dad, just because I love you
ABSTRACT OF THE THESIS

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by

Brittany Nicole Mellen

Master of Public Health with a Concentration in Health Promotion and Behavioral Science
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The purpose of this study was to determine if a television in a child’s bedroom is related to his/her risk for obesity through reduced sleep duration. Social Cognitive Theory provided the theoretical framework for this study. Data were collected through interviews with 104 caregivers who are participants in the intervention LUCES de Cambio. Caregivers were asked to report the typical bedtime and wake times of their child to determine average nightly sleep duration. The interview asked the caregivers to also report whether there was a television in the child’s bedroom. Baseline measurements were taken of the child’s height and weight to determine the child’s BMI percentile. Relationships were assessed with linear regression including bivariate and multivariate analyses.

The children were Hispanic and had a mean age of 7.9 (SD=1.3). Fifty-seven percent of caregivers had a family monthly income of less than $2000 and 40% had less than a high school education. The average BMI percentile for children was 90.8 (SD=6.4). Twenty-one percent of the children had a healthy weight, 43% were overweight, and 39.5% were obese. There was a trend in the relationship between the presence of a television in the bedroom and a child’s BMI percentile. No significant relationship was found between sleep duration and a child’s BMI percentile.

These findings suggest that it is important to investigate the impact of televisions in the bedroom on a child’s risk for obesity. Due to limitations in parent-reported sleep duration, future research should consider using objective measurements, such as an actigraph, to more precisely investigate the relationship between sleep and obesity risk in children.
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CHAPTER 1

INTRODUCTION

CHILDHOOD OBESITY TRENDS

In the U.S., national childhood obesity rates have remained the same between 2003-2004 and 2011-2012 (Ogden, Carroll, Kit, & Flegal, 2014). About 34% of children in the U.S. are overweight or obese, and 17% of children in the U.S. fall into the obese category (Ogden et al., 2014). Overweight is defined as children in the 85th to less than the 95th percentile per sex-specific Centers for Disease Control and Prevention BMI-for-age growth charts; and obesity is defined as children falling into the 95th percentile and above.

Current childhood obesity trends may have begun leveling off over the past few years, but the proportion of children in the higher end of the obese category has continued to grow (Cunningham, Kramer, & Narayan, 2014). In a longitudinal study, Cunningham et al. (2014) found that the prevalence of childhood obesity increased about 5% between the ages of kindergarten to eighth grade. BMI percentiles of 97th or above have continued to rise among boys aged 6-19 years old, from the years of 1999-2008 (Kelly et al., 2013). The overall prevalence of childhood obesity may have stopped growing, but high-risk subgroups are worth studying.

Childhood Obesity Trends within the Hispanic/Latino Community

The Hispanic community has experienced significant increases in obesity prevalence rates. Research continues to show that Hispanics have higher rates of obesity than other ethnicities (Kelly et al., 2013). In most recent national estimates, Hispanics have the highest percentage of children in the overweight and obese category (Ogden et al., 2014). Forty-six percent of Hispanics fall into the overweight and obese BMI percentile, while only 20% of Asians, 29% of Whites, and 38% of Blacks fall into the same category (Ogden et al., 2014). Twenty-six percent of Hispanics fall into the obese category, which is significantly higher than the overall national average of 18% (Ogden et al., 2014). Therefore, even though the
overall obesity prevalence has remained unchanged in the last few years, childhood obesity, especially in Hispanics, remains high.

**Importance of Studying Childhood Obesity**

There are many issues related to childhood obesity, and probably the most concerning one is that childhood weight problems often affect an individual through adulthood (Kelly et al., 2013). This relationship of childhood obesity to adulthood obesity is associated the strongest in children who fall into the severe obesity range (Kelly et al., 2013), which as stated earlier, has continued to grow. In a meta-analysis of four longitudinal studies, it was found that childhood obesity trends followed an individual into adulthood (Juonala et al., 2011). Children who were overweight at 12 or 13, were 5.2 times more likely to be severely obese as adults (Ferraro, Thorpe, & Wilkinson, 2003). Obesity can create a myriad of problems, which have recently started to be seen in young children (Baker, Olsen, & Sorensen, 2007; Juonala et al., 2011; Kelly et al., 2013).

Childhood obesity can interfere with a child’s insulin metabolism, and other hormones (Kelly et al., 2013). Insulin resistance in children is most often caused by obesity (Weiss et al., 2004). Severe obesity in children has also been linked to hyperinsulinemia, prediabetes and impaired glucose tolerance (Kelly et al., 2013). All of these factors will increase a child’s risk for type II diabetes, which is an expensive disease with damages that can accumulate and create more harm to a person’s health the longer it is uncontrolled (World Health Organization, 2013). When an overweight child has insulin resistance, there is a strong correlation to the metabolic syndrome, a term used to describe a combination of several medical conditions that can increase an individual’s risk for cardiovascular disease and diabetes (Weiss et al., 2004).

Obesity in childhood has been strongly correlated to many cardiovascular disease (CVD) risk factors (Baker et al., 2007; Weiss et al., 2004). The risk factors involved with CVD include hypertension, dyslipidemia, and vascular abnormalities (Baker et al., 2007). These risk factors have already been found in children (Baker et al., 2007). A national study tracked children through adulthood, and found that every one-unit increase in a BMI score significantly increased a child’s risk of CVD as an adult (Baker et al., 2007). The risks for CVD increase the longer children are overweight. Baker et al. (2007) found that a 13 year old
boy, who has a BMI score of 11.2 kg over normal, will increase his risk of CVD as an adult by 33%. This is a dramatic increase in risk, so it seems that the earlier we can manage childhood obesity, the better it will be for the individual.

Childhood obesity may be correlated to several health issues, but many health risks can be lowered or even eliminated, if the child returns to a normal weight. In a longitudinal study it was found that, if obese children grew up to become lean adults, their risk for type II diabetes was eliminated (Juonala et al., 2011). Addressing the issue of childhood obesity as soon as we can, may save our economy a significant amount of obesity-related healthcare expenses.

Obesity costs our healthcare system a significant amount of money to treat (Finkelstein et al., 2012). If obesity rates decrease by 1%, the United States would have 2.9 million obese adults in 2030 (Finkelstein et al., 2012). Through a significant reduction in number of obese adults, there is a significant reduction in obesity-related healthcare expenditures (Finkelstein et al., 2012). Finkelstein et al. (2012) found that if we can maintain the obesity rates that we had in 2012, rather than an increase in rates as currently projected, the American government could save $549.5 billion in obesity-related health care costs over the next twenty years. Unhealthy children grow up to be unhealthy adults, and so it is imperative that we discover what factors are related to increasing a child’s risk of obesity.

**CURRENT SLEEP PATTERNS**

Children are reportedly sleeping less now than previous generations. According to the National Sleep Foundation (2013), children aged 5-12 years old need 10-11 hours of sleep at night. Although children’s sleep needs have not changed, in longitudinal studies, researchers have found that the average amount of sleep a child gets each night has decreased between thirty to sixty minutes compared to older generations (Blair et al., 2012; Dollman, Ridley, Olds, & Lowe, 2007; Meltzer et al., 2013). In two nationally administered surveys, one administered in 1985 and one administered in 2004, children aged 10-15 years old reported sleeping an hour less than children in 1985 (Dollman et al., 2007).

It is difficult to determine the national average for sleep durations in children because researchers have found significantly different sleep durations at each age. In a community-based normally distributed population, it was found that on average 6-year old children sleep
10.32 hours and 13-year old children sleep 10.03 hours (Spruyt, O’Brien, Cluydts, Verleye, & Ferri, 2005). Another regional study found that children on average get 9.4 hours of sleep by 5th grade or 11-years of age (Nuutinen, Ray, & Roos, 2013). Studies may report a wide range of average sleep durations for children because of issues in measuring sleep durations.

Often studies will use parental-reported sleep durations but parental-reports may overestimate the actual amount of time a child sleeps (Nixon et al., 2008; Pileggi, Lotito, Bianco, Nobile, & Pavia, 2013). One study reported that 60% of fifth graders were awake at least once during the night when their parents thought they were sleeping (Meltzer et al., 2013). A national meta-analysis showed that parents are generally overestimating how much sleep their children are getting by comparing subjective parental-reports to objectively measured sleep durations (Gozal & Kheirandish-Gozal, 2012). The objective measure that was used to measure sleep durations was an actigraph. An actigraph is an instrument that measures sleep through a child's bodily movements (Nixon et al., 2008). When an actigraph was used, researchers found that children sleep on average 50 minutes less than their parent’s reported sleep duration (Nixon et al., 2008).

Older children tend to get less sleep than younger children (Gonnissen et al., 2012). Dollman et al. (2007) found that children sleep on average fourteen minutes less with each year they age, beginning at 10 years old. In a longitudinal study researchers found that once children hit puberty, the average amount of sleep they get at night is two hours less than before puberty (Gonnissen et al., 2012; Knutson, 2005). Small drops in sleep durations can add up to children getting insufficient sleep. A longitudinal study followed children from the age of six until the age of eleven and found significant delays in bedtimes as children aged (Blair et al., 2012). Researchers found children 6-years old go to bed around 20:08, but by the time they are eleven the children’s mean bedtimes move to 23:21, even though their sleep needs have not changed (Blair et al., 2012).

Another finding that is consistent across most research is that the majority of children are going to bed later on weekends compared to weekdays. A national study using wrist actigraphs, determined that total sleep time in children aged 6-10 years old, decreased about thirty minutes on the weekends compared to weekdays due to later bedtimes (Ekstedt, Nyberg, Ingre, Eklbom, & Marcus, 2013). Children do not seem to be sleeping in later on the weekends to counteract going to bed later (Ekstedt et al., 2013). Even the studies that have
found children are sleeping longer over the weekends, report that the extra sleep may not be enough for children to recover from the sleep debt accumulated through the week (Spruyt et al., 2005).

There are differences between the ethnicities in the amount of sleep children get. Ethnic minority children may experience greater delays in bedtimes as children age. Spilsbury et al. (2004) found that Hispanic children, in the same age group, go to sleep thirty-one minutes and twenty-seven minutes later than non-Hispanic girls and boys respectively. It was also found Hispanic children are 4.8 times more likely to go to bed later than 23:00 than non-Hispanic children (Spilsbury et al., 2004). It is unclear the reasons why Hispanic children go to bed later than non-Hispanic children, but this may indicate that there are cultural or lifestyle differences behind why children are going to bed later.

For example, there seems to be generational factors tied to children’s sleep durations. National data has shown younger generations are going to bed later than older generations (Dollman et al., 2007; Iglowstein, Jenni, Molinari, & Largo, 2003). One national study reported that between 1985 and 2004, children’s bedtimes moved nearly thirty minutes later within the same age groups (Dollman et al., 2007). There have been many changes in diet and lifestyles between older and younger generations that may explain why sleep durations are decreasing in younger generations.

**Theories behind Reduced Sleep Durations in Children**

Increased caffeine use may be a factor in why children are getting less sleep now than previous generations (Meltzer et al., 2013). National NHANES data found that 75% of children aged 6-11 consumed caffeine in a 24-hour dietary recall (Branum, Rossen, & Schoendorf, 2014). This same dataset identified that the most common source of caffeine for children was soda, at 38% of intake being attributed to it (Branum et al., 2014). One alarming finding in this study was that children are currently consuming energy drinks, which contain significant amounts of caffeine (Branum et al., 2014). NHANES data reported that energy drinks represented 6% of the caffeine consumed by children aged 6-11 years old (Branum et al., 2014). In 2010, the mean intake for caffeine among children was 31.8 mg (Branum et al., 2014); one fluid ounce of espresso contains on average 64 mg of caffeine (U.S. Department of Agriculture, n.d.), so it seems children are consuming the equivalent to half a shot of
espresso worth of caffeine on a daily basis. In a national survey of children aged 8-12 years old, it was found that children who went to bed later than 22:00 reported more caffeine use than children going to bed before 22:00 (Meltzer et al., 2013).

It is unclear whether the caffeine intake itself is of concern, or the timing has a more pronounced effect on sleep durations in children. Evening intake of caffeine in children was correlated to shortened sleep duration and decreased sleep efficiency when compared to children who do not consume evening caffeine (Calamaro, Mason, & Ratcliffè, 2009). Caffeine intake could also play a role in children having later bedtimes, due to caffeine’s stimulant effects.

Shorter sleep durations may be linked to later bedtimes. In a longitudinal, community study, bedtimes after 21:00 were associated with significantly shorter bedtimes for children (Nixon et al., 2008). In child-reported national data sets, it was found that boys between the ages of 7-15 years old get less sleep than girls in the same age group, due mostly to delayed bedtimes (Dollman et al., 2007). Minority children report shorter sleep durations compared to non-minority children, and this is associated with later bedtimes in minority children (Spilsbury et al., 2004). Later weekend beds times have been associated with shorter weekend sleep durations (Nixon et al., 2008).

The introduction of stimulating electronics in younger generations may also help explain why children now have shorter sleep durations compared to older generations. The Kaiser Foundation conducted a national survey and found that on average, children, aged 8-18 years old, live in households which contain: “3.8 TVs, 2.8 DVD or VCR players, 1 digital video recorder, 2.2 CD players, 2.5 radios, 2 computers, and 2.3 console video game players” (Rideout, Foehr, & Roberts, 2010, p. 9). The prevalence of media in a child’s home has dramatically increased over the past few years, and children have access to an increasingly large number of electronics in their homes (Rideout et al., 2010). This change in media presence in a child’s life may impact a child’s sleep through media displacing the time a child could spend sleeping (Magee, Lee, & Vella, 2013).

Again, the timing of electronic use may be more important than the electronic use itself. It is very common for children to have electronic devices they use all night long, right up to going to bed (Meltzer et al., 2013). In a survey conducted nationally, children who identified themselves as poor sleepers, had a higher use of electronics at bedtime than
children who identified themselves as good sleepers (Meltzer et al., 2013). This same study found an association between later bedtimes and watching television as part of a bedtime routine in children between the ages of three months and twelve years old (Owens, Jones, & Nash, 2011). Nuutinen et al. (2013) theorize the reason behind the association of decreased sleep times and increase electronic media use, may be due to the physiologic and mental arousal that occurs when an individual is exposed to the bright lights of a particular electronic device right before trying to sleep. The bright light from the electronic media screen may suppress melatonin production and so delay the onset of sleep in individuals (Nuutinen et al., 2013). Regardless of what the cause is for reduced sleep durations in children, there are many detrimental health effects correlated with children getting less sleep than they need.

**Physiologic Changes Related to Reduced Sleep Durations**

Inadequate sleep among children and adolescents is related to a larger waist circumference, higher BMI, and a higher body fat percentage (Flores & Lin, 2013; Gonnissen et al., 2012; Gozal & Kheirandish-Gozal, 2012). In a meta-analysis of obesity research done around the world, children who were under the age of ten and slept 8 or fewer hours at night were 2.09 times more likely to be overweight or obese compared to children who slept 10 or more hours (X. Chen, Beydoun, & Wang, 2008). In a cross-sectional national survey, it was found that children with higher sleep durations were 1.26 times more likely to have a healthy waist-to-height ratio compared to children who slept fewer hours (Sokolovic, Kuriyan, Kurpad, & Thomas, 2013).

It appears that the effects of inadequate sleep follow children into adulthood. In a longitudinal study conducted in Brisbane, Australia, it was found that children who experienced sleeping problems were 1.9 times more likely to be obese at 21 years old compared to individuals who did not experience sleeping problems in their childhood (Mamun et al., 2007). Increased body size is likely related to the numerous hormonal changes that accumulate when children do not get at least ten hours of sleep during childhood, a critical developmental period (Mamun et al., 2007).

When children do not get the required amount of 10-11 hours of sleep at night, there are hormonal changes that affect fat storage. Studies show that inadequate sleep durations are
related to insulin resistance (Gonnissen et al., 2012) and decreased growth hormone production (Mamun et al., 2007). During the night, growth hormones induce a fat burning process known as lipolysis; therefore, if there are reduced levels of growth hormones children burn less fat (Mamun et al., 2007). Insulin is the key that allows glucose into cells to be used for energy (Mahan & Escott-Stump, 2008). When cells become more resistant to insulin, more glucose is stored as fat, rather than used up as energy (Mahan & Escott-Stump, 2008).

Additionally, appetite hormones can be affected when children get less than the 10-11 hours of required sleep. When children do not get adequate sleep, they have increased ghrelin hormones and decreased leptin hormones (Garaulet et al., 2011; Mamun et al., 2007). Ghrelin is a hormone responsible for signaling hunger and leptin is a hormone responsible for signaling satiety (Garaulet et al., 2011). When a person has reduced leptin hormone production, they need to eat more calories in order to feel satisfied. Increased levels of ghrelin will increase a person’s hunger and so they feel the desire to eat greater quantities of food as well as an increased desire to eat more often. With an increased desire for a child to eat, there will be greater opportunities for them to consume excess calories. Skewed appetite hormones and increased fat storage may explain why children who do not sleep the required 10-11 hours are often more likely to be overweight or obese.

**Behavioral Outcomes Related to Reduced Sleep Durations**

Sleep duration may be linked to the amount of time a child spends doing physical activity (Ekstedt et al., 2013; Garaulet et al., 2011; Ortega et al., 2011). One international study found that sleep duration and physical activity levels were associated, independent from BMI (Garaulet et al., 2011). In a national study using accelerometers to measure activity of children aged 9-10 years old, it was found that children who had slept 9 or fewer hours per day spent less time being physically active across all levels compared to children who slept more than 10 hours/day (Ortega et al., 2011). It was found that children who slept 9 or fewer hours spent 91.9 minutes per day in moderate activity, whereas children who slept more than 10 hours spent 166.4 minutes per day (Ortega et al., 2011). Also, sleep efficiency is increased with higher levels of moderate physical activity levels (Ekstedt et al., 2013).
Exercise has been shown to improve sleep quality (Yang, Ho, Chen, & Chien, 2012) and often, improved sleep quality is linked to healthier dietary choices (Hart et al., 2013).

It is unclear whether diet may impact sleep or vice versa, but there appears to be a significant relationship between the two (Hart et al., 2013; Wilkinson & McCargar, 2008). Only 10% of American children meet the recommended 5 or more servings of fruits and vegetables per day (Folta et al., 2013) and the lowest rates of fruit and vegetable consumption have been associated with overweight and obese (Wilkinson & McCargar, 2008). Hart et al. (2013) conducted a small cross-over study to observe the effect of sleep restriction on children, aged 8-11 years old, and found that when they restricted sleep, children ate on average more than 500 calories per day more than prior to sleep restriction. In a national study, researchers found the greatest consumption of fruit was in children who slept 10 or more hours and the lowest consumption in children sleeping fewer than 9 hours (Shi et al., 2010).

Short sleep duration has been associated with increased television viewing time (Gonnissen et al., 2012). In a national longitudinal study done with children between the ages of four and five years old at the onset of the study, it was found that media use at six years old predicted sleep duration at eight years old and vice versa (Magee, Caputi, & Iverson, 2014). An inverse relationship was found between sleep duration and television viewing time (Gonnissen et al., 2012; Magee et al., 2013; Nuutinen et al., 2013). Ten and eleven year old children in the Helsinki region of Finland, were found to have greater decreases in sleep duration on school days where the children had greater television viewing times (Nuutinen et al., 2013). Magee et al. (2013) found that television viewing partially mediated the longitudinal relationship between a child’s sleep duration and their BMI. Based on the findings in several research studies, it seems that television viewing could be a factor that helps explain the relationship between short sleep and obesity (Magee et al., 2013).

**TELEVISION AND CHILDREN**

Children in the U.S. are spending almost a quarter of their waking time watching television (Williams, 2011). The American Academy of Pediatrics recommends children watch no more than two hours of television per day (del Rio Rodriguez, Himers, & O’Connor, 2013). Across several studies using parent-reported surveys, children were found
to watch about two hours of television per day (Dennison, Erb, & Jenkins, 2002; Nuutinen et al., 2013; Scragg, Quigley, & Taylor, 2006), but parent-reported data may not be the most accurate way to determine a child’s TV viewing time. The American Academy of Child and Adolescent Psychiatry (2011) found that the average length of television U.S. children watch is closer to three to four hours per day using more objective information from national surveys. Regardless of how much television children are watching, there appear to be differences in television viewing time among various ethnicities (del Rio Rodriguez et al., 2013; Dennison et al., 2002; Scragg et al., 2006).

Researchers found that Hispanics watch more television than any other ethnicity group (Dennison et al., 2002). In a survey of parents who participated in the national Women, Infants, and Children program, it was found that 87% of White and Black four-year-old children watch more than two hours of television per day (Dennison et al., 2002). Ninety-seven percent of four-year-old Hispanic children watch more than two hours of television per day, a 10% increase from the other ethnicities (Dennison et al., 2002). Researchers carried out analyses on sixty-six different global research projects, and in a U.S. study, it was found that 33% of Hispanic children watch more than six hours of television per day, while only 25% of White children watch more than six hours of television per day (Scragg et al., 2006). It appears that there is a higher prevalence of television watching in the Hispanic population. Regardless of which ethnicity is watching the most television, all children are watching significant amounts of television, and so researchers have started investigating why.

**Theories about the Increased Prevalence of Television**

One reason television is so prominent in a family’s home, is because television can be an inexpensive babysitter. Research done in Houston reported that the use of television as a babysitter was the most common parent-reported response (del Rio Rodriguez et al., 2013). In the same study, another common survey response was that televisions allowed parents the freedom to do other things around the house, such as chores and upkeep (del Rio Rodriguez et al., 2013). Parents know where their children are and what they are doing when they are watching television, so busy parents utilize TV to maintain their busy lifestyles (del Rio Rodriguez et al., 2013).
Television is overly accessible to children, because they can watch television shows on many, often portable platforms. Children today watch 59% of their television on TV sets, and 12% on mobile devices (Rideout et al., 2010). Other platforms children can use to watch television, include smartphones, tablets, and computers. Rideout et al. (2010) reported that child ownership of these mobile platforms has increased dramatically in a five-year time span. Child ownership of an iPod or MP3 player has significantly increased from 18% to 76% from 2004 to 2009 (Rideout et al., 2010). Sixty-five percent of children, aged 8-10 years old, have their own gaming device that can provide instant TV streaming (Rideout et al., 2010). Not only is there a greater variety in television viewing platforms, there is an increased variety of television viewing options.

Since the introduction of cable, there has been a significant increase in the availability of networks. Cable was invented in 1948, and in 1970 there were 28 television networks established (National Cable and Telecommunications Associations, 2014). Between the years of 1990 and 1998 the number of television networks increased from 79 to 171 (National Cable and Telecommunications Associations, 2014). Due to the increased number of television networks, everyone in the family can find several shows they are interested in watching. In order for the entire family to be able to watch their own shows, the family must have enough television sets in the home and it is not uncommon for families to own several TV’s.

The affordability of televisions may explain TV’s prominent placement in families’ homes. The price of a television set has plummeted since it was first introduced in 1939 (Cox, 2011). The price of a television set in 1939 was $600, which adjusted for inflation, would be equivalent to $9773 today (Cox, 2011). Currently, an individual can purchase an eighteen-inch high definition television for $99 (Walmart, 2014). Televisions today cost approximately 1% of the price they did when they were first introduced to the American public, a significant reduction in price. With 99% of family homes having a television (Rideout et al., 2010), owning a television has become attainable for essentially all Americans. In a national survey it was found that even children have their own TV, with 71% of children having a television in their bedroom (Rideout et al., 2010). There are health-related issues the American public seems to be experiencing related to the increased availability of televisions.
Behaviors Associated with Television Viewing

Television viewing can have a negative effect on dietary behavior of children (Coon & Tucker, 2002). Most television ads are for foods high in fat, sugar, and sodium (Kent, Dubois, & Wanless, 2012). These unhealthy food ads are often played during children’s television programs (Dietz & Gortmaker, 2001). The high rate of exposure of a child to unhealthy foods ads may change a child’s preference for and selection of unhealthy food choices (Dixon, Scully, Wakefield, White, & Crawford, 2007). In a cross-sectional, child-reported survey, there was a significant association found between television viewing time and healthy food habit scores (Hare-Bruun et al., 2011). In this study, it was found that children who watched more than two hours of television per day, chose 1.45 times less healthy food options than children who watched less than one hour of television per day (Hare-Bruun et al., 2011). Dixon et al. (2007) found that Australian children, aged 9-11 years old, had nearly a third increased frequency in self-reported junk-food intake with each additional hour of television viewing time. There seems to be an overall increased propensity for children to choose unhealthy food options when they are exposed to significant amounts of television. TV, unhealthy snacks and lack of physical activity seem to go hand-in-hand.

The increased risk of obesity related to television viewing time, may be attributed to TV effects on physical activity (Dietz & Gortmaker, 2001). When children spend more time watching television, they are less likely to spend time being physically active (Kiess et al., 2001; Strasburger, Jordan, & Donnerstein, 2010). A study published in the Harvard Journal of Public Health, found that with each hour increase of TV watching, a pedometer recorded people walking 144 steps less per day (Dana-Farber Cancer Institute, 2006). Increased sedentary activity will decrease how many calories a child is expending throughout the day, which can lead to a positive balance in their caloric intake and consequently can cause weight gain as they age (Dennison et al., 2002).

Children move less when they watch television, and they have less quality and quantity of sleep (Arora, Broglio, Thomas, & Taheri, 2013; Calamaro et al., 2009). In a national, longitudinal study it was found that children had about 5 minutes shorter sleep durations at night with each additional hour of television watched (Nuutinen et al., 2013). Nuutinen et al. (2013) theorize that television viewing may decrease REM-sleep and short-wave sleep. Television emits a bright light that could interfere with a child’s melatonin
production, the hormone which makes individuals tired (Nuutinen et al., 2013). This delay in melatonin production may help explain why children who watch more TV, especially around bedtime, go to bed later than children who watch less TV (Arora et al., 2013; Nuutinen et al., 2013).

There are specific concerns related to children watching television around their bedtime. When children watch television around their bedtime, they are more likely to have problems falling asleep and staying asleep (Arora et al., 2013). Arora et al. (2013) found sleep duration to be 20 minutes shorter when children watch television right before bed. Frequent bedtime use of television has been correlated with insomnia, early awakening episodes, sleepwalking, and nightmares (Arora et al., 2013). One reason children may be more likely to engage in watching television right before bed may be due to the presence of a television in the bedroom. Ravikiran, Baliga, Jain, and Kotian (2013) found harmful television viewing practices are significantly more prevalent in children who have a television in their bedroom.

**Televisions in the Bedrooms**

It is more common than not, for children to have a television in their bedroom. Rideout et al. (2010) found that 71% of school age children have a television in their bedroom and 24% of children report even having access to premium cable or satellite with their bedroom televisions. Televisions in the bedroom have become the norm, and it may play a role in many of the health-related problems children are starting to experience that were unheard of in previous generations.

The prevalence of a television in the bedroom is different among minority groups. Atkin, Corder, and van Sluijs (2013) found that bedroom televisions are more prevalent in lower socio-economic status households, and Owens, Maxim, Nobile, McGuinn, and Msall, 2000) found that Hispanics were more likely than Whites to have electronics in their bedroom. Dennison et al. (2002) found that 50% of Hispanics had television sets in their bedroom, while only 20% of the White population reported television sets in their bedrooms.

Hispanic children also have higher rates of cable and premium networks in their bedrooms compared to White children. The Center on Media and Human Development (Rideout, Lauricella, & Wartella, 2011) found that 28% of Hispanic children have premium
cable access in their bedroom, while only 17% of White children do. There are differences across ethnicities regarding access to televisions, but all ethnicities have been linked to health concerns with televisions in the bedroom.

**Concerns with Televisions in the Bedroom**

Research shows that the presence of a television in the bedroom is correlated with an increased likelihood for a child to be overweight (Cameron et al., 2013; Dennison et al., 2002; van Zutphen, Bell, Kremer, & Swinburn, 2007). Strasburger et al. (2010) found that the risk of a child to be overweight is 31% greater with a television in the bedroom, compared to a child without a television in the bedroom. There are also differences between obesity risks versus overweight risks in children who have televisions in their bedrooms. Sixty-six percent of obese children reported the presence of TV’s in their bedroom compared to 44% of overweight children who reported the presence of a TV in their bedroom (Gates, Hanning, Martin, & Tsuji, 2013). Even after controlling for other risk factors associated with being overweight, such as total TV viewing time and physical activity, children who have televisions in their bedrooms have an increased risk of being overweight or obese (Adachi-Mejia et al., 2007). There seems to be some unknown reason directly correlated to TV’s in the bedroom that are increasing a child’s risk for obesity.

Children with televisions in their bedrooms may be more likely to watch television near their bedtime due to ease of access (Meltzer et al., 2013). It is not uncommon for children to use a bedroom television as a part of their bedtime routines (Owens et al., 2011). When children do this, they tend to classify themselves more often as poor sleepers (Meltzer et al., 2013). Children also report more daytime sleepiness when television is part of their bedtime routine (Meltzer et al., 2013). Children can impair their sleep quality when they fall asleep to the bright lights emitted by the TV (Nuutinen et al., 2013). The bright light from the television can disrupt a child’s circadian rhythm and melatonin production therefore, preventing the child from feeling tired at a consistent time each night (Nuutinen et al., 2013).

Children who have a television in the bedroom, tend to have more varied and later bedtimes than children without a television in their bedroom (Nuutinen et al., 2013; Owens et al., 2011). Televisions in the bedroom were found to be correlated with a greater discrepancy between weekday and weekend sleep times (Nuutinen et al., 2013). Blair et al. (2012) found
that the variations in sleep that children get is influenced more by the time the child goes to bed, rather than what time the child wakes up. A later and more varied bedtime may reduce the amount of sleep a child gets on average (Olds, Maher, & Matricciani, 2011), so it appears having a television in the bedroom does more than just entertain. The home environment and a child’s interaction with it may impact their sleep durations as well as their overall risk for obesity.

**SOCIAL COGNITIVE THEORY**

Social Cognitive Theory (SCT) is a theory that states people learn through observing other people’s behaviors and outcomes to behaviors (Bandura, 2004). The main constructs in SCT include knowledge (whether the person is aware of the health risks associated with certain behaviors), self-efficacy (a person’s confidence in their control over their behaviors), outcome expectations (the costs and benefits associated with certain behaviors), goals (self-incentives people set for themselves), and perceived barriers to behavior change (including personal and environmental barriers; Bandura, 2004). SCT looks at the dynamic relationship between personal and environmental influences on behavior (Bandura, 2004), and can be applied to interventions aimed at improving the public’s health.

**Social Cognitive Theory in Health Promotion Research**

Many behavioral interventions aimed at increasing healthy behaviors in children have used constructs from the SCT (Berlin, Kolodinsky, Norris, & Nelson, 2013; Zimmerman, Ortiz, Christakis, & Elkun, 2012). SCT was used to predict health-related behaviors in children (Sharma, Wagner, & Wilkerson, 2005). The number of hours watching television and engaging in physical activity was predicted using self-efficacy and knowledge constructs from SCT in a child-reported survey (Sharma et al., 2005). The research showed that the more knowledge children have about healthy behaviors, the more likely they are willing to engage in those activities (Sharma et al., 2005).

A longitudinal study looked at improving a child’s sleep through decreasing media use by using SCT as the framework for increasing parental outcome expectations (Garrison & Christakis, 2012). The longitudinal intervention gave parents the tools and skills needed to
make healthy media choices for their children, and children’s sleep durations improved (Garrison & Christakis, 2012).

SCT states that one way to increase an individual’s motivation towards behavior change may be through increasing their self-efficacy of that behavior change. One way to increase self-efficacy is through creating an environment that is designed to help an individual be successful in engaging in healthy lifestyle behaviors. In order to create an environment that promotes health, researchers need to know what in a child’s environment is not conducive of a healthy lifestyle.

**Current Study**

SCT states that environmental factors may play a role in deterring an individual from attaining optimal health (Bandura, 2004). As such, not only was sleep duration and risk of obesity studied, but the child’s sleep environment was studied as well. Children who have televisions in their bedroom often have higher BMI’s (Dennison et al., 2002). A child may have a hard time self-regulating when to turn the television off, since it is in his/her bedroom. If televisions in the bedroom were found to be significantly associated with a risk of overweight or obesity, removing the television from the bedroom would be an easy environmental change for a future intervention. The presence of a television in the child’s bedroom was studied to determine if it affected their obesity risk through interactions with the child’s sleep duration.

Research has demonstrated that the amount of sleep a child gets can influence their risk of overweight or obesity. Due to the rise in prevalence of children having televisions in the bedroom, the current study looked at television in the bedroom as a correlate for how much sleep a child gets. Having a television in a child’s bedroom does not promote sleep and may impact the child’s risk of overweight and obesity through impacting their sleep duration. This study looked at each variable separately and then together to determine if they interact with each other or are unrelated risk factors of obesity in children.
CHAPTER 2

METHODS

STUDY DESIGN

The LUCES de Cambio (LUCES) study is a randomized clinical trial led by investigators from San Diego State University and the Institute for Behavioral and Community Health. The primary purpose of LUCES is to reduce children’s BMI by reducing children’s sedentary behavior and consumption of unhealthy foods and increasing physical activity, consumption of fruits, vegetables, water, and quality sleep. The baseline LUCES caregiver interview was used to obtain information on children’s sleep habits and their home environment. The child’s BMI was obtained by measuring the child’s height and weight. A cross-sectional analysis was done using interview data from 104 primary caregivers in the LUCES study and the child’s measured BMI. The SDSU Institutional Review Board granted human subjects approval.

Setting

LUCES is being carried out through the San Ysidro Health Center (SYHC). San Ysidro is located in the southern end of San Diego County. According to the San Diego Association of Governments (2012), San Ysidro contains the world’s busiest border crossing. San Ysidro’s border crossing has significantly contributed to the growth of San Ysidro (San Diego Association of Governments, 2012). San Ysidro is an area of young, low-income individuals, with a median age of 24.5 and 26% of residents living in poverty (BAE Urban Economics, 2012). The average household size in San Ysidro is 4.41 people, which is higher than San Diego city’s average of 2.8 people (BAE Urban Economics, 2012). English-speakers are a minority in San Ysidro; 86% of San Ysidro’s population are Spanish speakers and 93.2% of San Ysidro residents are Hispanic or Latino (U.S. Census Bureau, 2010). Almost half of the population is foreign-born and of those foreign-born, 94% were born in Mexico (Movoto, n.d.). Based on data found in the 2010 U.S. Census, 47% of San Ysidro residents do not have a high school education (BAE Urban Economics, 2012).
Analysis of clinic data carried out by the study team showed that between the summer of 2006 and 2008, there were 4,407 unique visits to SYHC for children aged 6-9 years old. Of these 4,407 unique visits, 96% were Latino children. SYHC’s (n.d.) website states that they are “fully committed to providing the highest quality, most compassionate, easily accessible and affordable health care services for the entire family” (para. 1) and according to preliminary research done by the LUCES staff, 74% of SYHC’s population was 200% below the Federal Poverty Level (J. P. Elder, personal communication, October 18, 2013).

Participants

There were 104 primary caregivers interviewed for this study; this represents the sample available for analyses. The recruitment goal for LUCES is 390 dyads. The children of these caregivers were aged 6-9 years old and enrolled as current pediatric patients with the SYHC. The primary caregiver and the child were involved in the baseline assessment.

To obtain this sample, the project manager received a list containing a random sample of children using the clinic’s Practice Management System (PMS). The PMS includes demographic information, as well as all of the appointment information on registered patients. The list consisted of all pediatric patients aged 6-9 years old who had made at least one visit to the clinic in the previous 24 months. From the random sample, children were selected based on BMI status of greater than the 75th percentile. If a family had two children who were eligible for the study, the child with the closest birthday, at the time of selection, was chosen. Once a child was selected, the child and their caregiver were brought into SYHC, and a screening was carried out. The dyads were eligible to be part of the study if they met the inclusion criteria (see Table 1).

Data Collection Procedures

Trained, bilingual, bicultural measurement technicians conducted the baseline assessment protocol with eligible and consented families. The baseline assessment included many questions and procedures, but only steps pertinent to this study are described here. Strict protocols were used in implementing the baseline assessment. Measurement technicians were trained by senior staff during the first year of LUCES to ensure they followed measurement protocols. Measurement technicians were instructed on the rationale
Table 1. Inclusion Criteria

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
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</thead>
<tbody>
<tr>
<td>1. The child is 6-9 years old.</td>
</tr>
<tr>
<td>2. The child’s BMI is between 75-95th percentile using measured data.</td>
</tr>
<tr>
<td>3. Family plans to live in San Ysidro area for the duration of the study.</td>
</tr>
<tr>
<td>4. Caregiver and child able to read English or Spanish.</td>
</tr>
<tr>
<td>6. Family willing to be randomized into one of the two experimental conditions.</td>
</tr>
</tbody>
</table>

behind anthropometric measurements and senior staff demonstrated how to carry out measurements. Measurement technicians were assessed on their techniques through role-playing and live demonstrations in front of senior staff to ensure anthropometric measurements were carried out the same for each participant.

Informed parental consent and child assent were received from the primary caregiver and the child, respectively. During the baseline assessment, anthropometric measurements were taken to determine the child’s BMI. At the same visit, the trained technician administered the primary caregiver interview. All of the baseline and eligibility assessments were held at the clinic in either Spanish or English. The baseline assessments took approximately 60 minutes to complete. Caregivers were given $15 for participating in the interview and children received a toy valued at $5.

**Measures of BMI**

The trained measurement technicians assessed the height and weight of the child once, during the initial screening. Height was measured using a Seca model 214 stadiometer. Height measurements were taken to the nearest 1/8 inch. Weight was measured with a Seca model 770 portable electronic scale. Weight measurements were taken to the nearest 0.1 pound. BMI percentiles were calculated using the NHANES III Anthropometric Procedures and SAS programming available from the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2013). Using the online program, the measurement staff entered the child’s birth date, measurement date, sex, height, and weight.
BMI percentiles were kept as continuous due to the inclusion criteria restricting the sample to children with BMI percentiles of 75th and above.

**Measures of Sleep Duration**

The caregiver interview included questions about the average bedtimes and wake times of the child on weekdays and on weekends, separately. The child’s total nightly sleep duration was determined by the differences between bedtimes and wake times. Due to average weekday sleep durations and weekend sleep durations differing only by .3 hours, the average sleep duration for the week was obtained. Average weekday sleep durations per night were multiplied by 5, and the average weekend sleep durations per night were multiplied by 2. These were then summed and divided by 7 to get the average nightly sleep duration.

Parent-reported child sleep duration shows mixed validity (Owens, Maxim, et al., 2000). In the study carried out by Owens, Maxim, et al. (2000), there were differences in sleep onset by about thirty minutes when comparing objective accelerometer measurements to subjective parent-reported measures. Due to funding and study constraints, objective sleep measures could not be used in this study. Despite these limitations, a high reliability score has been found in parent-reported sleep durations. In a sleep study about children with ADHD, parent-reported measures were used to determine a child’s sleep duration between two different study populations, with similar characteristics (Abou-Khadra, Amin, Shaker, & Rabah, 2013). In these two studies, the Cronbach’s alpha for the sleep questions were found to be .85 between the study’s experimental (children with ADHD) and control (children without ADHD) groups (Abou-Khadra et al., 2013). A Cronbach’s alpha score can range between 0 and 1, and a score of .85 lies in the acceptable range for internal consistency (Tavakol & Dennick, 2011). The Children’s Sleep Habits Questionnaire (CSHQ) is a survey that gathers parent-reported sleep durations for school-age children, similar to how LUCES sleep questions were asked in the caregiver interviews. A study looked at the test-retest reliability of CSHQ by asking a group of parents to report their child’s sleep habits on two separate occasions, two weeks apart (Owens, Spirito, & McGuinn, 2000). Owens, Spirito, et al. (2000) found the test-retest reliability for the parent-reported sleep question interviews to be between .62 and .79.
Measures of Television Availability in Bedroom and Daily Television Viewing Time

The caregiver interview asked about the availability of televisions in a child’s bedroom and how many hours a child usually spends watching television per day. The interview asked about the presence of a television in the bedroom and the response options were: 0, 1, 2, or 3. The television responses were kept continuous for linear statistical analysis. The interview asked the caregivers to report how much time their child spends watching television on a given weekday. The response options were: 15 minutes, 30 minutes, 1 hour, 2 hours, 3 hours, or 4 hours or more. The television viewing times were all recoded into minutes and kept continuous. These questions were based on a validated survey used in the study “Active Where?” (Joe, Carlson, & Sallis, n.d.). The measure is reliable and valid for parents of adolescents. In the validation study, the survey questions were given to adolescents and adults on two separate occasions, two to four weeks apart, to determine test-retest reliability. Televisions in the bedroom had a test-retest score of .96 and total television viewing time had a score of .67 for the parent-reported questionnaires (Joe et al., n.d.). The measure has not been validated with parents of younger children, but due to similarities between adolescents and children, it was deemed reasonable to use for this study.

Demographics

Demographic variables were recoded as necessary. For the gender variable, male was coded as 1 and female as 0. For survey language, English was coded as 1 and Spanish was coded as 2. Income was categorized into four different responses, from 1 = ≤ $999/month to 4 = ≥ $3000/month. Response 1 (≤ $999) for income was kept as the reference group for statistical analyses. Child’s race had 8 options that were recoded into either white (= 0) or other (= 1). A parent’s educational level was separated into two categories in the caregiver interview: within the U.S. and outside of the U.S., therefore, the highest educational level completed, within the U.S. and outside of the U.S., was taken to determine a caregiver’s education. Parental education level was then categorized into 3 categories and was coded as: 1 = up to 11th grade, 2 = 12th grade or GED, and 3 = beyond 12th grade.
Statistical Analyses

SPSS (Statistical Package for the Social Sciences) was used to analyze the data. The primary caregiver interviews went through quality control procedures to ensure all questions were answered correctly. If there were missing data, LUCES staff reached out to interviewers and/or primary caregivers to obtain the answer. If there was still no answer to a specific question, it was coded as -999 for missing data. Answers where there was an option to select “other” and an area to write an additional answer, were entered as -666 if this selection was not chosen. In the event of an answer that could not be coded, the answer was taken out and recoded as -999. Once data were entered into SPSS, a quality check was conducted to ensure all responses were valid and no outliers remained by two additional LUCES staff members.

A linear regression was used to determine the relationship between sleep duration and televisions in the bedroom and a child’s BMI percentile, controlling for family income, parent educational level, child’s gender, and child’s age. The Food Research and Action Center emphasize that there is a relationship between a child’s BMI and their family’s income level, but it can vary based on the child’s gender and age (Food Research and Action Center, 2010). Studies have found that children with more educated parents have lower BMI’s (Huffman, Kanikireddy, & Patel, 2010).

All variables were tested individually to see if there were significant unadjusted associations between them and BMI percentiles. If significant relationships were found in the bivariate regression analyses, other variables were brought in for multivariate analyses and their respective slopes and p-values were compared to assess interactions, effect mediation and confounding.
CHAPTER 3
RESULTS

DEMOGRAPHICS

A total of 104 caregivers completed the baseline assessment interview. Demographic characteristics of the children are shown in Table 2. Fifty-five percent \( (n=57) \) of the children were male. The age of the children ranged between 5-10 years old with a mean age of 7.9 \( (SD=1.3) \) years old. All children were considered Latino or Hispanic in order to be eligible for the study, but the caregivers were asked to identify what the child’s race was. There were nine caregivers who did not respond to this question, but of those who did, 64.2\% \( (n=61) \) of the children were identified as white. One of the caregivers did not know her monthly household income, but of the remaining caregivers, 57.7\% \( (n=60) \) had a household income < $2000. Fifty-five percent \( (n=57) \) of the caregivers did not attend any schools in the U.S., and 26.9\% \( (n=28) \) did not attend any school outside of the U.S. Of caregivers who attended school in foreign countries, 41.3\% \( (n=41) \) only completed up to an 11th grade education.

MAIN STUDY VARIABLES

Almost half (45\%) of the children fell in the overweight category for BMI percentile and an additional 40\% \( (n=37) \) fell into the obese category. The mean BMI percentile was 90.8 \( (SD=6.4) \). The average nightly sleep duration was 10 hours \( (SD=0.8) \). Caregivers reported that 77.9\% \( (n=81) \) of children had a television in their bedroom.

Unadjusted associations were determined for each variable’s relationship with BMI percentiles. The unadjusted associations for each variable can be found in Table 3. There were no significant relationships between BMI percentiles and the following variables: sleep duration, child’s gender, child’s race, child’s age, family income, and parent education. Televisions in the bedroom produced the only trend in a relationship with BMI percentiles.

Two models were run, one model to assess the relationship between a child’s sleep duration and their BMI percentile, and one model to assess the relationship between the presence of televisions in the bedroom and children’s BMI percentiles. The first model of
### Table 2. Descriptive Statistics of Study Sample (N=104)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percent (n)</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Age</td>
<td></td>
<td>7.9 (1.3)</td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>54.8 (57)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>45.2 (47)</td>
<td></td>
</tr>
<tr>
<td>Child Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>64.2 (61)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33.0 (34)</td>
<td></td>
</tr>
<tr>
<td>Interview Language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>4.8 (5)</td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
<td>95.2 (99)</td>
<td></td>
</tr>
<tr>
<td>Monthly Family Income</td>
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<td></td>
</tr>
<tr>
<td>≤ $999</td>
<td>22.1 (23)</td>
<td></td>
</tr>
<tr>
<td>$1000-$1999</td>
<td>35.6 (37)</td>
<td></td>
</tr>
<tr>
<td>$2000-$2999</td>
<td>28.8 (30)</td>
<td></td>
</tr>
<tr>
<td>≥ $3000</td>
<td>12.5 (13)</td>
<td></td>
</tr>
<tr>
<td>Parent Education</td>
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<tr>
<td>Up to 11th grade</td>
<td>38.5 (40)</td>
<td></td>
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<tr>
<td>12th grade/GED</td>
<td>24.0 (25)</td>
<td></td>
</tr>
<tr>
<td>More than high school</td>
<td>37.5 (39)</td>
<td></td>
</tr>
<tr>
<td><strong>Main Study Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child BMI Percentiles</td>
<td></td>
<td>90.8 (6.4)</td>
</tr>
<tr>
<td>Healthy 75th-&lt; 85th</td>
<td>21.2 (22)</td>
<td></td>
</tr>
<tr>
<td>Overweight 85-&lt; 95th</td>
<td>43.3 (45)</td>
<td></td>
</tr>
<tr>
<td>Obese ≥ 95th</td>
<td>39.5 (37)</td>
<td></td>
</tr>
<tr>
<td>Child Nightly Sleep Duration</td>
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<td>9.9 (0.8)</td>
</tr>
<tr>
<td>Child’s Bedroom Television</td>
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<tr>
<td>0</td>
<td>21.2 (22)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>77.9 (81)</td>
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</tr>
<tr>
<td>3</td>
<td>1.0 (1)</td>
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</table>
Table 3. Unadjusted Associations on BMI Percentiles

<table>
<thead>
<tr>
<th>Variable</th>
<th>Slope</th>
<th>SE</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (Reference)</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>0.896</td>
<td>1.260</td>
<td>.479</td>
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<td>Child Race</td>
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<td></td>
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<tr>
<td>White (Reference)</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
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<td>.326</td>
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<tr>
<td>Child Age</td>
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<td>0.476</td>
<td>.156</td>
</tr>
<tr>
<td>Family Monthly Income</td>
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</tr>
<tr>
<td>$\leq$ $999$ (Reference)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$1000$-$1999$</td>
<td>2.642</td>
<td>1.300</td>
<td>.117</td>
</tr>
<tr>
<td>$2000$-$2999$</td>
<td>2.160</td>
<td>1.745</td>
<td>.219</td>
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<tr>
<td>$\geq$ $3000$</td>
<td>3.227</td>
<td>2.194</td>
<td>.144</td>
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<td>Parent Education</td>
<td></td>
<td></td>
<td>.747</td>
</tr>
<tr>
<td>Up to 11th grade (Reference)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12th grade/GED</td>
<td>0.555</td>
<td>1.637</td>
<td>.736</td>
</tr>
<tr>
<td>More than high school</td>
<td>-0.679</td>
<td>1.445</td>
<td>.640</td>
</tr>
<tr>
<td>Child Nightly Sleep Duration</td>
<td>0.515</td>
<td>0.834</td>
<td>.538</td>
</tr>
<tr>
<td>Television in Child’s Bedroom</td>
<td>2.552</td>
<td>1.338</td>
<td>.059</td>
</tr>
</tbody>
</table>
sleep duration and BMI percentiles can be seen in Table 4. Total nightly sleep duration’s relationship with BMI percentiles was not significant. The relationship remained insignificant even after controlling for family income, parent education, child’s gender, and child’s age.

Table 4. The Adjusted Relationship between Sleep Duration and BMI Percentiles

<table>
<thead>
<tr>
<th>Variable</th>
<th>Slope</th>
<th>SE</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Nightly Sleep Duration</td>
<td>0.732</td>
<td>0.851</td>
<td>.392</td>
</tr>
<tr>
<td>Child Gender (Female)</td>
<td>1.024</td>
<td>1.294</td>
<td>.431</td>
</tr>
<tr>
<td>Child Age</td>
<td>0.798</td>
<td>0.494</td>
<td>.109</td>
</tr>
<tr>
<td>Monthly Family Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1000-1999</td>
<td>2.861</td>
<td>1.725</td>
<td>.101</td>
</tr>
<tr>
<td>$2000-2999</td>
<td>2.329</td>
<td>1.769</td>
<td>.191</td>
</tr>
<tr>
<td>$3000+</td>
<td>3.120</td>
<td>2.213</td>
<td>.162</td>
</tr>
<tr>
<td>Parent Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12th grade/GED</td>
<td>-0.637</td>
<td>2.040</td>
<td>.756</td>
</tr>
<tr>
<td>More than high school</td>
<td>-1.047</td>
<td>1.571</td>
<td>.507</td>
</tr>
</tbody>
</table>

The second model assessed the relationship between televisions in the child’s bedrooms and BMI percentiles. The results for the second model can be seen in Table 5. The relationship between televisions in the child’s bedroom and BMI percentiles approached significance with a p-value of 0.059, after controlling for family income, parental educational level, child’s gender, and child’s age. Interactions and effect mediation could not be assessed due to the lack of association between sleep durations and child’s BMI percentiles.
### Table 5. The Adjusted Relationship between Television in the Child’s Bedroom and
BMI Percentiles

<table>
<thead>
<tr>
<th>Variable</th>
<th>Slope</th>
<th>SE</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Televisions in the Child’s Bedroom</td>
<td>2.602</td>
<td>1.356</td>
<td>.058</td>
</tr>
<tr>
<td>Child Gender (Female)</td>
<td>1.067</td>
<td>1.275</td>
<td>.405</td>
</tr>
<tr>
<td>Child Age</td>
<td>0.725</td>
<td>0.486</td>
<td>.139</td>
</tr>
<tr>
<td>Monthly Family Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1000-1999</td>
<td>2.890</td>
<td>1.694</td>
<td>.091</td>
</tr>
<tr>
<td>$2000-2999</td>
<td>2.579</td>
<td>1.749</td>
<td>.144</td>
</tr>
<tr>
<td>$3000+</td>
<td>3.253</td>
<td>2.178</td>
<td>.139</td>
</tr>
<tr>
<td>Parent Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12th grade/GED</td>
<td>-0.108</td>
<td>2.002</td>
<td>.957</td>
</tr>
<tr>
<td>More than high school</td>
<td>-0.862</td>
<td>1.546</td>
<td>.578</td>
</tr>
</tbody>
</table>
CHAPTER 4

DISCUSSION

The United States has experienced a large population growth in the Hispanic population (U.S. Census Bureau, 2010), and Hispanics have higher rates of childhood obesity compared to non-Hispanics (Kelly et al., 2013). Hispanic children often have lower reported sleep durations compared to non-Hispanic white children (Spilsbury et al., 2004). This evidence drove this study’s research to look at the association between a child’s BMI and sleep duration. With childhood obesity costing our country significant healthcare dollars (Finkelstein et al., 2012), and the strong possibility of obesity following an individual into adulthood (Kelly et al., 2013), it is important to determine possible obesity risk factors.

LUCES de Cambio is a prevention program working to increase the number of Hispanic children who are at a healthy BMI, by targeting healthy lifestyle behaviors. LUCES is based out of San Ysidro, a predominantly Hispanic community, in San Diego. It is important to study at-risk communities in order to better understand what uniquely is related to their obesity risk.

SCT stresses the importance of an individual’s environment to how successful they will be in adopting a suggested behavior change (Bandura, 2004). When looking at the Hispanic community and the factors that may differentiate them from other non-Hispanic communities, it was found that Hispanic children often are more likely to have televisions in their bedrooms (Owens et al., 2011). This study wanted to determine whether a television in the bedroom may impact a child’s risk of obesity through reducing their sleep duration. Although significant associations with sleep durations were not found, there were many significant discoveries regarding television’s possible role in childhood obesity.

MAIN STUDY VARIABLES

When children had a television in the bedroom, the trend that was evident was a higher BMI percentile in the study population. After controlling for family income, parent education, child’s gender, and child’s age, the relationship remained the same. Previous
research has demonstrated a significant relationship between TV’s in the bedroom and a child’s increased obesity risk (Cameron et al., 2013; Dennison et al., 2002; van Zutphen et al., 2007), and the current study supported these findings.

The purpose of this study was to investigate whether a television in the bedroom can increase a child’s risk for being overweight through influencing sleep duration. Contrary to what previous research has found (Flores & Lin, 2013; Gonnissen et al., 2012; Gozal & Kheirandish-Gozal, 2012), the present work indicates that sleep duration is not significantly associated with a child’s obesity risk. This may be due to nightly sleep duration being measured through parent-report, which may not be accurate.

**CONTROL VARIABLES**

Family income, parent education, child’s gender, and child’s age were not significantly associated with BMI percentiles in children. Previous research has found family income and parent education are associated with a child’s BMI (Food Research and Action Center, 2010; Huffman et al., 2010). This finding may be due to the lack of variability in the sample population, with more than half of the population falling below a monthly income of $2000. According to the U.S. Census Bureau in 2010, about 75% of Americans make more than $2000 per month. Within California, the median income range is nearly $5000 per month (U.S. Census Bureau, 2010). The current study recruited a sample of families with an income bracket much lower than state and national averages, thus limiting the possibility of finding a significant association.

Parent education was not associated with BMI percentiles. Parent education is often associated with family income levels (Huffman et al., 2010), and the lack of association in parent education and BMI percentiles may be due to similar limitations seen in family income, namely, lack of variability in the study population. The child’s age was not associated with BMI percentiles.

**LIMITATIONS**

One of the limitations of this study was the sample size. With a smaller sample size, it is more difficult to find statistical significance due to the lack of power. Second, this study consisted of Latinos, given the inclusion criteria. Even though it is a limitation to look at only one ethnicity, it is important to identify associations within this high-risk population. In
addition, the Latino community is the fastest growing subgroup in the U.S. (U.S. Census Bureau, 2010), and has the highest reported rates of childhood obesity (Kelly et al., 2013).

The current study’s small BMI percentile range may be a factor in understanding why nightly sleep duration was not significantly associated with a child’s risk of obesity. The original inclusion criteria for the LUCES study was to only include children with a BMI percentile of 85th and above, but due to difficulties in recruiting an adequate number of dyads, the inclusion criteria was expanded to include children in the 75th and above percentile. Regardless of this change, the majority of the present study’s BMI percentiles fell into the 85th percentile and above, so most children were either overweight or obese. A significant relationship may have been found if this study’s population had included more children in the less than 85th percentile range. Previous studies that found a significant relationship between sleep duration and a child’s BMI, compared healthy children and overweight/obese children in their analyses (Flores & Lin, 2013; Gonnissen et al., 2012; Pileggi et al., 2013).

Another limitation of the study was a lack of information regarding room and bed sharing among children and adults living in the household. Research has shown that bed sharing is more common in families of large size and low-incomes (Liu, Liu, & Wang, 2003). Sleep studies have shown that when children share their sleeping environment with others, the child may experience a decrease in sleep quality, irrespective of sleep duration (Liu et al., 2003). Sleep quality has been shown to contribute towards a child’s risk for obesity (Jarrin, McGrath, & Drake, 2013). This study’s participants were drawn from a large family, low-income population (BAE Urban Economics, 2012), and so whether a child shares his/her sleeping environment with another person would be an important variable to control for in future studies.

As stated previously, parent-reports may not be the most accurate method to determine a child’s sleep duration, often because parent reports may be inflated (Nixon et al., 2008; Pileggi et al., 2013). Parent-reported sleep durations are estimations and with estimated values, precision is lost. Precision in sleep duration is important, because when appropriate sleep durations are ten to eleven hours, a significant difference is only sixty minutes. In prior research that looked at parent-reports, the reports were on average thirty to sixty minutes higher from the objective measurements (Gozal & Kheirandish-Gozal, 2012; Nixon et al.,
Therefore, it is hard to capture accurate sleep durations through parent-reports and future research may benefit from using more objective measures to determine a child’s sleep duration.

When studying sleep, an objective measurement is important not only for measuring sleep quantity, but also for determining sleep quality. Sleep quality is often measured by how tired an individual feels throughout the day, whether they wake up feeling rested, and how often they wake throughout the night (Harvey, Stinson, Whitaker, Moskovitz, & Virk, 2008). Reduced sleep quality in children has been correlated with reduced physical activity and increased BMI (Chamorro et al., 2013; D. R. Chen, Truong, & Tsai, 2013). When an individual sleeps, his/her body cycles through many stages of sleep and although each stage of sleep is important, the deeper stages of sleep are the most restorative to the body and mind (National Institute of Neurological Disorders and Stroke, 2014). Poor quality sleep is when an individual does not spend enough time in the deeper stages of sleep (Harvey et al., 2008). Due to its highly subjective nature, it is hard to get an accurate measurement of a child’s quality of sleep with parent-questionnaires (Lewandowski, Toliver-Sokol, & Palermo, 2010). The LUCES’ caregiver interview asked about the child’s energy levels throughout the day and difficulties waking the child, but low validity was found on several parent-reported questionnaires (Lewandowski et al., 2010) and so, the information was not used. Nevertheless because of the correlations found between sleep quality and BMI in children (D. R. Chen et al., 2013), it is important for researchers to investigate this relationship further using more objective measurements.

Another limitation of this study was that the child’s physical activity levels and diet were not included in the control variables. Many studies have shown that television viewing has been correlated with children making less healthy dietary choices compared to children who do not watch as much television (Hare-Bruun et al., 2011). There also have been studies that show children who watch more television tend to be less active than children who do not watch as much television (Kiess et al., 2001; Strasburger et al., 2010). Due to both an unhealthy diet and less physical activity having a direct impact on a child’s risk for obesity (Folta et al., 2013), the analysis are limited in that they did not control for child’s diet and physical activity.
**Implications for Future Research**

There are many implications for future research. First, it is important to use objective measurements for sleep duration. Many researchers have used an actigraph to measure sleep durations and were able to accurately, and precisely, measure the amount of sleep a child gets each night (Gozal & Kheirandish-Gozal, 2012; Nixon et al., 2008). In order to determine if sleep duration is related to obesity risk in children in the Latino population, it is important to objectively measure their sleep duration.

Secondly, it would be beneficial to have a study population that has children distributed across all of the BMI percentile categories. When researchers have children with a healthy BMI to compare with overweight and obese children, the healthy weight group can be a control group to compare associations of BMI and sleep duration against. Also, having children with a greater range in BMI will allow researchers to determine if the association of sleep duration and BMI changes between the various BMI categories: healthy, overweight, or obese. The association between sleep duration and BMI may be an exponential relationship, and so affect each BMI group differently.

Also, researchers could look at quality of sleep in children with a television in their bedroom. Meltzer et al. (2013) found that children who use electronics around bedtime identified themselves as poorer sleepers compared to children who did not use electronics at bedtime. Prior research has found that exposure to television screens decreases melatonin production (Nuutinen et al., 2013), and one way to determine if this effects the quality of sleep for the entire night is through an actigraph. An actigraph has been validated in measuring the sleep efficiency of preschoolers (Belanger, Bernier, Paquet, Simard, & Carrier, 2013), and would be one way to measure if children are getting less sleep and/or poorer sleep, due to televisions in the bedroom. If researchers find televisions in the bedroom impact sleep quality, this may help to determine the possible mechanism by which televisions in the bedroom may be associated with increased BMI for children.

**Conclusions**

Many studies have shown that a child’s BMI is associated with the amount of sleep they get (Flores & Lin, 2013; Gonnissen et al., 2012; Gozal & Kheirandish-Gozal, 2012). Research has many theories as to why this relationship exists and this study looked at the
possibility of televisions in the bedroom impacting BMI through reducing the amount of sleep a child gets. The limitations in this study, related to parent reports of sleep duration, can guide other investigators to use more objective measurements, such as the use of an actigraph.

This study found children who have a television in the bedroom are more likely to have a higher BMI percentile than children who do not have a television in the bedroom. In future interventions, researchers could see if removing the television from bedrooms alone would decrease a child’s obesity risk. Also, based on the television in the bedroom showing a trend in BMI percentiles, this may lead future researchers to look into the mechanism behind this.
REFERENCES


food attitudes and preferences. *Journal of Social Science and Medicine, 65,* 1311-1323. doi:10.1016/j.socscimed.2007.05.011


