IMPACTING THE HOME ENVIRONMENT TOWARD THE PREVENTION OF CHILDHOOD OBESITY

by

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B.A., University of Kansas, 1993
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AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Abstract

The environment can be broadly defined as all things external to an individual. One of the most important environments for children is the home in which they live, particularly with regard to the role that parents play to provide opportunities for healthful development, including adequate physical activity and healthful eating habits. Parents are the gatekeepers of children's healthful opportunities, and are influential in numerous aspects related to obesity. The present paper consists of four chapters related to impacting the home environment for prevention of obesity in children. Although obesity is a complex issue, its cause is energy imbalance, wherein less energy is expended than is consumed. Consideration of both sides of the equation is essential for obesity prevention.

In this dissertation, chapter 1 serves as a literature review for the home food environment. A conceptual model is presented as an attempt to place relevant literature in the greater context of environmental variables related to childhood obesity. Frequent family meals have been shown to be protective for child and adolescent obesity, and to promote fruit and vegetable consumption. However, time pressures and lack of cooking skills are potential barriers to this healthful practice. Decreases in television viewing and sugar-sweetened beverage consumption are other home environmental aspects showing promise in the obesity prevention literature.

Chapters two and three address the influence of parents on children's obesity-preventive behaviors and relative weight status. These chapters help to inform the planning of interventions to prevent obesity in children. Parent-child shared physical activity may hold promise as a strategy to decrease the likelihood of children becoming obese, and bonding may be an important consideration in programs aimed at obesity treatment or prevention.

Chapter four describes the evaluation of an intervention developed to impact the home environment of young girl scouts. This intervention was implemented by troop leaders altering troop-meeting environments toward more healthful opportunities for physical activity and nutrition, and through the delivery of a scouts-tailored curriculum. Results of the intervention showed marked changes to troop meeting environments, but apparently little impact on parents or the home environment.

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Thanks also to my committee members Carol Ann Holcomb, Mark Haub, Stewart Trost, and Melissa Bopp for their guidance, encouragement, and support. Finally, I am forever grateful to David Dzewaltowski for his mentorship and supervision of my development from graduate student to scientist and professor.

Dedication

This work is dedicated to the memory of my grandmother, the late Mae Corrine Talbot Bigler. Mae succumbed to cancer as I was halfway through my doctoral studies, and it pains me to think she was unable to help me celebrate this accomplishment. Remembering her big heart, big smile, and easy laugh continues to brighten my days.

Preface

By the fall of 2004, I was already growing weary of the media reports of our obesity epidemic in the United States. About that time, I saw the movie *Supersize Me*, which humorously highlights many of the problems related to poor nutritional intake, sedentary lifestyle, and obesity. An especially troubling issue in this movie concerns the extent to which children are now growing up in a toxic environment, wherein the opportunities for healthful eating and adequate physical activity are already insufficient, and rapidly diminishing. Millions of children are now growing up without ever knowing the joys of being physically fit, substituting instead too much television, computer games, and junk food. Although I had already decided to return to school to pursue my doctorate as I was confronted with these sensationalistic media experiences, they helped to shape a sense of purpose for me- toward the betterment of public health with a focus on children. Thus, I have focused my work toward the primary prevention of childhood obesity through the promotion of healthful eating and physical activity. If I know anything at this point, it is that obesity and the underlying poor lifestyle behaviors in our youth will prove to be rather tough opponents. However, the world is changing, albeit slowly. McDonalds is now the world's largest purchaser of apples. Cartoon characters are being used to sell legumes and spinach. Videogames are being created to promote physical activity. As someone seeking more rapid improvements to the obesigenic environment, my modest hope is that I can add important data to the scientific evidence base, and to discover novel methods to stem the tide of obesity through health behavior change, at least for those individuals and institutions interested in adopting strategies of prevention and treatment. I relish the opportunity to continue devoting my energies toward this end in my future academic enterprises.

Chapter 1- A Model of the Home Food Environment Pertaining to Childhood Obesity

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Abstract

The home food environment can be conceptualized as overlapping interactive domains composed of built and natural, socio-cultural, political and economic, micro-level and macro-level environments. Each type and level of environment uniquely contributes influence in a mosaic of determinants depicting the home food environment as a major behavior setting for child dietary behavior and the development of obesity. Obesity is a multi-factorial problem, and the home food environmental aspects described in the present paper represent a substantial part of the full environmental context in which a child grows, develops, eats, and behaves.

Introduction

In the United States, children and adolescents (under age 18) as a whole are faring poorly in meeting recommended nutritional goals.[1-3] Many children are consuming excess calories and exceeding recommended intakes of total fat, saturated fat, added sugar, and sodium.[4] Recent data from the Centers for Disease Control and Prevention show only about 20% of adolescents reported eating five or more fruits and vegetables a day in the past week.[3] Such nutritional shortcomings can result in both short- and long-term health problems, such as obesity, which has seen an extraordinary increase in prevalence over the past thirty years (figure 1.1).[5,6] Poor eating habits and obesity contribute to the development of health burdens such as hypertension, dyslipidemia, chronic inflammation, asthma, endothelial dysfunction, hyperinsulinemia, diabetes, cardiovascular disease, certain cancers, and premature death.[7]

Children's eating patterns are strongly influenced by environmental characteristics.[8] Despite the growth of fast food, convenience foods, and trends toward increased eating away from home, about two-thirds of the foods children consume is from home.[9] Home and family environments are essential in the development of food preferences and consumption habits, and families represent a promising avenue toward improvement of children's eating habits and prevention of obesity.[10,11] Although parental and familial contributions to obesity are well documented, research has insufficiently addressed the bigger picture or full environmental context of nutrition-related behaviors and adiposity status of children.[10] Specifically, the home food environment has not been consistently defined or measured in this body of literature.

Childhood obesity is a multi-factorial problem, and a variety of approaches have been used to study the problem, and to create and test interventions.[10] Egger and Swinburn argued for an ecological approach, conceptualizing obesity as a normal response to an abnormal "obesogenic" environment.[12] As the interplay of environmental factors and health behaviors continues to emerge as a science, a need exists for attention to one of the most influential environments for the development of eating behaviors and obesity in children: The home. Therefore, the purpose of this paper is to review selected literature relevant to the home food environment's influence on obesity, and to present an ecologically informed model for future research and intervention in the home food environment, which provides a majority of children's dietary intake.

This model of the home food environment pertaining to childhood obesity (figure 1.2) is composed of three domains, each with macro-level and micro-level contributions. Micro-level components are defined here as those most proximal to a child's home life, whereas macro-level components are defined as existing at the larger community level, with potential carry-over into the child's home life. Built and natural environments are those composed of physical structures. Political and economic environments are those composed of financial resources, policies, and laws. Socio-cultural environments are those composed of social interactions, demographic characteristics, and secular trends. Components may interact across domains, represented here via bi-directional arrows connecting the three domains. For example, a parent's education level can influence the family's socio-economic status, which can influence parenting practices, each impacting the degree to which fresh fruit is available and accessible at home. Although micro-level components are contained within the macro-level, the collection of micro-level components

across a population also shapes the macro-level environment. The extent and quality of these micro-level and macro-level components in the home will combine to bring the full home food environment picture into focus. From there, the influence of the home environment on the dietary intake of children can be moderated or mediated by factors within the individual child.[12,13] What follows is a selected review of literature illustrating this model.

Political and Economic Environments

As the global economy continues to develop, international political and trade practices influence the types and costs of foods grown and brought to market, as well as trends in employment, wages, and other factors shaping our way of life. Within nations, states, and communities, laws and policies determine our financial resources, available foods, and food costs. From international levels to the neighborhood, political and economic environments play a role in shaping the home food environment.

Macro-level

Food Pricing

The financial costs of foods are strongly related to the likelihood of those foods being present in the home. In a nationally representative sample of almost 3000 adults, Glanz and colleagues found that cost was second only to taste as a criterion for food selection, as nutritional concerns and weight impact were much less important in food choice.[14] In small-scale experiments, researchers have found that pricing strategies directly influence food purchases.[15-17] French, Story and Jeffery reported that household income is associated with the types of foods consumed: Higher income families are more likely to purchase healthful foods.[18] In related articles applying national dataset findings from France, Drewnowski and Darmon found that lean meats, fish, fresh vegetables and fruit generally cost more than less healthful alternatives such as energy-dense foods made from refined grains, sugars, and fats.[19,20] Another article used the dataset from France to demonstrate how those spending the least money on food had diets higher in energy-density and lower in micronutrients.[21] Between 1980 and 2000, childhood obesity more than doubled in the USA as relative prices of all food fell 14%, with even greater drops in cost of energy-dense foods.[22] These findings support contentions that food costs partly explain consumption patterns and obesity rates as the obesigenic foods are less expensive.

Government and Business Policies

The pricing of food is a result of government and business policies that determine the costs and profits associated with production, distribution, and marketing- see Nestle for a full review.[23] Drewnowski and Darmon posited that a broader problem lies with the economics of food production, importation, and trade, along with poverty, employment, and minimum-wage policy.[20] Agricultural subsidies and trade practices affect the quantity and types of crops grown, resulting in imbalances and price differences for certain commodities. Businesses make use of inexpensive commodities by processing and adding value to create and market profitable, palatable energy-dense foods.[23] Families are targeted through marketing, and often ignore long-term health implications when purchasing food. Several European governments have banned advertising directed at children, but the American food industry has resisted similar efforts here.[24] While some research has shown connections between advertising and obesity,[25] there is no good evidence that advertising bans, by themselves, can prevent or reduce obesity.[26] Drewnowski and Darmon called for cooperation between governments, businesses, and academia, to address growingly unequal distributions of wealth and an economic slant toward consumption of obesigenic foods.[19, 20]

Federal & Community Food Programs

In the USA, federal special assistance food programs are available to bolster the dietary adequacy of low-income families, including WIC, food stamps, school meals, child and adult care, and other programs. Many communities also have food banks or support programs available to the needy. Such programs can impact nutritional outcomes of participants, even more than equivalent increases in earned income.[27] The Food Stamp Program and WIC are structured to improve participants' home food environments by directly providing foods to be stored, prepared, and consumed at home. Other programs may not directly influence the home food environment (e.g., the National School Lunch Program), but can have impact through food exposure, shaping preferences, and offsetting total food costs. Beyond just participants, federal programs have ripple effects by shaping institutional policy in schools and after-school programs. Federal programs also help shape the national food supply through financial support and outlet mechanisms for excess commodities, though sometimes to the detriment of other food sources.[23] Federal agencies have responded to some criticisms by making efforts to provide

more fresh fruits and vegetables, and by using local farmers markets. (http://www.fns.usda.gov, accessed January 1, 2007).

National & Community Economic Conditions

Worldwide, the link between diet and economics is clearly visible. As wealth rises and the population becomes less rural, societies undergo a nutrition transition, wherein diets high in unrefined carbohydrates and fiber are replaced by varied diets higher in fats, saturated fats, and sugars.[28] Within developed countries and at the community level, economic conditions are related to employment, wages, health, and nutrition.[29] Economic recessions, depressions, layoffs, and unemployment are likely to affect families' home food environments by altering socio-economic status, relative food costs, and food insecurity at the micro-level.

Micro-level

Family Socio-Economic Status

Socio-economic status (often measured by income, education, occupation, food-program eligibility, or the like) is a well-established influence on dietary habits, nutritional outcomes, and obesity.[19-22] Table 1.1 lists ways that socio-economic status may influence nutritional outcomes and the home food environment. The potential influence of socio-economic status on the home food environment is pervasive enough that nutrition-related studies usually measure and account for its contribution or confounding potential in relationships between other observed variables.[30-32] Strauss and Knight conducted a prospective study of children to determine home environmental risks for obesity.[30] These authors found that family income and home cognitive stimulation were significantly related to obesity in children at follow-up, controlling for other socio-economic factors, marital status, race, ethnicity and baseline BMI of mother and child.

Family Food Insecurity

Food insecurity is the limited or uncertain availability of nutritionally adequate foods, and is strongly related to financial insecurity and poverty.[33] Food insufficiency, a term used by some authors, is an inadequate amount of food intake due to a lack of money or resources. In the U.S., more than 14 million children under age 18 live in a home where they sometimes don't get enough to eat.[34] These children have significantly greater likelihood of poor health, lower

quality of life, poorer physical function, and school difficulties.[34,35] Food insecurity can often be characterized by alternating patterns of "feast and famine" wherein family members over-eat at times when food is available, and under-eat at times when little food is available. Food insecurity may be associated with lower intakes of fruits and vegetables and higher intakes of energy-dense foods (when available).[33,36] Such dietary patterns may lead to a net positive energy balance and result in obesity. A large nationally representative sample using NHANES III data revealed that poverty and food insecurity were unrelated to nutritional outcomes and obesity among schoolchildren, and that poverty was a suitable predictor for nutritional outcomes in preschoolers.[37] The authors offered the possibility that food stamps and national school lunch programs could explain the null result. This finding suggests caution with regard to connections between food insecurity and nutritional outcomes. However, a more recent study, based on NHANES III data, found that household and child food insecurity were related to risk for obesity among certain demographic categories of children.[38] Food-insecure adolescents, young children, Mexican-American children, and youth living below poverty were more likely to be above the 85th percentile of BMI. Another study demonstrated a potential moderating effect of the food stamp program on health-related outcomes of food-insecure households.[39] Thus, child food insecurity may be independently related to childhood obesity.

Food Program Participation

Less than 75% of those eligible actually use federal assistance programs, and three related explanations for lack of participation have been offered: stigma, transactions costs, and lack of information.[40] Despite eligibility, family decision-makers may not participate due to barriers of required documentation, perceived enrollment difficulties, guilt and shame from taking handouts, or ignorance of the program, process, or benefits.[40] Among the eligible, immigrants (especially Hispanics) are less likely to participate in assistance programs.[40] Those who do participate in food programs are likely to have better food security and nutritional intakes,[27] possibly improving home food environments and decreasing risk for obesity, though little evidence is available. Cook and colleagues found that children in food stamp program-participating, food-insecure households had lower adjusted odds of fair/poor health than children in similar non-program households.[39] In a study of participating families with preschool children, Rose and

colleagues found that the WIC program positively influenced the intakes of ten nutrients, while the food stamp program positively influenced five nutrients.[27]

Socio-Cultural Environments

Children are socialized from birth by the social forces and cultures that surround them. Early on, parents and caretakers provide the bulk of influence. As children age, other individuals, institutions, and media increasingly add to the socio-cultural environmental influences on children.

Macro-level

Race, Ethnicity, & Cultural Identity

Callery noted the importance of recognizing how diets differ across and within societies and how food patterns are part of cultural expression.[41] Dettwyler posited that cultural ideas of child feeding may influence nutritional intake to a similar extent as availability and household income.[42] Two major determinants of culture are race and ethnicity, both with important impacts on home food environments. Though certain groups of people purchase and prepare specific foods in certain ways, cultural impact can be confounded by education and economics. Race and ethnicity appear to work through assorted mechanisms to influence the home food environment, and this influence can vary by time, place, and food.[43]

Racial and ethnic influences may stem from cultural and genetic differences, affecting food selection and nutritional outcomes of children and adults.[44,45] Children from ethnically diverse groups are at increased risk for obesity and are more likely to have diets failing to meet nutritional recommendations.[44] In a study of adolescent meal patterns, Blacks were about four times as likely as whites to eat less than two meals per day, indicative of food insufficiency, meal skipping, or a predominance of snacking- all of which raise concerns for health, weight status and nutritional adequacy.[46] Children of Mexican Americans may be held to culturally specific standards, as their parents are more inclined to push food, expect hearty appetites, and have differing ideals of child body weight.[47] One cross-cultural study showed ethnic differences for child feeding responsibility, child weight concern, and perceived child weight were moderated by parent education and child BMI.[31]

Media Advertising & Marketing Exposure

Innovative strategies continue to emerge via schools, endorsements, internet, and movies, but television remains the pinnacle of food marketing targeting children and families.[48] A review of television and consumption patterns revealed that food is the most frequently advertised product category on kid's TV, with sugary products and fast food predominating.[49] Market segments are apparent as analyses of TV ads appearing during African-American program content showed greater likelihood of fast food, candy, soda, and meat, with less likelihood of cereals, grains, pasta, fruits, vegetables, desserts or alcohol compared to general program content.[50] Children exposed to TV advertisements are more likely to prefer the advertised product, to request such products from parents, and to consume these products.[51] Because advertising is effective,[51] and currently directs children and families disproportionately toward less nutritious foods, legislated regulations or bans have been used in some countries and proposed in many more,[48] though the impact of such legislation has not been determined.

Consumption Trends

Recent data show that the availability of food calories has increased dramatically since 1980,[52,53] and consumption patterns have also changed (figures 1.3,1.4).[54-56] Over the past few decades, soda consumption, snacking, and food portion sizes of in and out of the home have shifted in an obesigenic direction.[57] Portion sizes, which predict food consumption, have increased over recent decades, and are implicated in overeating and obesity.[58-61] U.S. children get approximately 20% of their daily calories through snacks, compared to Chinese kids who get only 1% of daily calories from snacks.[9] There has been an increased prevalence, across all age groups of youth for frequent snacking and for deriving a large proportion of one's total daily calories from energy-dense snacks, and some evidence exists linking opportunities for snacking with youth obesity.[62-64]

Overall caloric consumption may have increased slightly in recent years (figure 1.5), though perhaps not among children.[54-57] A nationally representative sample revealed no increased consumption for children aged 6-11, but significant increases for adolescent boys and girls.[55,56] Whether caloric intake has changed among children requires further study, but solid data show that source of calories has shifted remarkably over the past few decades.[58,62,65]

Sweetened beverage consumption increased from the 1970s to the beginning of the 21st century.[57] Prevalence of soft drink consumption among children aged 6-17 has increased 48% during roughly the same time period.[66] Nielson reported increases in the proportion of calories from salty snacks, soda, cheeseburgers and pizza, with decreases in milk, desserts, beef, and pork consumption.[54,62] While milk has dropped in consumption, cheese has more than doubled.[18]

A nationally representative sample of children consumed about 33% of their calories in food prepared away from home, with about 20% in the form of fast food.[9] Foods prepared away from home find their way to the home food environment via takeout, carry out, and delivery. In a study of Australian parents, over 70% reported purchasing carry-out foods for the evening meal.[67] Food preferences and exposures outside the home help shape the home food environment. Among foods consumed at home, modern times have brought an increasing variety of prepackaged convenience foods[23] (added value to food through preparation, processing, and packaging) requiring minimal preparation time or effort.[18,68] Portion sizes have increased for most foods consumed in or out of the home between 1977 and 1996.[18,58] Unfortunately, many convenience foods sacrifice nutritional quality (loss of fiber, vitamins, minerals, & phytonutrients; addition of sugars, fillers, preservatives, hydrogenated or saturated fats, sodium, artificial colors and flavors), come in large portion sizes, have high energy density, and may promote obesity.[19,23,69] With these consumption trends, poor nutritional outcomes are predictable.

Micro-level

Customs & Traditions

The home food environmental impact of traditions, culture, religious practices, ethnicity, race, and related social influences is important to consider as many customs and traditions involve food as a central focus. In a study of familial aggregation of dietary intake, cultural inheritance accounted for 30-40% of the dietary intake variance for children.[70] Correlations in energy intake and macronutrients were higher between spouses and between siblings than between parents and children, suggesting a stronger contribution from culture and shared environment than from genetics. The study also found that families who shared meals together more often had more similar dietary intakes.

Family Structure, Stress, & Schedules

Secular trends have revealed an increase in dual earner and single-parent families and more women in the workforce.[18,71] Working mothers are more likely to have reduced participation in meal planning, shopping and food preparation.[72] Mothers who work may opt for greater convenience in food choices, as time pressures influence the foods in their home environment.[18] Demographic shifts have resulted in less time available for food preparation, with significant effects on the home food environment.[73] Children who lived with a single mother were shown to have higher saturated fat intake.[74] In another study, children of single mothers were more likely to become obese in a six-year prospective study, though this effect appeared to be mediated by other socio-economic factors.[30] Teens from a single-parent household were more than twice as likely as those from a dual-parent household to have inconsistent meal patterns (placing them at risk for poor nutritional outcomes and obesity).[46] The makeup and size of families may influence the impact of the home food environment on children's risk for overweight, but few data are available in the literature. Households having more than one adult may have more family income and opportunities for monitoring or socialization. Family size may be associated with financial security, time constraints, and opportunities for the modeling of desirable or undesirable eating habits.

Family stress may be partially determined by socio-economics, race, ethnicity, employment, and health. Data have shown that food-insufficient households are much more likely than food-sufficient households to have experienced recent events that stress household budgets, such as losing a job, gaining a household member or losing food stamps.[75] Stress may have a reciprocally determined relationship with the environment.[10] Relationship stress could mediate the effect of other influences of the home food environment. For instance, stress could decrease the quality and frequency of family meals, or alter the degree to which parents monitor and regulate the types of foods purchased and consumed. Children in a stressful home environment may eat and behave in ways that exacerbate their exposure to stress and further shape their home food environments.

Parenting: Practices, Styles, & Rules

Golan and colleagues have consistently argued that parents can and should play the primary role in controlling the obesigenic environment at home.[76-79] Other researchers have acknowledged the importance of parents while focusing interventions on prevention and treatment of weight problems in children.[80-83] However, children and parents may not perceive the home food environment in the same way.[84,85]

The home food environment typically has one nutritional gatekeeper, often the mother, who controls a majority of the food eaten.[86] According to parental surveys, parents believe that they control an average of 83% of the food that children eat at home, with the proportion remaining high regardless of parental body mass, sex, age, cooking ability, and food type.[86] Mothers are often presumed to be nutritional gatekeepers, but studies have attested to the fact that fathers are also influential[80,87-89]

Parenting style provides the emotional context of the parent-child relationship, reflecting attitudes and creating an emotional climate wherein parenting practices and behavior are enacted.[90] Too often, studies have enmeshed general parenting styles within more specific domains, such as child feeding practices.[91,92] Specific parenting practices always take place within a greater parenting style context, and outcomes of individual practices may vary as a function of parenting style. In the parenting literature, typically three parenting styles are discussed: Permissive, Authoritarian, and Authoritative.

Permissive parents are warm but not firm, allowing their children great freedoms in behavior and decision-making.[90] Typically, permissive parents are less likely to set limits or control the food choices of their children.[93] Authoritarian parents are firm but not warm.[90] They are likely to set rigid limits for children, and to employ punitive and forceful actions of enforcement.[94] In contrast, authoritative parents are warm, firm, and accepting of the child's needs for autonomy.[95] Authoritative parents are likely to set limits for children based on reasoning, and to enforce limits through persuasion, rather than intimidation.[94] In research on parenting style and obesity-related behavior, parental permissiveness has been significantly related to soda consumption while fruit consumption and fruit-specific cognitions were best among adolescents who reported that their parents were authoritative, followed by those with permissive and authoritarian parents.[32,96]

Parenting practices are specific actions, but may be categorized similarly to style. Parents with authoritative-type feeding practices provided better availability of fruits and vegetables, made more attempts to get children to eat dairy, fruit and vegetables, and had children with better consumption of dairy and vegetables.[91] Authoritarian-type feeding practices were negatively related to vegetable consumption and fruit/vegetable availability. Maternal child feeding practices and perceptions of daughters' risk for obesity have been shown to predict girls' eating and weight status.[87] A review of the literature, discussed the development of food preferences as a function of exposure to foods and parenting practices.[97] This review highlighted how genetic predispositions to like foods with high-energy density, sweet and salty flavors, and to dislike sour and bitter tastes are modified with experience and exposure. Repeated exposure to foods can increase children's liking for that food.

Using food as a reward is associated with nutritional problems for children, and parents practicing this had children with higher regular sweet consumption.[32,98] Less-educated and lower-income mothers are more likely to reward good behavior with food, but obese mothers were no more likely than non-obese mothers to do so.[99,100] In contrast, parental support and verbal praise have been positively associated with children's fruit and vegetable consumption.[32,101]

Research on control in the context of the home food environment has frequently failed to distinguish different types of control. Authoritative and authoritarian parents both employ behavioral control, but psychological control reflects restrictive practices and is associated only with authoritarian parenting style.[102] Ogden and colleagues further differentiated control as either covert (undetectable), or overt (detectable).[166] Lighter parents and those with heavier children were more likely to use covert control, while parents of higher social status were more likely to use overt control. Some studies have shown a positive relationship between controlling practices and child overweight, while others have not.[89,103] Restricting access to palatable foods has backfired in laboratory studies, such that children showed increased interest for restricted foods.[104] Overweight parents, those concerned with their child's weight, and those having difficulty with self-control are more likely to use control, which may interact with genetics to foster child eating and weight problems.[10,92]

Overfeeding and pressure to eat have been shown to be associated with undesirable nutritional outcomes in most studies.[47,91] Some studies have also focused on family rules such as

eating with the TV or snacking between meals.[78] In an Australian sample, about one-third of families reported watching television more than four times per week while eating the evening meal, and only 11% had a rule against using the phone during dinner.[67] More research is needed to illustrate influences of family rules on children's dietary behavior.

Parental Eating/Dieting

Similarity exists in the dietary habits of people living together, irrespective of genetic relationships.[70] In children, food preferences are strong predictors of consumption, and those for fruits and vegetables are influenced by availability, variety, and exposure, likely stemming from foods mom and dad eat.[105] Siblings, peers, and parents can act as role models to encourage tasting of novel foods.[97] In a sample of middle-school students, parental modeling predicted adolescent fruit and vegetable consumption.[101] Separating out potential genetic effects, parental overweight is frequently cited as a predictor of child overweight but parents can also model positive food attitudes and intake, and practice appropriate socialization techniques.[10,87] Home social influences may impact eating behaviors consciously or unconsciously via attitudes, subjective norms, mimicry, awareness, and involvement.[13] Parental reluctance to meet nutritional recommendations in their own dietary practices may serve to undermine attempts to ensure healthful dietary practices of their children.[106] If this is true, modeled eating and availability of obesigenic foods in the home food environment will prove a stronger influence on child consumption patterns than parental encouragement or instructions. Several studies have focused on parental dietary practices, including disinhibition and dietary restraint, with a majority finding dietary restrictive practices a risk factor for children.[10,107,108]

Family Eating Patterns

The family mealtime aspect of the home food environment has great potential to affect the eating behaviors of youth in the family.[85,109] Among adolescents, those eating six or more family dinners per week had significantly better dietary outcomes, being less likely to: skip breakfast; eat fewer than two servings of fruit; eat fewer than two servings of vegetables; consume fewer than two servings of dairy products.[110] Eating family dinner has been associated with healthful dietary patterns, better fruit/vegetable intake, lower intake of fried food and soda.[111] Children without regular family dinners ate sweets and fast foods more often, and had

more behavioral problems than those having regular family dinners.[112] In a longitudinal study of television and food intake, the frequency of family dinners was inversely related to overweight prevalence at baseline, but not with likelihood of becoming overweight at follow-up.[113] The frequency of meals eaten at home was shown to influence the success of 10-year family treatment outcomes of obesity.[114] Overall, there is ample cross-sectional evidence showing positive associations from family meals, though further work is necessary to determine whether family meals have potential to prevent obesity.

Eating a breakfast meal has been associated with positive outcomes for both school performance and protection from obesity.[115-118] Among preschoolers, lack of daily breakfast consumption nearly doubled the odds of being overweight.[119] Unfortunately, research has demonstrated a documented decline over past decades in breakfast consumption among both boys and girls.[120] Eating breakfast also tends to decline as children age.[117] Studies show female adolescents are more likely to skip breakfast than are males.[110,118,120] Meal skipping is more prevalent among children of working mothers, and urban versus rural or suburban children[72,121]

Education & Nutrition Knowledge

In parents, general education level contributes to socio-economic status, and is thought to have far-reaching effects on many health outcomes. Parent education may impact the home food environment via financial income, money management, priority for nutrition, nutritional knowledge, parenting skills, general resources, or in other ways. Education level of mothers has been associated with child and mother consumption of fruits, vegetables, soft drinks, use of restrictions, verbal praise, negotiation, discouragement of sweets and restraining from negative modeling behavior.[32] In a population study, better maternal nutritional knowledge was associated with better diets in children, although the influence decreased with child age.[122] Conversely, a study of adolescents found a significant association between nutrition knowledge and food choices for seventh and eighth grade boys and girls, but not for sixth graders.[123] These findings depict shifts in knowledge-related influence from parent to child as the child ages and develops more autonomy. However, environmental availability may moderate the impact of knowledge, and self-efficacy or parental support may mediate the knowledge-behavior relationship.[101,124]

Food preparation skills

By using interviews, focus groups, and surveys, Wansink and Park showed how nutritional gatekeepers vary in cooking skill, food usage, motivations, and personality, suggesting that interventions should consider such factors when targeting dietary change in the home.[125] A recent study of young adults showed that although they had positive attitudes toward food preparation, they overestimated their food preparation ability and held negative views of from-scratch preparation.[126] This highlights how limited skill may prevent adults from making improvements to the home food environment. According to another study in England, most people learn food preparation skills from their mothers, though cooking classes in schools also served an important role.[127] This study's data suggests that socio-economic status and education are associated with the sources of people's knowledge about cooking, and that that knowledge may be an important factor in dietary choices and health.

Built & Natural Environments

According to Sobal and Wansink,[128] Certain aspects of the built environment are able to influence perceptions and cognitions regarding food consumption, to provide distractions or disruptions to self-regulation processes, or to increase awareness and promote convenience toward facilitation of eating. Built environments exert influence on what and how much is eaten, when and where it is eaten, and who is eating. In describing the physical environment in relation to obesity, Wells suggested that a full spectrum, from small-scale design elements to large-scale community infrastructure, should be considered.[129] Food acquisition is a function of numerous influences both inside and outside the home as outlined above. Once food is available within the home, it (and its packaging) becomes part of the physical makeup of the home food environment.

Postulating that behavior is simultaneously influenced consciously and unconsciously by the environment, the Environmental Research framework for weight Gain prevention (EnRG), has been put forth as an attempt to describe the obesigenic environment.[13] This framework bears resemblance to the ecological model published by Egger and Swinburn in describing types and levels of the environment, but expands the areas related to moderators and cognitive mediators of the environment-behavior relationship.[12] In the EnRG framework, moderators include demographic, personality, awareness, involvement, habit strength and clustering, while

mediators include attitudes, subjective norms, intention, and perceived behavioral control. The present paper's home food environment model (Figure 1.2) builds on the ideas put forth by those authors above in depicting the influence of moderators and mediators of the environment-behavior connection.

Macro-level

Food Landscape- Institutionalized Food Production, Availability, and Accessibility

Food becomes available and accessible through a wide variety of ways, including grocery stores, convenience stores, restaurants, shops, markets, schools, and churches. Overall availability per capita (including children) in the USA increased from 3300 kilocalories in 1970 to 3800 kilocalories in 1994.[53] Caloric availability is a large overestimate of food consumption due to spoilage and waste, but micro-level studies show that availability is associated with consumption.[18,105]

Recently, studies have examined relationships between the food landscape, availability and intake. Low-income neighborhoods are less likely to have grocery stores or restaurants offering fruits and vegetables.[130] Wealthier neighborhoods have significantly more supermarkets than poor and ethnically diverse neighborhoods.[131] Edmonds used a sample of African-American Boy Scouts to assess the influence of food landscape, finding that census tract methods were useful for determining fruit and vegetable availability from restaurants, but not grocery stores.[130] Among African-Americans, a nearby grocery store predicted increased likelihood of meeting dietary standards for fruit, vegetable, and saturated fat consumption. Massive increases in fruit and vegetable consumption were seen in local residents after the building of a supermarket in a "retail-poor" area.[132] The measurement of food deserts and other uses of geographic information systems are still in their infancy as tools of science. As these measurement tools continue to develop, so too will methods of analysis that may bolster our understanding of how the macro-level environment carries over to the home food environment.

Information Infrastructure

Considering the resources devoted to television, radio, cable, satellite, internet, newspapers, magazines, books, podcasts, billboards and related vehicles, a truly vast information transfer system exists in modern society. Among its many uses, this vast system is used to direct consumers to food purchase and consumption opportunities.

Micro-level

Home Availability & Accessibility of Foods

Children are unable to eat foods not available to them.[133] This simple point, however, has practical and theoretical implications for the home food environment. Less availability of obesity-protective foods such as fruits and vegetables predicts lower consumption levels, while higher availability of obesity risk-factor foods predicts higher consumption, each pathway leading toward obesity. Hearn and colleagues reported in two studies that children's fruit and vegetable consumption was significantly related to availability of these foods.[134] In a review of the literature, Blanchette and Brug found that along with taste preferences, the availability and accessibility of fruit and vegetables were most consistently and most positively related to consumption.[135] Le Bigot Macaux found that children's taste preferences for fruit are similar to those of candy, suggesting that the taste of fruit is more benefit than barrier for consumption, and that greater availability should promote consumption.[84] Availability moderates children's consumption such that homes with greater availability of fruits and vegetables have higher levels of motivating factors for children's consumption of fruits and vegetables.[136] Larson and colleagues studied eating habits of more than 4,000 teens in Minnesota, and found that calcium intakes of males and females were positively related to the availability of milk at meals.[137] A pilot intervention used nutrition information and media literacy to increase availability and parental social support, finding children were able to increase their consumption of fruits and vegetables.[138] The better the availability and accessibility of nutrient-dense foods in the home environment, the more likely it is that children will choose to eat these obesity-protective foods. Intervention programs should target availability and accessibility of healthful foods, such as the preparation of fruits and vegetables so that they are flavorful and ready to eat.[139]

For obesigenic foods, the home food environment is the largest source of sugar-sweetened beverages, as consumption increased from 5oz/day to 12oz/day from the mid-1970s to the late-1990s.[66] A review of the literature showed strong evidence for the role of such beverages in the development of obesity in children, accounting for eight to nine percent of children's daily calories.[140] Among high-fat foods, cheese consumption has increased in convenience foods such as pizza, tacos, nachos, and fast-food sandwiches.[18] Stockpiling of foods in the home may increase consumption for preferred and convenient products when food is visible and accessible, and when the family is frequently reminded of the food via marketing.[141] As nutritional gatekeepers, parents are capable of manipulating the availability of foods in the home food environment through their purchases, which can influence children's eating patterns without undue control or restriction.

Audiovisual Media Equipment

Several years back, the average child in the U.S. lived in a home with three televisions, two VCR or DVD players, and a computer, though these numbers may have climbed even higher recently.[142,143] American homes have a TV on about 25% of each day, and TV watching begins at an early age, with many children exceeding recommended levels of viewing.[144] Research has tied television viewing to a host of nutrition-related outcomes including fast-food consumption, lower fruit and vegetable intake, higher intakes of fat and salty snacks, and obesity.[49,113,145-148]

Figure 1.6 illustrates how television may promote an obesigenic home food environment through three main avenues of influence: promotion of sedentary behavior, food advertising, and eating while watching television.[11] Sedentary behavior results in a lower energy expenditure, leading to weight gain unless caloric intake is proportionally reduced. Sedentary behavior inside the home allows opportunities for eating, since food is nearby, and because being sedentary (as opposed to being vigorously active) is compatible with eating. Mindless eating can occur while watching TV, wherein a person is unlikely to be aware of how much is eaten, leading to higher energy intake and obesity.[149] Food is the most frequently advertised product type, often sugary snacks or fast-food products.[49] Children purchase and influence their parents to buy advertised foods, and parents respond directly to advertising from their own TV viewing.[150] Thus, advertising can lead to energy-dense foods being available at home, foster

more eating opportunities, higher energy intake, and promotion of obesity, unless offset by physical activity.

Computer use can also promote sedentary behavior and lower energy expenditure, although its influence on energy intake is not likely as powerful, due to the more interactive nature, occupation of one's hands, and currently lower levels of exposure to food advertising. Supplemental to the advertising influence, the internet has become one avenue for the direct purchase of food that may be delivered to the home. Presumably, advertising via internet or related media technologies could function in similar ways to TV. In the 1990s, numerous ethically questionable corporate data collection practices were revealed wherein food companies' kid-friendly websites used animated characters to gather personal information via interactive surveys.[48] Such information was then used to create targeted marketing for children. While this specific practice has subsided, the use of internet advertising overall is growing.[48]

Irrespective of advertising source, controlled studies have demonstrated the effectiveness of children's advertising in product recognition, selection, purchase requests, and parental acquiescence with resultant presence of advertised products at home.[49] Older children with access to money may purchase advertised food products themselves. Time-strapped parents are likely to let children watch TV, and to seek time-sparing methods of food provision through conveniently prepared foods.[69] Whatever the mechanism, television has shown larger effect sizes on obesity than either physical activity or nutritional intake alone.[151]

Saelens and colleagues longitudinally followed 169 families, finding that viewing, number of TVs, presence of VCRs, frequency of eating meals while watching TV, and percentage of children with a bedroom TV all increased from ages 6 to 12.[152] TV watching was related to weight status when children were younger and older, and watching more than 2 hours per day was a risk factor for higher weight. Some research suggests an increase of television viewing at mealtimes.[84] In one study of an ethnically diverse sample of children, about 20% of calories were consumed while watching television, and food fat content consumed with TV was related to BMI in the 3rd grade sample.[153] Other work has found that television viewing predicted fat intake in Black and white adolescents.[139] Reducing the frequency of meals eaten while watching TV may be useful for reducing television exposure and obesity risk.[152]

Beyond television, modern food marketing impacts the home food environment via internet websites, movie product placement, movie or TV character toy tie-ins, sponsorship of

sports teams and icons, postal mail advertisements, newspaper and magazine advertisements and inserts, and even with coupons or vouchers from school programs.[48,154,155] With such ubiquitous product pushing aimed at children, reducing television exposure or advertising may only partially stem the tide of influence on the home food environment. Various public health policies have been proposed to protect children by regulating food marketing to children, but the issue is politically charged. Many have called for food companies to self-regulate and to develop more healthful product lines, yet the feasibility of this approach remains unknown.[155]

Kitchenscapes, Tablescapes, Platescapes, & Foodscapes

Food intake is influenced by the physical setting and the objects therein.[18] The "microscale" built environment has become a substantial focus of research relating to obesity. A recent literature review described how small-scale elements of the built environment have an influence on food intake and obesity.[128,149] Rooms, furniture, containers, and the structure of food itself have been shown to modify consumption patterns. For instance, characteristics such as the visibility and accessibility of food, kitchen ambience and size, furniture characteristics, organization pattern of serving, size and shape of serving utensil, plate, and food all have been shown to influence eating habits. Preferred foods that are prominently visible and accessible, along with larger plates, bowls, cups, and serving utensils are all likely to promote greater food consumption.[149] Small kitchens with inefficient designs may discourage the preparation and consumption of less convenient and more healthful meals.[128] Kitchenscapes, tablescapes, platescapes, and foodscapes provide subtle, yet pervasive influence in the home food environment, partially determining food choices, consumption, and obesity. Structural changes to the micro-scale built environment may offer an effective means to change food intake.[128,149] Some examples of structural changes to alter obesigenic micro-scale built environments may include the use of smaller tableware, increasing the accessibility of stored fresh fruits and vegetables, storing otherwise convenient energy-dense foods in hard-to-reach and out-of-sight areas, limiting the size of food storage areas, or keeping dining areas clear of clutter and set up for family meals at home.

Kitchen Appliances & Cooking Equipment

If the micro-scale built environment is intended to account for influences on eating behaviors in the home, it should also include food preparation and storage equipment such as refrigerators, freezers, microwave ovens, ranges, and conventional ovens, cooking utensils, pots and pans, and other such items. While literature is lacking, these aspects of the built environment could influence consumption patterns in the home food environment. One study in the UK, showed that those with unskilled occupations were significantly more likely to own a deep fat fryer and least likely to own a food processor, suggesting potential negative impacts on their diet.[156]

Home & Community Gardens

Before most Americans lived in cities, much of the food in the home was grown in gardens and farms nearby. More recently, gardening became more hobby than necessity, but garden-grown foods can positively impact the diet and budget of families.[157] Foods grown in the garden may be consumed in season, or canned, dried, and frozen for later use. An overabundance of certain foods ripening simultaneously may also result in sharing these foods with friends, neighbors, and relatives.[158] As many as one quarter of households in the USA have gardens, saving families hundreds of dollars in food cost each year.[158] Because the types of foods grown in home or community gardens are likely to be fruits, vegetables, herbs, spices, and grains, the more that a family uses products from gardens, the less obesigenic their home food environment should be. Recently, interventions have focused on ways to involve youth in horticultural activities to promote physical activity, decrease sedentary activity, and increase fruit and vegetable preferences and consumption.[159,160]

Discussion and Conclusions

The home food environment can be conceptualized as overlapping interactive domains composed of built and natural, socio-cultural, political and economic, micro-level and macro-level environments. Each type and level of environment uniquely contributes influence in a mosaic of determinants depicting the home food environment as a major behavior setting for child dietary behavior and the development of weight status. Obesity is a multi-factorial problem, and the home food environmental aspects described in the present paper represent a

substantial part of the full environmental context in which a child grows, develops, eats, and behaves.

The epidemic levels of obesity now seen among children and nearly pandemic level in adults warrant grave concern due to decreased quality of life, potential tracking of weight and health behaviors from childhood to adulthood, and comorbid cardiovascular diseases, certain cancers, diabetes and others. If preventive measures are not taken, the negative outcomes of obesity are likely to result in great costs to society, not only in terms of health and quality of life, but also in fiscal impact on the healthcare system and national economy. Preventive changes are needed, spanning individual to national levels, and researchers have called for the development of family-based prevention programs for childhood obesity as a primary public health goal.[10]

Dufour cogently noted that the phenotypic development of obesity is only possible in an environment that permits overeating relative to energy expenditure.[93] Although the present paper does not address energy expenditure or physical activity, consideration of both sides of the energy balance equation is essential for the study of obesigenic environments and the development of obesity. These environments consist not only of physical structures, but also interlaced social, cultural, economic, and political components that create behavior settings for individuals and groups of people. In the present paper, we have made an attempt to draw upon ecological frameworks and extant literature to describe a comprehensive conceptual model of the home food environment that likely plays a strong role in the escalating problem of childhood obesity. It is hoped that this model will help to inform intervention efforts designed to alter the obesigenic qualities of the home food environment.

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Figures and Tables

Figure 1.1 U.S. Prevalence of Obesity by Age Group

(Data from Hedley et al.,[6] *JAMA*. 2004;291:2847- 2850)

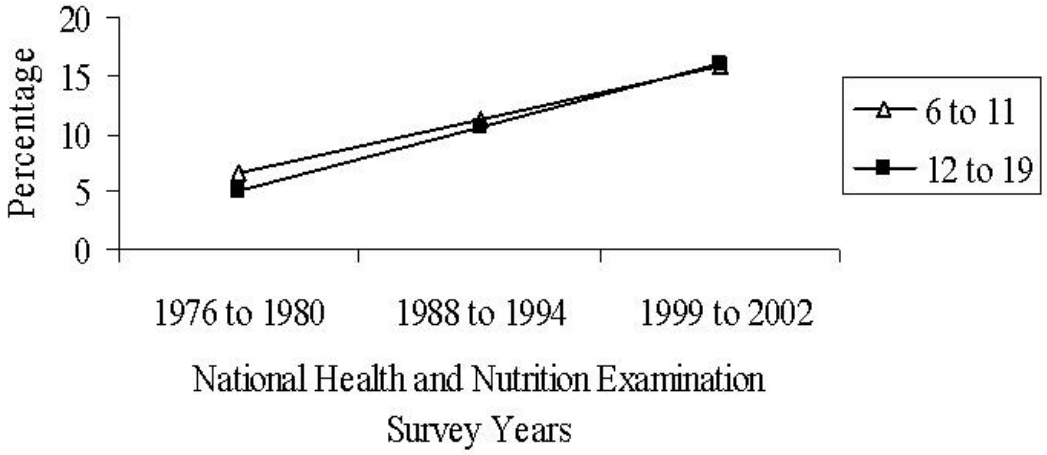

Figure 1.2 A Model of the Home Food Environment Pertaining to Childhood Obesity

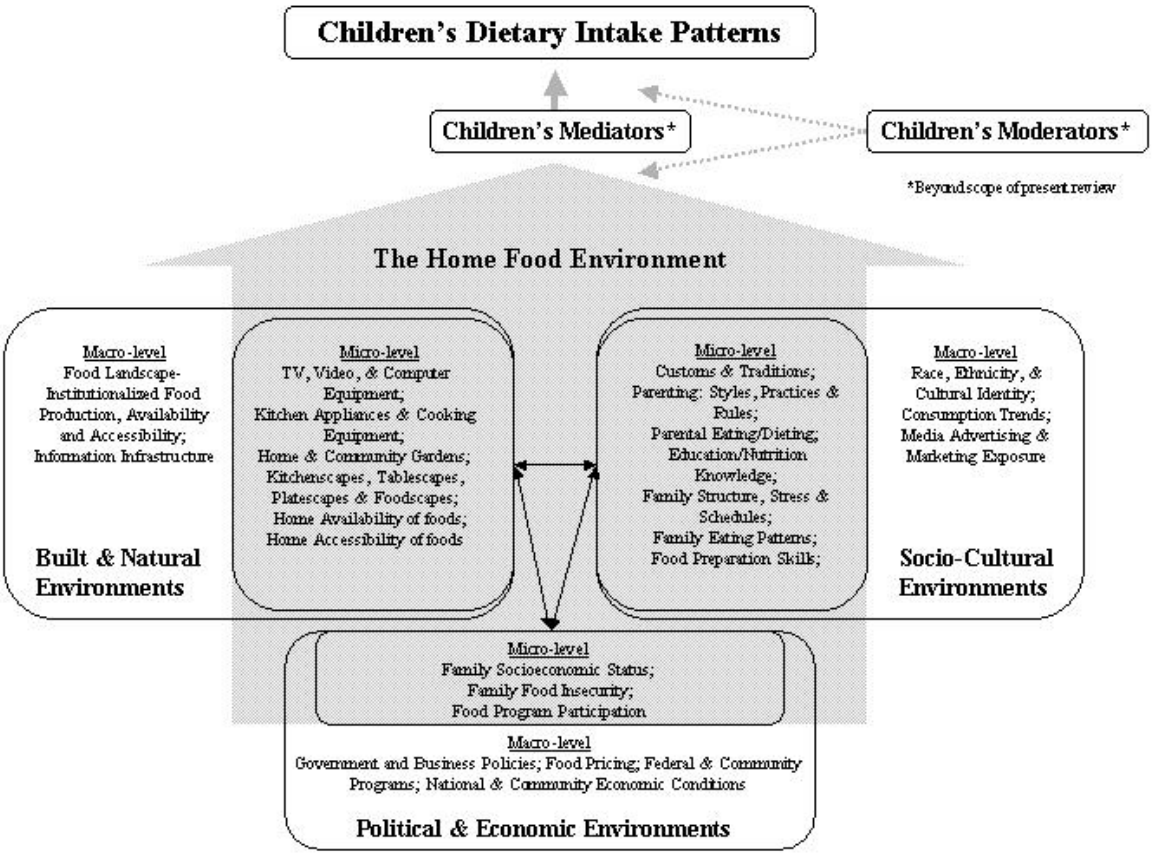

Figure 1.3 U.S. Dietary Consumption Trends for Girls Aged 6-11
(Data from Nielsen et al.,[54] *Obes Res.* 2002;10:370-378)

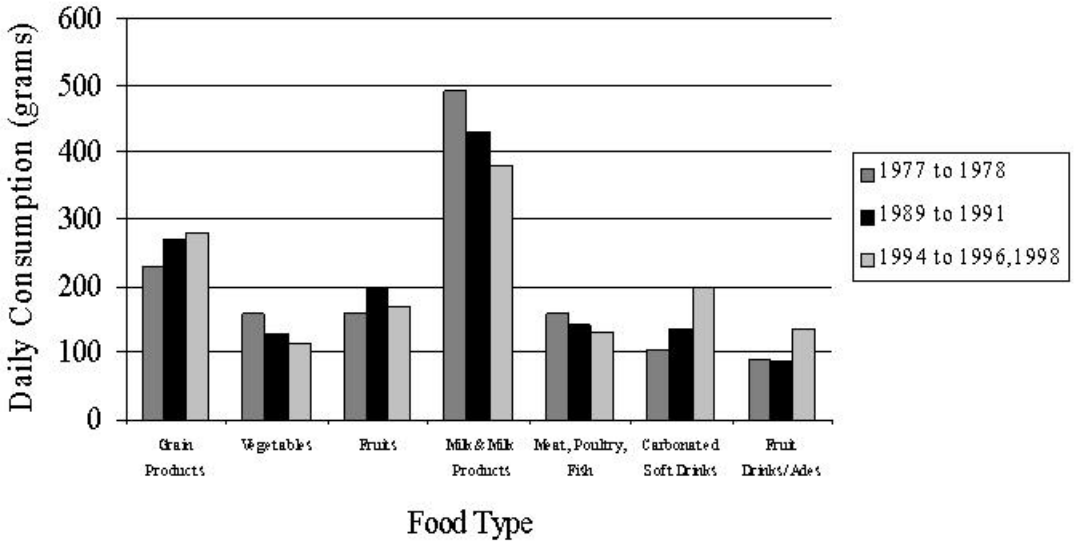

Figure 1.4 U.S. Dietary Consumption Trends for Boys Aged 6-11

(Data from Nielsen et al., [54] *Obes Res*. 2002;10:370-378)

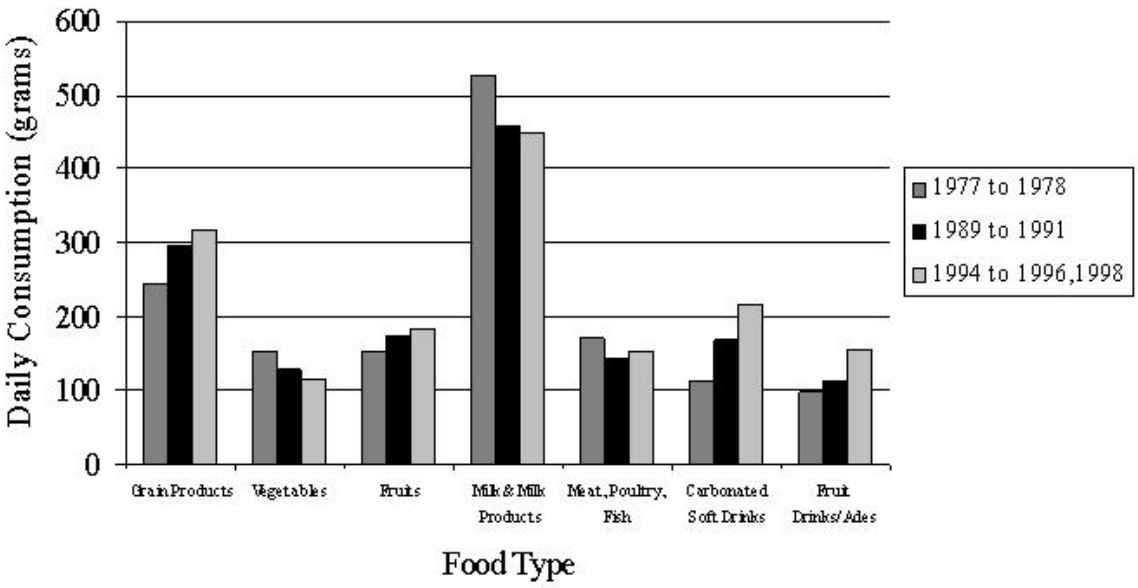

Figure 1.5 Caloric Intake Trends for Children and Adolescents
(Data from Enns et al.,[55] *Fam Econ Nutr Rev.* 2002;14:56-68
and Enns et al.,[56] *Fam Econ Nutr Rev.* 2003;15:15-27)

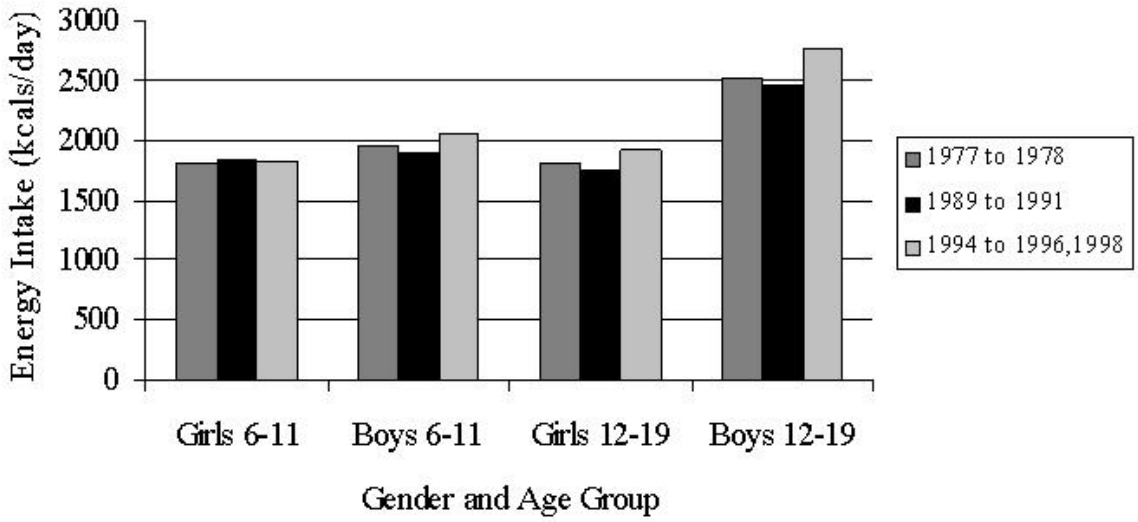

Figure 1.6 Conceptual Model of Television's Impact in a Permissive Home Food Environment

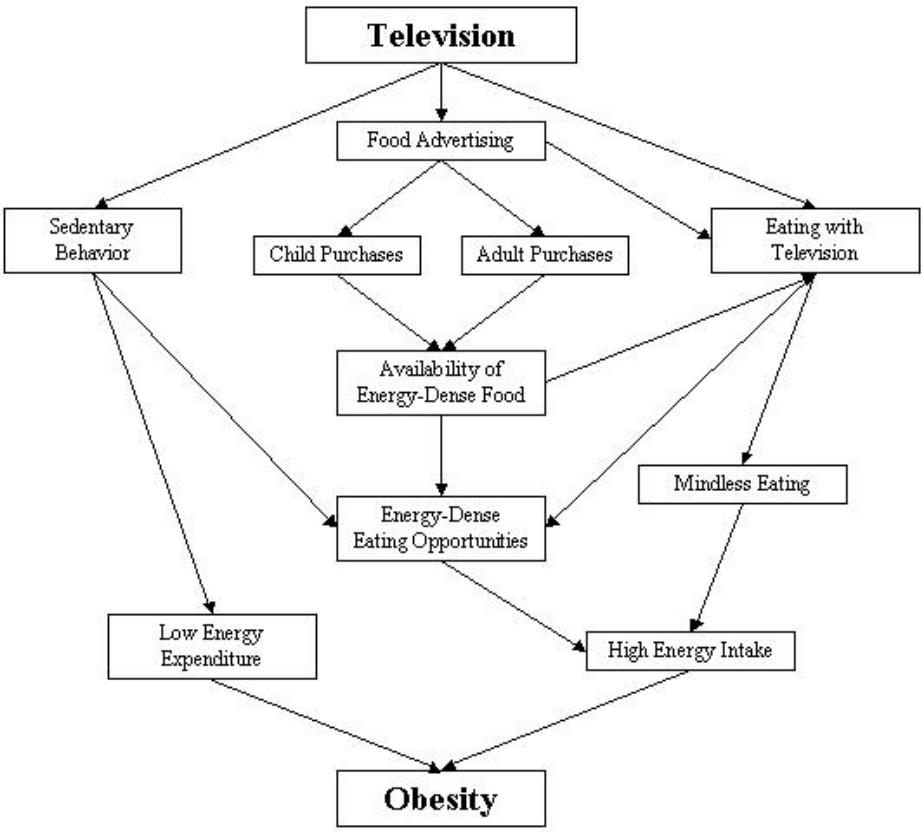

Table 1.1 Socio-Economic Status Influence on Nutritional Outcomes and the Home Food Environment

Compared to their higher-SES counterparts, children from lower-SES families…

- ► Eat fewer family meals.[110]
- ► Have parents with less authoritative feeding practices.[32]
- ► Have parents less concerned with child weight.[31]
- ► Have parents more likely to use food as a reward.[99]
- ► Get less parental discouragement from sweets.[32]
- ► Have parents who eat less fruits and vegetables.[32]
- ► May live in neighborhoods without grocery stores or restaurants that provide fruits and vegetables.[130]
- ► Have less availability of fruits and vegetables.[20]
- ► Eat less fruits and vegetables. [32,161]
- ► Are more likely to be food-insecure.[33,37]
- ► Are more likely to skip breakfast.[119]
- ► Are less likely to have healthful foods at home.[18]
- ► Have less healthy food habits.[37,161]
- ► Are more likely to eat fast food.[20]
- ► Drink more sugar-sweetened beverages.[161-163]
- ► Have lower calcium intakes.[137]
- ► Watch more television.[48,152,161]
- ► Are more likely to watch television while eating.[152]
- ► Are more likely to be overweight.[162,164]
- ► Are more likely to become overweight as adults.[165]

Chapter 2- Physical Activity-Related Parenting Behaviors May Influence Children's Relative Weight

Abstract

Background: Previous research studies have demonstrated that parents may influence the physical activity levels of their children. Purpose: The present study sought to determine whether physical activity-related parenting behaviors were associated with the relative weight of children, while controlling for potential confounds. Methods: A community sample of mothers (n = 193) of after-school program attendees completed questionnaires assessing parental social support for physical activity, sedentary behavior, and moderate to vigorous physical activity. Children (n = 193, 51% girls) were objectively assessed for height and weight via stadiometer and digital scale, with data converted to body mass index (BMI) percentile via CDC growth charts. Results: Linear regression analysis revealed that parental physical activity and encouragement for child physical activity were positively related to child BMI percentile. However, parent-child shared physical activity was negatively related to child BMI percentile. Conclusions: Varying types of physical activity-related parenting behaviors may have differential relationships with child relative weight.

Introduction

Current recommendations indicate that children should attain 60 minutes or more of moderate to vigorous physical activity (PA) per day.[1] Many children are not sufficiently active,[2] and may therefore be more vulnerable to obesity and other maladies.[3] Among the potential determinants of children's physical activity and obesity, parents emerge as potent influences on children's PA.[4-6] Children's PA may be influenced by parents through physical activity-related parenting behaviors (PARPB).[6-10]

PARPB dimensions represent multiple methods of influence on the likelihood of children being physically active, and each may have unique influence on children's PA and relative weight. PARPB is often termed social support for physical activity, which may include

instrumental and direct support, emotional and motivational support, or observational support.[11] In one exploratory study, Hovell and colleagues operationalized PARPB as frequency of PA encouragement, frequency of parent-child shared PA, and frequency of transportation for PA.[10] Trost and colleagues[6] conceptualized parents' own physical activity as separate from an omnibus social support for physical activity scale, and showed how parents' physical activity indirectly influenced children's PA through social support. Davison and colleagues[7] developed a questionnaire to assess how parents promote physical activity, and found that their items grouped into two factors: logistic support and explicit modeling. Logistic support included such behaviors as enrolling children in sports programs, and explicit modeling included parents using their own behavior to encourage activity. In a subsequent study, PARPB was grouped similarly into logistic and modeling factors.[8]

Although the positive relationship between several PARPB dimensions and children's PA has been fairly well established,[5,12] our review of the literature revealed that there is a lack of consistency on PARPB dimensions and measurement, and most of the studies have been conducted using self-report outcome measures. Very few studies[10] have examined the association of specific PARPB dimensions with objectively measured relative weight of children in a community sample. Therefore, the purpose of this cross-sectional study was to determine the level of association between physical activity-related parenting behaviors and children's relative weight. Our hypothesis was that all social support PARPB dimensions would have a protective (inverse) relationship with children's BMI percentile, whereas other (parent PA, sedentary) dimensions would have no relationship.

Methods

Participants and Setting

As part of a site-randomized controlled trial, participants for this study were recruited from seven after-school programs operating in one school district in the U.S. Midwest. Parents of program attendees completed questionnaires assessing potential influences on children's MVPA and relative weight, and gave consent for a child to participate. Of the seven schools hosting the programs, average enrollment was 309, with minority students making up 31.2% of enrollment. In these schools, the proportion of students eligible for free or reduced lunch (lower socio-economic status) averaged 43%. Parents who signed consent forms for

child participation (n = 404) were offered a five-dollar reduction in program fees for completing the questionnaire, and 241 elected to take part (60%). For the present study, self-report data from all mothers (n = 193) and BMI data of children (n = 193, mean age = 9.5, SD = 0.8) were obtained prior to any intervention activities. All data collection procedures and measures were approved prior to data collection by the institutional review board at the authors' university.

Measures

Relevant measures of PARPB included parental social support, PA, and sedentary behavior. Social support was assessed using a previously published five-item scale that encompassed the PARPB dimensions of logistic support, encouragement, emotional/motivational support, and parent-child shared PA.[6] Parental self-reported physical activity was assessed using four relevant items from the Behavioral Risk Factor Surveillance System (www.cdc.gov). Parental sedentary time was assessed with one item stating, "How many hours each day does the mother/female adult typically spend sitting down while doing things like visiting friends, driving, reading, watching television, or working at a desk or computer?" Parents reported their own height and weight, educational attainment, and their child's eligibility for free/reduced school lunch (an estimate of socio-economic status). Children in grades three through six with parental consent were objectively assessed for height and weight in a private setting with light clothes and no shoes. Height was measured to the nearest millimeter, using a portable stadiometer (Seca Corp, Model #214- Road Rod, Hanover MD). Weight was measured to the nearest 0.1 kg with high-precision electronic scales (Seca Corp, Model #770, Hanover, MD). BMI was calculated for both self-reported parent data and objectively assessed child data. For children, BMI scores were converted to percentiles using the age- and sex-specific LMS parameters from the CDC growth charts (www.cdc.gov).

Analysis

All data were reduced and analyzed using SPSS software (version 15.0, SPSS Inc, Chicago, IL). Pearson product moment correlation was used to analyze zero-order association, and the enter method of linear regression was used to analyze associations between parental variables and child BMI percentile while controlling for socio-economic status, maternal education, and BMI.

Results

Table 2.1 presents characteristics of participants. Table 2.2 presents associations between PARPB and children's relative weight. Pearson correlations revealed significant associations between BMI percentile and: 1) mother's encouragement for PA encouragement ($r = .234$, $p = 001$); and 2) telling child PA is good for them ($r = .157$, $p = 030$). For the linear regression, the overall model explaining 14% of the variance in children's BMI percentile was significant, $F(10,152) = 3.645$, $p < .001$. Within the overall model, significant standardized β coefficients were found for mother's encouragement of physical activity ($\beta = .246$, $p = .013$), mother-child shared physical activity ($\beta = -.195$, $p = .036$), and mother's meeting moderate or vigorous physical activity standards ($\beta = .199$, $p = .014$).

Discussion

Our results indicate that maternal physical activity-related support was significantly associated with children's relative weight in cross-sectional analyses. However, the direction of association was not as hypothesized, since only mother-child shared PA showed evidence for a potentially protective (inverse) relationship. Higher levels of mother-child shared PA were associated with lower BMI percentiles, when controlling for the socio-economic status, educational level, and BMI of the parent. In contrast, higher levels of maternal encouragement for PA were associated with higher BMI percentiles. Similarly, there was no evidence for a potentially protective (inverse) relationship between maternal meeting of PA standards and child BMI percentile. Instead, mothers who reported meeting PA standards were associated with higher child BMI percentiles. Our results differ from those of Hovell and colleagues,[10] who found a significant negative relationship between nine-year old girls' BMI values and logistic support for PA. However, in accordance with our findings, their study did show an insignificant association between BMI and parent-child shared PA.

Some of our findings were unanticipated, as it appears from these cross-sectional data that maternal PA and PA encouragement may be positively related to child BMI, such that heavier children have more active and encouraging mothers. If further research confirms such a relationship, a potential explanation could be that mothers are recognizing their child's and their own risk for overweight and obesity, and taking preventative steps for themselves and their children. Another possibility could be that active and supportive mothers are inadvertently

contributing to the development of heavier children through other behavioral avenues, such as feeding practices. The observed inverse relationship between mother-child shared PA and BMI percentile was as hypothesized. This suggests that mothers being active *with* their children may be a potentially protective behavior against overweight and obesity. If that is the case, interventions could promote parent-child shared PA as a mediator of obesity prevention.

Although some studies have grouped the PARPB dimensions of parental physical activity together with parent-child shared PA as "modeling," our results show that these dimensions have differential association with child relative weight. Future research on the dimensions of PARPB may reveal the proper measurement and operational use of these constructs relevant to physical activity, as well as to relative weight and obesity. More research is warranted on the relationships between PARPB and relative weight, as it is unclear which dimensions may serve as mediators in the prevention and treatment of obesity and overweight.

The main strength of this study is the use of objective measures of children's relative weight. Other strengths include the novelty of focusing solely on maternal parenting behaviors related children's BMI percentile, which revealed associations which may have been hidden in a study not assessing potentially differential effects of male and female caregivers. With these strengths, the present study has a number of limitations, which may temper the interpretation and conclusions. First, our design is strictly cross-sectional, so any causal inference is unwarranted. Next, we did not have a suitable measure of child PA, which could have helped to determine whether variations in relative weight were operating through PA. Also, although our participant sample appears fairly representative of our project's target population, non-participants may differ in important ways. Our sample is limited to one city's school district, and findings may or may not generalize to other locales. Further, we relied on self-report measures of parenting behaviors and relative weight, which may be subject to biases such as social desirability.

In conclusion, our study demonstrated that some dimensions of physical activity-related parenting behavior were related to children's relative weight. Placed in the context of relevant literature, these findings first suggest a need for theoretical and empirical refinement of measures of PARPB. Next, further studies including longitudinal or interventional research designs may be useful to uncover relationships between these parenting influences and children's PA and relative weight.

Acknowledgements

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Figures and Tables

Table 2.1 Participant Characteristics

	Children	Parents
Percent female	51[a]	100[a]
Percent male	49[a]	0[a]
Relative weight		
BMI Percentile Rank	68.4 ± 27.3[b]	--
BMI	--	26.7 ± 7.0[c]
Percent underweight	1.6[b]	1.1[c]
Percent normal weight	60.1[b]	48.4[c]
Percent overweight	17.1[b]	28.2[c]
Percent obese	21.2[b]	22.3[c]
Percent lower socio-economic status	49[d]	--
Percent ethnic minority	>28[d]	--
Percent with some college education	--	76.1[a]

Notes: a = self reported; b = computed from objective assessment; c = computed from self-report; d = proxy report by parent

Table 2.2 Relationships between PARPB dimensions and children's BMI percentile

Study Variables	Pearson r	Standardized beta coefficient	F
			(10,152) 3.645*
PARPB Dimensions			
PA Encouragement	.234*	.246*	
Mother-child shared PA	-.058	-.195*	
Transport for PA	.072	.091	
Watch child do PA	.051	.017	
Tell child PA is good	.157*	.000	
Mother meeting PA standards	.099	.199*	
Mother sedentary time	-.036	-.107	
Demographic Covariates			
Mother education	-.086	-.113	
Socio-economic status	-183*	.105	
Mother BMI	.271*	.257*	

Note: *adjusted $R^2 = 0.14$, $p < .05$,

Chapter 3- Parent-child bonding may moderate relationships between the BMI and obesity-prevention behaviors of parents and their daughters.

Abstract

Purpose: In a cohort of Girl Scouts, this study sought to determine whether parent-child bonding would moderate: The level of association between parent obesity-prevention behaviors and child obesity-prevention behaviors; The level of association between parent BMI and child age-and-gender-adjusted BMI percentile. Methods: Seventy-six Girl Scouts (ages 9 to 13 years) were objectively assessed for height and weight, and completed questionnaires assessing behavioral and psychosocial variables related to obesity. Weight and height were converted to BMI percentile via computerized application of CDC growth charts. Sixty-eight of the girls' parents also completed questionnaires assessing height, weight, behavioral and psychosocial variables related to obesity. Results: A significant moderation effect was found such that level of parent-child bonding moderated the relationship between parent BMI and child BMI percentile. No other significant moderation effects were found, but direct effects were found for parent eating with television and parent fruit and vegetable consumption on their corresponding child behavioral variables. Conclusions: The degree to which girls are bonded to their parents may influence their similarity to parents in relative weight. The specific obesity-related behaviors leading to greater similarity between parent and child relative weight need further study. Parent-child bonding may be an important consideration in programs that seek to prevent or treat childhood obesity.

Introduction

Obesity has rapidly increased across most demographic categories in the United States. According to recent surveillance data, about two thirds of the American adult population is overweight (BMI > 25), and over 30% are obese (BMI >30).[1,2] Among the adults, overweight and obese parents appear to be raising a generation of overweight and obese children. Nearly one third of children aged 6-19 are over the 85th percentile of age/gender-adjusted weight-for-height.[2] Approximately 17% of children in the U.S. are considered obese (at or above the 95th percentile[3]) according to most recent data.[1]

Considering the problem from an energy-balance perspective, whereby body weight must increase when more energy is consumed than expended, the observed obesity epidemic raises the question of obesity-related behavior: How much are Americans eating, or how much are they being physically active? With regard to energy intake, there has been an apparent overall increase over the past few decades,[4] possibly from eating larger portion sizes,[5] and consuming more sugar-sweetened beverages.[6] With regard to energy expenditure, data are not as clear on shifts over time, but the current proportion of Americans meeting the recommended guidelines for physical activity is very low.[7]

For children, parents provide opportunities, exhibit preferences, beliefs, and attitudes and model behaviors that contribute to a child's weight status.[8-11] Parents shape many of the environmental features of the child's home with regard to food, beverages, physical activity, and sedentary opportunities.[8,12,13] Beyond the home, parents have influence on what they expose their children to in other environments.[14] In concert with environmental opportunities, the behavior of parents can foster similar behaviors in children through modeling, provided the modeled behavior and its outcome has been observed by the child.[15] This vicarious learning scenario can then be either a risk factor or a protective factor relevant to obesity, depending on the nature of the parent's behavior (e.g., sedentary or active).

With regard to obesity-prevention behaviors, some studies report a family resemblance in children's physical activity behavior.[16] More specifically, the physical activity levels of children likely resemble those of their parents, across varying levels of socio-economic status and weight status.[17] For sedentary behaviors in general, and television viewing in particular, there is also some evidence of parent-child concordance or familial aggregation.[18] The family has strong influence on children's eating practices,[11] so children are also likely to resemble their families in fruit and vegetable intake.[19] and other low-fat eating practices.[20] Among the results from the Stanislaus Family study, children and parents had similar patterns of breakfast food intake, particularly when meals were shared.[21]

Relative weight tends to be similar in families, sometimes also termed familial aggregation of BMI. Although there is an considerable genetic component to such associations, the focus in the present paper pertains to the social and environmental aspects, and how they may interact with genetic predispositions.[8,22] In a longitudinal study, children with at least one obese parent had slightly higher relative weight, but family history was not a significant predictor of

BMI during childhood.[23] Another study showed that mothers appear to be a stronger influence on child relative weight than are fathers.[24] Davison and colleagues illustrated the influence of obesigenic families on young girls studied over a four year period. In that study, girls of obesigenic families (sedentary parents with high caloric intake) had higher BMI, BMI z-scores, and adiposity (when controlling for the influence of parent BMI) after four years than girls from non-obesigenic families.[25] Other studies have shown how changes to parental obesity-related variables can influence children.[8,26,27] In one treatment study, overweight & obese mothers of toddlers participated in a weight loss program consisting of diet, physical activity, and behavioral modification.[28] This intervention found that as mothers lost a modest amount of weight, their children's dietary intake improved substantially with regard to intake of total energy, fat, saturated fat, high-fat snacks and desserts, sweetened beverages, fast food consumption, and family meals. Additionally, the children's physical activity patterns also improved. Many studies related to obesity treatment in older children rely on parental behavioral changes at home for resultant weight loss of children.[14,26,29-32]

Therefore, given the current state of adult obesity-related behavior and overweight and obesity prevalence, combined with all of the data on parental and familial influence, it is understandable how so many children have become obese. As with adults, many children are failing to meet recommended guidelines for physical activity[7] and sedentary behavior,[33,34] fruit and vegetable consumption.[35,36]

Children who live with a biological parent will be subject to both genetic and social influence from that parent. With shared genes and a shared environment, it is not surprising that children often emulate their parents. However, ample variability exists such that many children of obese parents are not obese, and many children of parents not practicing healthful lifestyle behaviors are themselves meeting guidelines for physical activity and fruit and vegetable consumption. Obviously, influences beyond parents help to shape the behavior and weight status of children, but one consideration that may account for some inconsistency between parent's obesity-related attributes and those of their children is that additional influences (mediator or moderator variables) may alter conditions or mechanisms under which parents have greatest impact on their children.[37]

A potential approach to understand parental social influence regarding obesity-related behaviors may exist in the Social Development Model, which has proven useful in explaining

antisocial and delinquent behaviors such as smoking, alcohol and drug use in adolescents.[38,39] Although SDM has mainly been used in the literature pertaining to substance abuse and delinquency, the model's components are not so specific to those domains as to prevent generalization to areas such as physical activity and healthful eating. In fact, the current school of thought indicates that many child and adolescent outcomes are influenced by a core set of mediators and moderators.[40]

According to Fleming and associates' description of the Social Development Model (SDM),[41] children learn to behave through the influence of socializing agents in the family, at school, and elsewhere. Children are socialized through processes involving four components: 1) Children's perceptions of opportunities for involvement through activities and interactions with others; 2) Children's actual involvement in activities and interactions with others; 3) Children's skills for participation in activities and interactions; and 4) Children's perceptions of reinforcement from these activities and interactions. According to SDM, the four components exist in causal sequence. The greater the perception of opportunities for involvement , the greater the actual involvement will be. With greater involvement, skills are built, leading to greater reinforcement and the perception thereof. If the socializing process is consistent, a social bond of attachment can develop between the child and the socializing agent. This social bond may then moderate behaviors by strengthening the ones that are consistent with the socializing agent's behaviors, and/or by weakening those that are not consistent with the socializing agent's behaviors. For example, children who have developed a very strong bond with physically active parents should be more likely to be physically active themselves, and one preliminary study has found support for this moderation effect in physical activity.[42]

Following the Social Development Model, the purpose of the present study was to determine whether parent-child bonding would moderate the relationships between parents'and children's obesity-related behaviors, and between parents' and children's relative weights. We hypothesized that parent-child dyads categorized as having a stronger bond would have greater similarity between parents and children than would dyads having a weaker bond, for the following variables: 1) Parent body mass index (BMI) and child BMI percentile; 2) Physical activity level of parent and child; 3) Television viewing of parent and child; 4) Eating with television of parent and child; 5) Fruit and vegetable consumption of parent and child; 6) Sugar-sweetened beverage consumption of parent and child.

Method

Study design

The present paper makes use of baseline data from the Scouting Nutrition and Activity Program (SNAP) project that was evaluating the effectiveness of an intervention designed to prevent obesity. All analyses presented here are cross-sectional in nature, with data collected prior to intervention. The girls agreeing to participate from participating Girl Scout Juniors troops completed questionnaire and anthropometric assessments within a two-week period in October 2007, prior to randomization for the intervention study.

Settings and Participants

Participating girls (ages 9 to 13) were members of Girl Scouts, attending one of seven Junior troops. In the seven troops, parental informed consents were obtained for all but one attending child (n = 76, 100% female). Families with parents or daughters unable to speak or read English were excluded (n = 1). Out of all Girl Scout families (n = 72) consenting for their child(ren) to participate, most also participated by returning a questionnaire (n = 68, 96% female). Parents agreed to complete a questionnaire for each child attending one of the troops, and four families had more than one child in a troop. Participating families earned a small stipend for returning the questionnaires and for allowing anthropometric measurements of the girls. Troops also earned a modest stipend for agreeing to take part in the study.

These Girl Scout troops held meetings in one of three adjacent mid-western towns, which ranged in population from about 4,000 to 50,000. Troop meetings were held either weekly (n = 2) or bi-monthly (n = 5), generally lasting between one and two hours in length. Meetings were held at the Girl Scouts organization's property (n = 4), at a troop leader's home (n = 2), or at a community center (n = 1). Troops ranged in size from six to sixteen girls (mean = 11).

Table 3.1 presents demographic characteristics of participating Girl Scouts. Mean age of participating girls was 10.5 $\pm$ 1.2. About half of the parents reported being college graduates, about one third were lower socio-economic status, and more than three quarters of the girls were non-Hispanic Caucasian. Maternal parity averaged about two and a half children for this sample, and mean parental BMI was 29.0, corresponding to overweight status. Parents averaged

2.5 children per household. On average, both parents and girls ate fewer than five servings of fruits and vegetables per day, and most parents and girls did not meet current physical activity recommendations.

Procedures

Girls' height and weight assessments were carried out in semi-private settings without shoes or heavy clothing. Height was measured to the nearest millimeter, using a portable stadiometer (Seca Corp, Model #214 Road Rod, Hanover, MD). Weight was measured to the nearest 0.1 kg with high-precision electronic scales (Seca Corp, Model #770, Hanover, MD). Girls completed questionnaires as a troop, administered according to a standardized script read by the first author. Parents completed a questionnaire at their own convenience.

Measures

Body mass index (BMI) was calculated by dividing body weight by height squared. Child BMI scores were converted to percentiles using the age- and sex-specific LMS parameters from the CDC growth charts.[43] Participants were classified as overweight or obese, respectively, if their BMI equaled or exceeded the age- and sex-specific 85th or 95th percentile.

Girl Survey

Questionnaires assessed: 1) Fruits and vegetable servings typically consumed. Numerous common fruits and vegetables were described and children were informed of how much constituted a serving. Two items (α = .714) assessed typical servings of fruit per day, and typical servings of vegetables per day;[44] 2) Physical activity level. Physical activity was defined as "any play, game, sport, or activity that gets you moving and breathing harder" and discussed with numerous examples. Two items (α = .758) assessed days in the past week, and in a typical week, of being physically active for an accumulated total of at least 60 minutes per day, not counting physical education class; 3) Frequency of eating with television was assessed with three items (α = .658) from the Family Eating and Activity Questionnaire-Revised (FEAQ-R)[45]; 4) Television viewing was assessed via two items (α = .688) from the SMART questionnaire[46] assessing the behavior for yesterday and last Saturday; 5) Sugar sweetened beverage consumption was assessed with one previously published item[45]; 6) Parent-child bonding was assessed with seven previously published items (α = .825).[47,48]

Parent Survey

Parents completed a questionnaire including: 1) Fruits and vegetable servings typically consumed. Text and pictures informed parents about how much constituted a serving. Two items (α = .722) assessed typical servings of fruit per day, and typical servings of vegetables per day; 2) Physical activity level was assessed with four previously published items from the BRFSS screener[44]; 3) Frequency of eating with television was assessed with three items (mother, father, child α = .681)[45], 4) Television viewing was assessed with one item, inquiring average television use. 5) Sugar sweetened beverage consumption was assessed with one previously published item[45]; and 6) Self reported height and weight.

Statistical Analysis

SPSS 15.0 (Chicago, IL) was used to compute all analyses. Descriptive statistics including means were calculated for all variables. Following the guidelines for testing the moderation hypothesis in a hierarchical multiple regression framework,[49], the two first order effects (each parent variable analyzed, and bonding score) were centralized by subtracting the mean across individuals from each individual's variable value. Next, the product, or interaction, of the two centered first-order effects was calculated for each analysis run. This interaction term was then entered into the second step of the regression. A significant change in R^2 from the first step of the regression analysis to the second step indicated a significant moderator effect. The F value's significance for each regression model indicated whether the model explained a significant proportion of variance in each child outcome variable analyzed. An alpha of .05 was set as the upper-level criterion of significance for all analyses.

Results

Direct and moderated relationships

BMI

Table 3.2 displays the hierarchical multiple regression used to analyze the direct and moderated effects of parental BMI and bonding on child BMI percentile. At step 1, less than three percent of the child BMI percentile variance was explained by the model, $p = .442$, and neither parental variable made a significant contribution to the model. At step 2, the model

significantly increased in explained variance, accounting for about 11% of the variation in child BMI percentile. However, the overall model at step 2 did not reach significance, $p = .07$. There was a significant moderation effect evident as the interaction between parent BMI and bonding showed a significant standardized beta coefficient in the model, $p = .022$. Figure 3.1 illustrates the moderation effect of bonding on the relationship between parent and child BMI variables. Children reporting higher bonding scores had greater similarity to their parent in BMI status. Children reporting lower bonding scores had less similarity to their parent in BMI status. Thus, there was no direct effect of bonding, rather a modifier effect of bonding for parental BMI on child BMI percentile.

Physical activity

Table 3.3 shows the hierarchical multiple regression models used to assess the direct and moderated effects of parental physical activity on child physical activity. At step 1, the model did not explain a significant proportion of child physical activity variance, and neither parental variable's standardized β-coefficient was significant. At step 2, the model was significant, and explained about 12% of the variance in child physical activity, $p = .042$. However, the change in R^2 did not reach significance ($p = .059$), indicating a lack of significant moderation effect for bonding. Thus, the model containing parent physical activity, bonding, and the interaction between parent physical activity and bonding was significant, but the trend for moderation was not significant.

Television viewing

Table 3.4 displays the hierarchical multiple regression used to analyze the direct and moderated effects of parental BMI and bonding on child television viewing. At step 1, an insignificant percentage of the variance in child television viewing was explained by the model, and neither parental variable made a significant contribution. At step 2, the model remained insignificant, and no moderation effect was apparent, $p = .691$. Thus, there were neither direct nor moderated effects of parental television viewing on child television viewing.

Eating with Television

Table 3.5 shows the hierarchical multiple regression models used to assess the direct and moderated effects of parental eating with television on child eating with television. At step 1,

the model explained approximately 12% of the variance in child eating with television, $p = .015$. Parental eating with television made a significant contribution to this model, $\beta = .358$, $p = .004$, but bonding did not have a significant β-coefficient, $p = .414$. At step 2, the model remained significant, $R^2 = .162$, p = 010. However, the interaction term was not significant, $\beta = .215$, $p = .094$, indicating no significant moderation effect. Thus, there was a significant direct effect of parental eating with television on child eating with television, but no significant moderation effect.

Fruit & vegetable consumption

Table 3.6 shows the hierarchical multiple regression models used to assess the direct and moderated effects of parental fruit and vegetable consumption on child fruit and vegetable consumption. At step 1, the model explained approximately 18% of the variance in child fruit and vegetable consumption, $p = .002$. Parental fruit and vegetable consumption made a significant contribution to this model, $\beta = .261$, $p = .031$, and bonding also made a significant contribution to this model, $\beta = .264$, $p = .030$. At step 2, the model remained significant, $R^2 = .187$, $p = 004$. However, the interaction term was not significant, $\beta = .110$, $p = .372$, indicating no significant moderation effect. Thus, there were significant direct effects for both parental fruit and vegetable consumption and bonding on child fruit and vegetable consumption, but no significant moderation effect.

Soda consumption

Table 3.7 displays the hierarchical multiple regression used to analyze the direct and moderated effects of parental soda consumption and bonding on child soda consumption. At step 1, an insignificant percentage of the variance in child television viewing was explained by the model, $R^2 = .009$, $p = .759$. Neither parental variable made a significant contribution to this model. At step 2, the model remained insignificant, $p = .043$, and no moderation effect was apparent, $\beta = -.190$, $p = .151$. Thus, there were neither direct nor moderated effects of parental soda consumption on child soda consumption.

Discussion

Our study sought to determine not only the association between parental obesity-related variables and their corresponding child obesity-related variables, but also whether parent-child bonding moderated these associations. The main finding of our study was that bonding moderated the relationship between parent BMI and child BMI percentile. This finding supports our hypothesis from the Social Development Model that those children most bonded to the socializing agent will bear most resemblance to that person. Children who reported higher bonding with the parent returning a questionnaire had more similar relative weight to this parent than children reporting lower bonding. For direct effects, we did not find a main effect of parent BMI on child BMI percentile, which is not an unusual result in the literature.[23] Assuming that there is no systematic error in this sample related to differences in shared genes or shared environments (neither was measured), our moderation effect finding has important implications. In general, children are at the mercy of their parents with regard to environmental opportunities for obesity-preventive behaviors, as well as the degree to which obesity-preventive behaviors are valued and modeled by parents.[8] In particular, those children most bonded to parents appear to be especially sensitive to parental influence with regard to obesity or its prevention.

However, the behavioral mechanism by which these higher bonded parent-child dyads have become more similar in relative weight remains unclear for now. According to both an energy-balance framework and the Social Development Model, the similarities between parents and children in relative weight should be due to behaviors associated with obesity development or obesity prevention. Although we tried to assess many of the behaviors shown to influence child weight status, we may not have assessed some important determinants (e.g., total energy intake). We found direct effects for both fruit and vegetable consumption, which could be protective against obesity,[50] and eating with television, which could be a risk factor for obesity.[12] Our study did not find significant direct effects for television viewing, soda consumption, or physical activity. This study showed no other significant moderation effects, though there were non-significant trends for moderation in physical activity and eating with television.

The use of the Social Development Model in the obesity-prevention literature is a novel application. To our knowledge, only one currently published study has tested the model in the area of nutrition or physical activity. Our group's previous study[42] of parent and child physical

activity after school showed a significant moderation effect by parent-child bonding, such that those with higher bonding were more similar in physical activity levels after school. The present study did not find a significant moderation effect in physical activity, though there was an insignificant trend for moderation. It is noteworthy that the present study differed from previous work as we assessed more global physical activity levels via different measures in an all-girl sample of children. However, our study appears to be the first to show that parent-child bonding influences the weight status similarity between parents and daughters.

Along with the novel application of the Social Development Model, our study featured some other notable strengths. We obtained objective measurement of child BMI percentile, rather than relying on parental report or other less reliable indices of relative weight. We had parents and children self-report separately on psychosocial and behavioral outcome measures, which should reduce bias from shared methods or parental instruction. Also, we were able to obtain anthropometric and questionnaire data from about 98% of the children in our target population of Girl Scout troops. We were also able to obtain parent questionnaire data from about 90% of the girls. Limitations of the study included our cross-sectional design, modest sample size, relatively low power, reliance on self-report measures of uncertain validity, and inability to obtain self-reported height and weight from several of the participating mothers (n = 5).

Overall, our study makes a contribution to the literature by considering whether parent-child bonding may help determine parent-child similarity with regard to the development of obesity. Future work can use better behavioral measures in a larger and more diverse sample of girls and parents to determine whether the present paper's findings generalize beyond our current sample. Also for future work, the independent effects of mother-child bonding and father-child bonding could be examined along with a diverse sample of boys and girls to address potential gender differences and interactions on obesity-related variables. If further work continues to support our findings in other samples and the Social Development Model, it may be desirable to create targeted interventions for children and parents. Among children of parents who do not have excess weight and who practice obesity-preventive behaviors, public health interventions could strive to strengthen the parent-child bond, in hopes of helping children emulate their parents. Targeting parents and children's obesity prevention behaviors in combination with parent-child bonding may help to make positive changes more sustainable. For children with

less health-conscious parents, it would be especially important to allow them the chance to develop opportunities and skills related to obesity prevention and bond with adult leaders and environments that model and support obesity-preventive behaviors. Interventions aimed mainly at parents' obesity-preventing behaviors would also be expected to influence their highly bonded children in a positive manner. Finally, overweight and obese parents may need socially marketed messages conveying the dire consequences for children, arising from parents who model poor dietary habits, sedentary lifestyle, and fail to provide obesity-preventive behavioral opportunities for their children.

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Figures and Tables

Table 3.1 Descriptive statistics for outcome and moderating variables

	Total Mean (SD)
Demographic Variables	
Percent parents are college graduates	52.1
Percent lower socio-economic status	31.9
Percent girls non-Hispanic Caucasian	77.0
Number of children in household	2.5 (1.0)
Girl's BMI	19.4 (3.4)
Girl's Age	10.5 (1.2)
Variables of Interest	
Parent-child bonding scale (0-4)	3.1 (0.8)
Girl BMI percentile	64.3 (25.5)
Parent BMI	29.0 (6.9)
Girl days/week 60min MVPA (0-7)	4.4 (1.9)
Percent of parents meeting MVPA standard	41.4
Girl TV watching time scale (0-8)	2.7 (1.9)
Parent TV watching time (hours/week)	9.8 (7.2)
Girl TV & eating Scale (0-3)	1.1 (0.7)
Parent TV & eating (scale 0-4)	1.9 (0.9)
Girl F&V servings/day (0-8)	4.3 (1.9)
Parent F&V servings/day (0-8)	3.8 (1.7)
Girl Soda/SSB consumption scale (0-7)	2.8 (2.4)
Parent Soda/SSB consumption scale (0-7)	2.4 (2.6)

Table 3.2 Hierarchical multiple regression analyses testing the relationship between child BMI percentile and parental variables

Variable	β	R^2	ΔR^2
Step 1		.026	.026
Parent BMI	.122		
Parent-child bonding	.125		
Step 2		.108	.082*
Parent BMI x Parent-child bonding	.322*		

Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Table 3.3 Hierarchical multiple regression analyses testing the relationship between child physical activity and parental variables

Variable	β	R^2	ΔR^2
Step 1		.072	.072
Parent meets MVPA standard	.201		
Parent-child bonding	.202		
Step 2		.125*	.053
Parent MVPA x Parent-child bonding	-.239		

Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Table 3.4 Hierarchical multiple regression analyses testing the relationship between child television viewing and parental variables

Variable	β	R^2	ΔR^2
Step 1		.053	.053
Parent television viewing	.127		
Parent-child bonding	-.153		
Step 2		.055	.002
Parent TV x Parent-child bonding	.055		

Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Table 3.5 Hierarchical multiple regression analyses testing the relationship between child eating with TV and parental variables

Variable	β	R^2	ΔR^2
Step 1		.124*	.124*
Parent eating with TV	.358*		
Parent-child bonding	.098		
Step 2		.162*	.038
Parent TV eating x Parent-child bonding	.215		

Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Table 3.6 Hierarchical multiple regression analyses testing the relationship between child fruit and vegetable consumption and parental variables

Variable	β	R^2	ΔR^2
Step 1		.177*	.177*
Parent FV consumption	.261*		
Parent-child bonding	.264*		
Step 2		.187*	.010
Parent FV consumption x Parent-child bonding	.110		

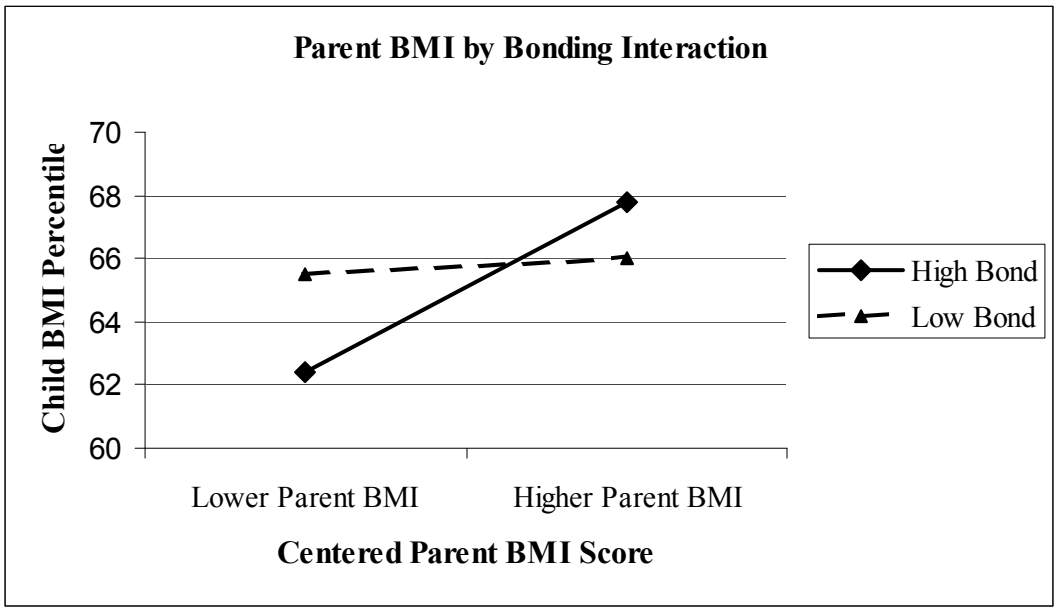
Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Table 3.7 Hierarchical multiple regression analyses testing the relationship between child sugar-sweetened beverage consumption and parental variables

Variable	β	R^2	ΔR^2
Step 1		.009	.009
Parent SSB consumption	.097		
Parent-child bonding	.012		
Step 2		.043	.034
Parent SSB consumption x Parent-child bonding	-.190		

Note: β = standardized regression coefficient; R^2 = multiple correlation squared; and ΔR^2 = change in squared multiple correlation. *p < .05

Figure 3.1 Moderation of relationship between parent BMI and daughter's BMI percentile



Chapter 4- A Site-Randomized Controlled Trial for Health Promotion in Girl Scouts: Healthier Troops in a SNAP (Scouting Nutrition & Activity Program)

Abstract

Purpose: This study evaluated the effect of an intervention delivered through Girl Scouts Juniors troops that was designed to create healthful troop meeting environments and foster healthful family mealtimes at home. Methods: Seven Girl Scout troops were randomized to intervention (n = 3, with 34 girls) or standard care control (n = 4, with 42 girls) conditions. Girls ranged in age from 9 to 13 years. Intervention troop leaders were trained to implement policies to promote physical activity and healthful eating opportunities at troop meetings, and to implement a curriculum to promote healthful family meals at home. Results: Intervention troops were successful in providing greater opportunities for healthful eating and physical activity relative to control troops. Intervention troop leaders promoted physical activity and healthful eating in the troop meetings more frequently than control troop leaders. However, the intervention's impact on the home environment and on the weight status and health behaviors of girls and parents was negligible. Conclusions: Implementing policies to provide more healthful environments in Girl Scouts troop meetings appears feasible on a broader scale. However, more work needs to be done to bridge health promotion from institutional settings to the home environment, if lasting behavior change and obesity prevention remain the targeted outcome.

Introduction

In the United States, there has been roughly a three-fold increase in childhood obesity prevalence over the past few decades.[1] According to the most recent data from the National Health and Nutrition Examination Survey,[2] 33.6% of children and adolescents aged 2 to 19 are now overweight or obese (at or above the 85th percentile of relative weight for their age and gender),[3] and 17.1% are obese (at or above the 95th percentile). Obesity in any age group is associated with several negative health outcomes, and particular public health concerns have arisen with regard to children and insulin resistance syndrome, hypertension, dyslipidemia, chronic inflammation, increased blood clotting tendency, endothelial dysfunction, and hyperinsulinemia leading toward type II diabetes.[4]

Influences on overweight and obesity in children

According to an energy balance framework, obesity is only possible when energy intake exceeds energy expenditure over long periods of time. Both sides of the energy balance equation necessarily depend on behaviors that facilitate energy intake and expenditure, including physical activity and food consumption. Beyond the physical and physiological outcomes of obesity, concurrent trends are not encouraging with regard to energy-balance behaviors, which also impact other health outcomes. According to the most recent national data, only 42% of children aged 6-11 and 8% of adolescents aged 12-19 are meeting the recommended guidelines of physical activity.[5] Children have a growing array of sedentary opportunities to fill their time, and opportunities for physical activity may not be as abundant as they once were.[6] In the nutritional realm, the majority of children's and adolescents' dietary intakes of fruits and vegetables do not meet national recommended standards.[7,8] Overall nutritional intake patterns have shifted away from meals with the family toward greater snacking, and from the consumption of food at home toward away-from-home eating.[9] With these changes, U.S. children vastly exceed recommendations for fat and added sugars, while failing to meet guidelines for fruits, grains, and dairy.[10,11]

Fruit and vegetable consumption

The consumption of fruits and vegetables is negatively related to obesity, and researchers and practitioners have often focused on boosting the intake of fruits and vegetables in both clinical obesity treatments, as well as in primary prevention efforts.[12] Among the numerous positive attributes of fruits and vegetables, is the fact that they contain ample amounts of water and fiber, which may promote satiety and reduce overeating.[13] Studies have shown that enhancing availability and accessibility of fruits and vegetables increases consumption by children.[14] Epstein and associates randomly assigned families of overweight parents and their at-risk children to either a fruit and vegetable increase condition or a fat and sugar reduction group.[15] In this study, the fruit and vegetable group not only increased consumption of those foods, but simultaneously reduced consumption of fat and sugar for a double effect. In school-based settings, both Sahota and colleagues[16] and Műller and colleagues[17] were able to modify fruit and vegetable consumption patterns, and the latter study achieved a corresponding indicator of obesity prevention. Interventions designed to boost fruit and vegetable consumption in

children have also been delivered with some effectiveness through scouting programs in prior studies.[18-20]

Sugar-sweetened beverages

Many studies have identified the consumption of soda and similar beverages to be a risk factor for obesity.[21,22] James and colleagues used a randomized controlled trial to demonstrate the effectiveness of an intervention designed to decrease the consumption of "fizzy drinks" in primary school children.[23] The children received an educational program and music designed to teach them the risks to oral health of soda, and to limit their consumption of such drinks, replacing soda with water. This intervention proved successful relative to controls in decreasing fizzy drink consumption and the percentage of overweight and obese children. Recent pilot work by Ebbeling and colleagues has attested to the effectiveness of replacing soda with low-calorie beverages on obesity prevention in adolescents.[24]

Television Viewing

Television may promote childhood obesity through three main avenues of influence: promotion of sedentary behavior, food advertising, and eating while watching television.[25] Gortmaker and coworkers based much of their Planet Health intervention curriculum on the reduction of television watching in 6th and 8th graders.[26] Planet Health achieved success in reducing television viewing, and the frequency of eating with television. However, this intervention was effective for obesity prevention only in girls, and that protective effect was mediated by the decreased television viewing. In a study based on decreasing television viewing in third and fourth graders, Robinson enlisted the aid of parents and an electronic device to restrict the amount of television viewing time.[27] This study achieved success in changing television behavior and preventing obesity for both boys and girls. Interventions designed to limit the amount of children's television viewing, and to eliminate the connection between eating and television viewing may be effective in preventing obesity.

Physical Activity

Increasing physical activity of children may be useful in public health interventions to prevent obesity.[28-30] Some prior research has used scouting programs in attempting to boost physical activity in children.[31,32] Generally, outcomes are often modest for these interventions,

and many have successfully modified physical activity without a concomitant change in body mass index or prevalence of obesity.[33,34] From an energy balance perspective to prevent obesity, and to gain other health benefits opportunities for regular, enjoyable physical activity is a desirable and useful component of obesity-prevention efforts.

Family Meals

As societal eating patterns have shifted along with increases in dual-income families, single-parent families, food marketing, and other factors, children and parents of the 21st century may not be spending as much time eating family meals together at the dinner table as in previous generations.[35] Instead, individuals are likely eating alone or in more casual fashion, often mindlessly snacking while watching television.[36] Eating alone and with the television may be associated with higher speed of eating and greater caloric consumption.[37]

Although it is not consistently defined or measured in extant literature, family meals can be operationalized as having at least one parent and one child dining together at home. Recent studies have illustrated the protective effects of family meals on children and adolescent health outcomes of varying types. Children and adolescents who frequently eat family meals are more likely to eat fruits and vegetables, less likely to consume fried foods, soda, and sweets, and less likely to be overweight or develop eating disorders.[35,38-40] Additionally, those who eat family meals frequently are less prone to psychological problems and delinquency, likely the result of parent-child connectedness fortified through time spent talking at the table.[41] Although most of this evidence for protective effects of family meals is from cross-sectional studies, recent data have now emerged from longitudinal studies, including support for the protective effects of family meals on overweight and obesity in youth.[42,43] Although the family meal appears to be a modifiable determinant of nutritional intake and children's relative weight, few interventions have attempted to increase the frequency, or improve the quality of family meals.[44, 45] Potential barriers to bolstering family meals would include the lack of time and skills needed to prepare the meal.[41]

Settings to Influence Health Behaviors to Prevent Obesity

According to one meta-analytic review many obesity prevention intervention results have not shown great signs of success with regard to preventing obesity.[46] Systematic reviews have been similarly pessimistic on intervention effectiveness.[47] Those interventions with better effect

sizes were ones more likely to be brief, focus on weight control outcomes, and target younger children and adolescents. Other authors have argued for the necessity of including parents,[48] but this approach has been difficult to achieve and has led to limited success.[17] Many of the school-based interventions have failed to engage parents, or to achieve beneficial outcomes with this approach.[33,49]

Most frequently, obesity prevention interventions are delivered in school settings, including a recent focus on after-school programs.[50] In addition, some interventions have been implemented in community centers, churches, and youth clubs. In contrast, most child obesity treatments are clinically based, and adopt an individual or family focus. Researchers have long recognized the importance of parents and the home environment on obesity prevention efforts, but the ability to bridge from institutional settings, such as schools, to parents and the home environment has thus far remained an elusive prospect.

Girl Scouts

The Girl Scouts of the USA is a not-for-profit national organization that is a member of the world association of Girl Guides and Girl Scouts, and is dedicated to building the courage, confidence, and character of girls to make the world a better place (http://www.girlscouts.org, accessed April 18, 2008). Currently, there are about 3.7 million members of the Girl Scouts of the USA, with about one of every six girls being a Girl Scout at some point in her childhood. Over 900,000 adults are members of the organization, most of whom are volunteers. The national organization is broken down into about 300 councils, which are divided into service units, which govern individual troops. Troops are composed of similarly aged cohorts of girls, from kindergartners up to those in high school.

Girl Scouts appears to be a viable channel for health promotion and obesity prevention interventions due to several inherent factors. First, the national organization is committed to promoting the health and wellbeing of girls, and several merit badges exist that reward girls for their efforts to improve knowledge and behavior related to physical activity, nutrition, and healthy living. Second, there is diversity amongst the members of Girl Scouts with regard to socio-economic status, race, and ethnicity. Third, the organization and troop leaders are focused on promoting youth development, and a system of socialization exists wherein the girls are expected to learn new skills, empowered to make changes in their lives, and asked to complete projects designed to demonstrate what they have learned. With these positive attributes, it is not

surprising that several researchers have made use of Girl Scout troops to deliver interventions designed to promote health behaviors.[20,31,32]

Although a broad array of obesity prevention interventions currently exists, there are no published reports of randomized controlled community trials targeting the promotion of healthful family meals. Further, there are an assortment of multi-level interventions based in schools and other institutions attempting to bridge health promotion and obesity prevention effects to the home environment. However, very few of these multi-level interventions have explicitly attempted to impact the home environment by enhancing the skills of children within the institutional environment setting. Therefore, the purpose of this study was to test an intervention designed to modify Girl Scouts troop meeting environments, and to improve the quantity and/or quality of family mealtimes in children's home environments.

Stemming from the purpose, the present paper will report the results of testing the following hypotheses: 1) Troops randomly assigned to the intervention condition will provide more leader promotion and opportunities for physical activity and fruit and vegetable consumption than control condition troops. 2) Children and parents assigned to the intervention condition will significantly increase from time 1 to time 2 in frequency of family meals, parent-child shared physical activity, fruit and vegetable consumption, bonding and family cohesion. 3) Children and parents assigned to the intervention condition will significantly decrease from time 1 to time 2 in relative weight, frequency of eating with television, and hours of television watching.

Methods

Study design

The present study is a small site-randomized controlled trial, with troops being the unit of randomization. The seven troops agreeing to participate completed time 1 assessment within a two-week period in October before randomization. Troops were split into large (n = 4) and small size troops (n = 3), which were then individually randomized to the control or intervention conditions. After attending training for curriculum and policy implementation, intervention troop leaders instituted the intervention at the next scheduled troop meeting. A trained research assistant observed each troop during seven full meetings between time 1 and time 2 assessments

to assess troop meeting environmental variables, including leader health promotion behaviors. Following the seven observations, troops underwent the time 2 assessment during a two-week period in March.

Settings and Participants

Girl Scout Troops- Inclusion criteria for the study were that the troop was an officially registered Girl Scouts Juniors troop, consisting of girls primarily in the 4th and 5th grades. To be officially registered, the troop leaders were required to complete Girl Scout leader training and pass a criminal background check. To be included, the troops also needed to meet at least twice per month, have meeting facilities capable of allowing physical activity and food preparation. Also, troops needed to have initial agreement of leaders and parents for the troop to participate in a research study. Exclusion criteria included troops not primarily composed of Girl Scouts Juniors, not regularly meeting during the study period, or not having leader and parental consensus approval for troop participation.

All registered leaders of Girl Scouts Juniors troops (generally composed of girls in the fourth and fifth grades) within a 45-mile radius of the primary investigator's university were initially contacted via telephone and/or email. The purpose of this initial contact was to inform leaders of the upcoming study, and to determine whether there was sufficient interest on their part to schedule an explanatory meeting. Eleven leaders agreed to meet for additional information on the study, and seven leaders then agreed to participate, and to be randomized to intervention or standard-care control conditions. Four leaders declined participation due to potential interference with previously planned troop activities (n = 3) and an inability to obtain informed approval from parents (n =1) by the study's start date. Participating troops earned a modest stipend for taking part in the study.

Girl Scouts & Parents- Inclusion criteria for the study at the individual level were that girls were attending members of Girl Scouts in one of our included troops. All girls were included in the observational aspects of our study, and those for whom we obtained parental consent were included in the full study. Parents were included if they agreed to complete a questionnaire for each child attending one of the troops. Exclusion criteria included an inability to speak or read

English. Participating families earned a small stipend for returning questionnaires and for allowing anthropometric measurements of the girls.

In the seven Girl Scouts Juniors troops, parental informed consents were obtained for all but one child (n = 76, 100% female). Of parents consenting for their child(ren) to participate (n = 72) a majority also participated by returning questionnaires (n = 68). Troops held meetings in one of three adjacent mid-western towns, which ranged in population from about 4,000 to 50,000. Troop meetings were held either weekly (n = 2) or bi-monthly (n = 5), generally lasting between one and two hours in length. Meetings were held at the Girl Scouts organization's property (n = 4), at a troop leader's home (n = 2), or at a community center (n = 1). Troops ranged in size from six to sixteen girls (mean = 11).

At the start of the study, mean age of participating girls was 10.5 $\pm$ 1.2. There were no significant demographic differences between conditions at time 1 (Table 4.1). About half of the parents reported being college graduates, about one third were lower socio-economic status, and more than three quarters of the girls were white. Maternal parity averaged about two and a half children for this sample, and average parental BMI was 29.0, corresponding to overweight status.

Intervention

Our intervention was based on core components of Social Cognitive Theory,[51] including: Role modeling of peers, troop leaders, and parents; Skill building through active mastery experiences in troop meetings; Enhancement of self-efficacy and proxy efficacy through role playing and active mastery experiences; and the reinforcement of behavior through verbal praise, and the earning of scouting badges. The intervention consisted of three main components: 1) An interactive educational curriculum delivered by troop leaders; 2) Troop meeting policies implemented by troop leaders; and 3) Badge assignments to be completed at home by Girl Scouts, requiring parental assistance. The educational curriculum consisted of eight modules, delivered over the course of about four months. The present curriculum is an expanded version of our previously published work used in summer programs.[45] Each module was formulaic, consisting of a discussion of intervention target behaviors, worksheet for goal setting and self-monitoring, physically active recreation session (including such activities as walking, dancing, yoga, and active games), fruit and vegetable snack recipe preparation, family meal role-playing, clean-up period, and description of the take-home assignment. The modules were designed to

require between 60 and 90 minutes of time to deliver, with flexibility allowed for specified program activities and module order. Troop leaders underwent two hours of training by this study's first author before beginning the intervention. Regular and ongoing email and phone support took place throughout the intervention time period. Monitoring of program compliance was achieved through observer reports and troop leader self-evaluation forms. Troop leaders self-rated the degree of implementation of eight components of each troop meeting. Leaders responded on a three-point scale from zero to two, indicating no implementation, partial implementation, or full implementation for each curricular component.

Target behaviors of the intervention included: 1) Frequent family meals; 2) Parent-child shared physical activity; 3) Elimination of television and other media presence during mealtime; 4) Drinking water instead of soda at mealtime; 5) Including a fruit and vegetable in family mealtime; 6) Practicing good manners during family mealtime; 7) Helping parents prepare family meals and cleaning up afterwards.

Troop meeting policies included: 1) Allowing at least 15 minutes per meeting for physically active recreation; 2) Troop leaders participating in physically active recreation with girls; 3) Provision of a fruit and vegetable snack to be prepared by girls; 4) Troop leaders eating fruit and vegetable snack with girls; 5) Troop leaders verbally promoting physical activity, fruit and vegetable consumption in troop meetings and for home, and verbally promoting family meals at home; and 6) Prohibition of sugar-sweetened beverages, candy, and television watching during meetings.

Badge assignments consisted of various activities designed to engage the girls in one of the target behaviors at or around family mealtime at home. Six existing Girl Scouts Juniors badges were identified as complementary to the intervention, and girls were able to earn these badges based on the completion of specified assignments. In addition, girls could earn a custom program badge for regular attendance at the meetings and for completing a minimum number of take-home assignments, with qualification standards determined by troop leaders.

Outcome Evaluation Procedures

Girls' height and weight assessments were carried out in semi-private settings without shoes or heavy clothing. Height was measured to the nearest millimeter, using a portable stadiometer (Seca Corp, Model #214 Road Rod, Hanover, MD). Weight was measured to the

nearest 0.1 kg with high-precision electronic scales (Seca Corp, Model #770, Hanover, MD). Girls completed identical questionnaires at times 1 and 2, administered according to a standardized script read by the first author. Parents completed a questionnaire at home for each time point, before and after the intervention period.

Process Evaluation Procedures

Objective monitoring at each troop meeting site was performed on seven occasions over the course of the intervention period. At the beginning of each meeting, a research assistant placed an accelerometer on each girl's right hip, using an adjustable elastic belt. The assistant recorded the starting time and the identification number of the accelerometer worn by each girl. Scouts wore the accelerometer for the duration of their attendance at the meeting. During meetings, the research assistant continuously observed aspects of the troop environment and activities, recording observations in a customized logbook. As the troop meeting ended, the research assistant removed all accelerometers and recorded the time. Accelerometers were then taken back to the laboratory for data downloading and storage.

Measures

Body mass index (BMI) was calculated by dividing body weight by height squared. BMI scores were converted to percentiles using the age- and sex-specific LMS parameters from the CDC growth charts.[52] Participants were classified as overweight or obese, respectively, if their BMI equaled or exceeded the age- and sex-specific 85th or 95th percentile.

Girl Survey

Questionnaires assessed: 1) Fruits and vegetable servings typically consumed. Numerous common fruits and vegetables were described and children were informed of how much constituted a serving. Two items (α = .714) assessed typical servings of fruit per day, and typical servings of vegetables per day[53]; 2) Physical activity level. Physical activity was defined as "any play, game, sport, or activity that gets you moving and breathing harder" and discussed with numerous examples. Two items (α = .758) assessed days in the past week, and in a typical week, of being physically active for an accumulated total of at least 60 minutes per day, not counting physical education class[53]; 3) Family meal frequency was assessed with three items

(breakfast, lunch, dinner, α = .768) from the Family Eating and Activity Questionnaire-Revised (FEAQ-R)[54]; 4) Family meal quality was assessed with six items (α = .690) developed for this study based on our target behaviors; 5) Frequency of eating with television was assessed with three items (α = .658) from the FEAQ-R[54]; 6) Television viewing and time spent outside were assessed via two items each (α = .688 & α = .412 respectively) from the SMART questionnaire[55] assessing these behaviors for yesterday and last Saturday; 7) Parent-child shared physical activity was assessed with three similarly worded new items (α = .768) stating "Over the past week, how often have you….been physically active with your mom or dad?…been physically active inside the house with your mom or dad?…been physically active outside the house with your mom or dad?"; 8) Self-management strategies for nutrition and physical activity were assessed with eight items (α = .817) tailored to the present intervention's target behaviors, based on a scale by Dishman and colleagues[56]; 9) Asking and helping efficacy (degree of confidence to ask and help a parent to complete target behaviors) was assessed with eight items (α = .782) based on Social Cognitive Theory and developed for this study; and 10) Family bonding was assessed with seven previously published items (α = .825).[57,58]

Parent Survey

Parents completed a questionnaire at time 1 including: 1) The Parental Authority Questionnaire-Revised,[59] containing 30 items, with three subscales indicating authoritative (democratic) parenting, permissive parenting, and authoritarian (autocratic) parenting; 2) Parenting practices was assessed with six previously published items[60] plus two new items (eight items α = .766) developed to include parental limit-setting; 3) Fruits and vegetable servings typically consumed. Text and pictures informed parents about how much constituted a serving. Two items (α = .722) assessed typical servings of fruit per day, and typical servings of vegetables per day; 4) Physical activity level was assessed with four previously published items from the BRFSS screener[53]; 5) Family meal frequency was assessed with three items (breakfast, lunch, dinner, α = .665) from the FEAQ-R[54]; 6) Frequency of eating with television was assessed with three items (mother, father, child α = .681)[54]; 7) Parent-child shared physical activity was based on a previously published item[61] plus two similarly worded items assessing shared physical activity inside or outside the home as above, α = .847; 8) The family cohesion subscale (16 items) of the FACES II instrument[62]; and 9) Self reported height and weight. At time 2, parents completed a similar questionnaire without the 30 parenting style items.

Accelerometry

Objective assessment of physical activity was obtained using the ActiGraph GT1M accelerometer (Shalimar, FL), employing a 30-second epoch. Raw accelerometer counts were processed through a customized software program for determination of time spent in moderate-to-vigorous (≥ 4 METs), vigorous (≥ 7 METs), moderate (4 -6.99 METs), light (1.5 – 3.99 METs), and sedentary (< 1.5 METs) physical activity levels. The age-specific count thresholds corresponding to these intensity levels were derived from the MET prediction equation developed by Freedson and co-workers,[63] and the appropriate count thresholds were divided by two to accommodate the 30-second epoch length. Invalid wearing time during the meeting period was assessed by counting the number of consecutive zero counts accumulated in strings of 10 minutes or longer. Accelerometer data for the entire meeting period was considered valid if wearing time was equal to or greater than 30 minutes.

Troop Observations

For each meeting's observation, a trained research assistant recorded details of the meeting context on a form called the SNAP Session Form (Appendix A). This session form was patterned off SOPLAY,[64] with observers noting the condition of the physical area for each session. Session was defined as a period of time that the majority of girls were engaged in one activity. Transition to a new session began when 51% or more of the children moved to a new activity. During snack, the research assistant completed the SNAP Snack Observation Form (Appendix B), which noted all foods and drinks accessible to girls and troop leaders, including the number of girls and adults consuming each food product. If food or drink was accessible and consumed at periods outside the snack session, details were also noted on the snack form. Throughout the troop meeting, the research assistant used the SNAP Troop Observation Form (Appendix C) to record the general structure, general content, knowledge content, and leader behavior relevant to promotion of physical activity and healthful eating. Using a portable timing device with vibrating alert (Time Now Inc., Model: Invisible Clock II, Larkspur, CA), the research assistant determined presence or absence of each condition and behavior every 60 seconds, for the duration of the troop meeting. The behavioral and environmental observation system and form were developed according to recommended guidelines for behavioral observation,[65] and largely patterned off of SOFIT methodology.[66] Two research assistants were

carefully trained for the use of all forms and observation techniques, and adequate inter-rater reliability (>90% agreement) was obtained prior to actual data collection.

Reliability estimates- Table 4.1 displays the results of two reliability checks held in the months of October and February for the two research assistants employed for this study. Overall, reliabilities for the troop observation variables were good (percent agreement ranging from 82.5 to 100), with most variables showing high percent agreement (>90). Among the session context variables, there was greater disagreement during the second reliability check regarding physical activity content. Among the leader promotion variables, disagreements existed for both physical activity and healthful eating verbal promotion. Collapsing the three physical activity promotion behaviors and three healthful eating promotion behaviors into two categories (any physical activity promotion, any healthful eating promotion) improved reliability substantially (percent agreement > 90).

Statistical Analysis

SAS 9.1 statistical software package (Cary, NC) was used for mixed-model analyses. SPSS 15.0 (Chicago, IL) was used to compute descriptive statistics and univariate analyses. To assess intervention effects, general linear model (PROC MIXED) analyses were run on difference scores between time 2 and time 1, with girls nested within troop as random effect (to address clustering of girls within troops) and weight status (overweight or not), authoritarian parenting level (median split), socio-economic status (free/reduced or not) as fixed effects. To assess differences in objectively monitored physical activity by condition, general linear model (PROC MIXED) analyses were run on MVPA, with girls nested within troop as random effect, and weight status, socio-economic status, and race/ethnicity as fixed effects. To assess differences between troop meeting environments, descriptive statistics and one-way analyses of variance were run with intervention condition as the independent variable, controlling for the troop site.

Results

Descriptive Information

Table 4.2 displays descriptive data by intervention and control conditions at baseline (time 1). At time 1, there were no significant differences by condition for demographic variables. At time 1, girls in the intervention troops reported significantly higher intakes of

fruits and vegetables, F (1,73) = 8.2, p = .005, but no other variables differed significantly. Among potential mediator or moderator variables, there were no significant differences by condition.

Leader Self Ratings of Intervention Implementation

The three troop leader self-rating averages for each component over the eight modules ranged from 1.52 to 1.86 (with zero indicating no implementation and 2.0 indicating full implementation). Troops differed somewhat in overall level of implementation, F (2, 18) = 21.5, p < .001, with troop overall implementation averages of 1.43, 1.86, and 1.84 (mean = 1.71).

Objective Measures of Implementation

Figures 4.1 and 4.2 display how intervention troops and control troops allocated their meeting time. Table 4.3 displays meeting time spent in physically active content for all seven troops. Intervention troops spent significantly more meeting time engaged in physically active content, compared to control troops, F (1,4276) = 367.9, p < .001. Figure 4.3 displays accelerometer-measured physical activity levels of attending girls for each condition. Girls in intervention troops accumulated significantly more moderate $F(1,5) = 12.8$, $p = .016$, and moderate-to-vigorous physical activity than girls in control troops, $F(1,5) = 10.0$, $p = .025$. Within troop meetings, there were no significant differences in moderate-to-vigorous physical activity by weight status, F(1,400) = 0.45, p = .50, by socio-economic status F(1,400) = 1.86, p = .173, or by race/ethnicity, F(1,400) = 0.01, p = .924. Also, there were no significant interactions between intervention and these categorical variables, F(1,400) = 0.01 to 0.21, p = .648 to .919.

Regarding snack, Table 4.4 lists many examples of the foods observed across conditions. Tables 4.5 and 4.6 display the raw frequencies and actual food exposures respectively for the two study conditions. Food exposures were defined as the number of girls actually eating an individual food product, regardless of amount eaten. Intervention troops provided a snack at 100% of meetings- consistent with the intervention policy, and control troops offered a snack at 71% of meetings. Intervention troops had substantially greater opportunities for consumption of fruits and vegetables and drinking water. Control troops offered candy, cakes and cookies, and sugar-sweetened beverages substantially more often than intervention troops offered these foods.

Table 4.7 illustrates the comparison between intervention troops and control troops in the meeting environment and leader behavior variables. Intervention meetings showed significantly

more: structured time, physical activity-related content, nutrition-related content, family connection content, and greater levels of physical activity promotion, healthful eating promotion. On the other hand, control troop meetings were more likely to have no promotion of physical activity or healthful eating, and also more likely to have leaders discouraging physical activity and healthful eating.

Primary BMI outcome

Table 4.8 displays the difference scores between time 2 and time 1 for both intervention and control conditions. Mixed-model analysis on difference scores revealed there were no significant main intervention effects for child BMI Z-scores, $F(1,5) = 0.42$, $p = .544$; or Parent BMI, $F(1,5) = 1.58$, $p = .264$. This analysis also revealed a significant main effect of socio-economic status on parent BMI, $F(1,35) = 6.74$ $p = .014$. Lower socio-economic status parents increased more than three BMI units from time 1 to time 2.

Child behavioral and psychosocial outcomes

Table 4.8 displays the difference scores between time 2 and time 1 for both intervention and control conditions. Mixed-model analysis on difference scores revealed there were no significant main intervention effects for: Child fruit & vegetable servings, $F(1,5) = 1.54$, $p = .269$; Child physical activity, $F(1,5) = 0.09$, $p = .779$; Child television viewing, $F(1,5) = 0.79$, $p = .416$; Child time spent outside, $F(1,5) = 2.18$, $p = .199$; Family meal quality, $F(1,5) = 0.03$, $p = .865$; Child sugar-sweetened beverage consumption, $F(1,5) = 0.41$, $p = .549$; Child TV-food connections, $F(1,5) = 0.63$, $p = .463$; Family meals, $F(1,5) = 3.24$, $p = .132$. This analysis also revealed a significant main effect of socio-economic status on child physical activity, $F(1,50) = 8.18$, $p = .006$. Lower socio-economic status children decreased in physical activity from time 1 to time 2. Also, there was a significant interaction between child weight status and intervention on time spent playing outside, $F(1,50) = 7.64$, $p = .008$. Non-overweight children in the intervention increased their time spent playing outside from time 1 to time 2.

Parent behavioral and psychosocial outcomes

Table 4.8 displays the difference scores between time 2 and time 1 for both intervention and control conditions. Mixed-model analysis on difference scores revealed there were no significant main intervention effects for: Family cohesion, $F(1,5) = 1.28$, $p = .310$; Parent-child

shared physical activity, F(1,5) = 4.70, p = .082; Parent fruit and vegetable consumption, F(1,5) = 1.94, p = .223; Parent TV-food connection, F(1,5) = 1.55, p = .269; Parent physical activity, F(1,5) = 0.87, p = .393; Parental social support for physical activity, F(1,5) = 2.13, p = .205. This analysis also revealed a significant main effect of socio-economic status on parent fruit and vegetable consumption F(1,50) = 5.51, p = .023. Lower socio-economic status parents increased in fruit and vegetable consumption by two servings from time 1 to time 2. There was a significant main effect of authoritarian parenting style on parent-child shared physical activity F(1,49) = 11.55, p = .001; and on parent physical activity, F(1,46) = 7.47, p = .009. Parents lower in authoritarian parenting level reported higher physical activity and shared physical activity at time 2, compared to time 1.

Aside from the lack of main intervention effects, there were significant interactions between socio-economic status and intervention on parent-child shared physical activity, F(1,49) = 4.53, *p* = .038 and on parent fruit and vegetable consumption. Parents of lower socio-economic status in the control condition reported significant increases of both parent-child shared physical activity and fruit and vegetable consumption across times 1 and 2. Also, there was a significant interaction between child weight status and parent TV-food connection F(1,50) = 6.95, *p* = .011 Parents of overweight girls in the control condition increased in TV-food connection across the two time periods. Finally, there was a significant interaction between attendance level and intervention on parent physical activity, F(1,50) = 5.07, *p* = .029. The parents of girls with irregular attendance increased significantly in physical activity across the two time points.

Discussion

The results of this study confirmed our first hypothesis, that troops randomly assigned to the intervention condition would provide more opportunities for physical activity and fruit and vegetable consumption than control condition troops. The results of this study did not support our second hypothesis that children and parents assigned to the intervention condition would significantly increase from time 1 to time 2 in frequency of family meals, parent-child shared physical activity, fruit and vegetable consumption, bonding and family cohesion. The results of this study also did not support our third hypothesis that children and parents assigned to the

intervention condition would significantly decrease from time 1 to time 2 in relative weight, frequency of eating with television, and hours of television viewing.

The main finding of this study was that the intervention was implemented and resulted in troop leader health promotion behaviors and substantial environmental opportunities for physical activity and healthful eating in the troop meetings, but little to no measured impact on the girls, parents, or home environment. Meetings for the intervention troops offered ample physically active content and fruit and vegetable snacks, while control condition meetings offered very little of either. Objective monitoring of physical activity showed that intervention troops did significantly more moderate-to-vigorous physical activity in meetings than control troops did. It appears that troop leaders delivered the curriculum, promoted physical activity, family meals, and healthful eating, and instituted troop policies in accordance with their training for the study. However, we saw no evidence that the intervention resulted in the hypothesized changes to body mass index, physical activity, family meals, fruit and vegetable consumption, television viewing, or other variables of interest. Although statistical power can be a consideration for a small sample size, we did not identify meaningful trends in the data to suggest potential effects.

These results indicating the lack of overall program effectiveness may mean that the curriculum itself was ineffective, that the troop leaders delivering the curriculum were ineffective, that girls failed to attend to the core messages and active learning opportunities, or that there were toxic components in the intervention, among numerous possibilities. According to a mediating variable framework[67] interventions impact mediating variables, which then act on behaviors and other outcomes. Because the purpose and hypotheses of this study were limited to determining the overall effect of the intervention on the main outcomes, we did not pursue tests of mediation, as this was beyond the scope of the paper. However, further work using a mediation analysis may help to answer the question as to why our intervention was ineffective. That is, either our intervention failed to impact potential mediators of behavior change, or the impacted mediators failed to result in behavior change.

More concretely, it is conceivable that even though the intervention was focused on promoting family meals, the curriculum and its numerous target behaviors resulted in a diffuse message, wherein the concentration of some components may have become too diluted and weak to impact behavior. Another possibility, based on our observers' informal comments, is that the troop leaders did not adequately stress the importance of take-home assignments, and may have

been too lax in offering scouting badges to girls who had not completed assignments according to more rigorous standards. Similarly, it is possible that girls "faked" completion of the assignments and obtained parent signatures for activities not done. However, because Girl Scouts places heavy emphasis on being honest and fair, it is doubtful this was the reason for lack of effect. Alternatively, it may be possible that some girls or parents were resistant to attempting the target behaviors, or had significant barriers to hinder them. Finally, it must be considered that meetings were held only twice per month for only about two hours per time. A few hours of health promotion out of 720 hours in a month may not be a sufficient dose to overcome the countervailing forces of an overwhelmingly obesigenic environment in which many children live.

More than a decade ago, Cullen and coauthors[20] conducted a nutrition education intervention in Girl Scout troops similar in age to the present study and found significant increases in fruit and vegetable consumption among the intervention troop scouts. Those authors suggested that troop positive norms and social support could be created by consistently serving fruits and vegetables at troop meetings, which may lead to increased consumption of fruits and vegetables in scouts. Although we did not assess troop meeting environmental norms, per se, it appears that our intervention policies created a snack norm of having fruits and vegetables, which nearly all the girls ate. Also, the healthful eating promotion efforts of the troop leaders could be considered social support, but we did not assess whether the other girls were supportive of fruit and vegetable consumption. We were unable to detect any positive outcome on overall dietary consumption levels in our intervention troop girls, but better measures combined with a greater focus on fruits and vegetables, and a larger study may have shown more favorable results. Similar to our approach, Baranowski and colleagues[18] also used a customized badge incentive with Boy Scouts, and were able to increase fruit and vegetable consumption in their intervention.

On the physical activity side, although we provided girls with opportunities to be physically active at troop meetings, our data suggest that this infrequent opportunity had no appreciable impact on girls' overall physical activity levels. In a similar vein, Ievers-Landis and colleagues implemented an intervention to increase weight bearing physical activity (and calcium intake) in Girl Scouts, with a goal of primary prevention of osteoporosis.[31] The results

of their study showed no significant differences in physical activity among the two intervention groups and a control group.

With regard to previous interventions focused on family mealtime promotion, our own results failed to achieve the results of two prior studies. Johnson and colleagues.[44] were able to increase self-reported family meals through an intervention delivered through WIC staff, which included promotional materials, group sessions, and staff training. Our previous pilot work with summer programs[45] suggested that our own intervention approach could be effective, but the present study failed to support that notion. Overall, our results bear strong resemblance to those of Sahota and colleagues,[16] in that we were able to make demonstrable changes to the institutional environment, but no real change in either behavior or body mass index. Donnelly and associates[68] also showed substantial improvements to a school environment regarding lunch quality and classroom physical activity, although the desired effects for children's daily physical activity and dietary intake failed to materialize.

The present study held a number of limitations, including a relatively small sample studied over only a five-month period. Under the best possible scenario, it would have been difficult to show a favorable difference in relative weight over such a short period of time. With regard to behavioral outcomes, the time frame was much less a limitation than were our measures. We relied heavily on self-report measures for both parents and children, and some of our measures may have suffered from questionable reliability and validity. Similar studies in the future could be strongly improved with better measures. Along with these limitations, there are some strengths to consider. Our study was among the first to frame family meals in an intervention as a potentially modifiable determinant of child nutrition and weight status, and to test the intervention designed to improve family mealtimes at home. Further, our use of a site-randomized design to test the intervention is a favorable attribute of the study. Although we were unable to impact neither family meals nor weight status, future work can build upon our efforts reported here. Also, the further use of Girl Scouting as a vehicle for the implementation of interventions can be considered a strong suit. Our experience was that the council officers, troops, and leaders were exceedingly accommodating, and their cooperation with the consent and data collection process allowed for excellent reach of our target population within the study. The use of parent-child dyads separately completing questionnaires allowed us to gather relevant

data without proxy reporting and associated bias. Also, our objective measurement of the troop meeting environment, and of child relative weight both strengthened the present study.

Few, if any, interventions delivered under real-world conditions with a primary obesity prevention focus have been successful in impacting parents and the home environment to provide more opportunities for physical activity and healthful eating. Until there is stronger success in impacting parents and the home environment, it is doubtful that the prevalence of childhood obesity will decline. Ideally, children will need to transition from one healthful environment to another throughout the course of the day, from home to school to after-school or club or sport to home again. Presently, there is urgent need for a method to communicate the seriousness of obesity, sedentary lifestyle, and poor dietary habits of children to their parents, and to enlist the support of parents in implementing effective evidence-based interventions.

In summary, our intervention was implemented to a reasonable degree of fidelity, and resulted in leader health promotion behaviors and presence of more healthful opportunities for physical activity and healthful eating at troop meetings, but no apparent impact on the health behaviors or home environments of children and parents. Implementing policies to provide more healthful environments in Girl Scouts troop meetings appears feasible on a broader scale. However, more work needs to be done to bridge health promotion from institutional settings to the home environment, if lasting behavior change and obesity prevention remains the targeted outcome.

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Figures and Tables

Table 4.1 Inter-rater reliability statistics for troop environmental variables (based on 144 observed minutes)

	Percent Agreement	Intra-class correlation	Cohen's Kappa	Significance
Session Context				
Free time or structured activity	100	1.000	1.000	P < .001
General meeting content	95.9	.977	.941	P < .001
PA educational content	88.8	.199	.099	P = .006
Nutrition educational content	98.6	.920	.850	P < .001
Troop Leader Promotion				
PA verbal promotion	82.5	.083	.038	P = .438
PA physical promotion	97.2	.954	.911	P < .001
PA promotion out-of-troop	100	1.000	1.000	P < .001
Any PA promotion	98.6	.980	.960	P < .001
Nutrition verbal promotion	94.4	-.026	-.012	P = .820
Nutrition physical promotion	96.5	.000	**	**
Nutrition promotion out-of-troop	97.2	.746	.588	P < .001
Any nutrition promotion	90.3	.542	.367	P < .001
No nutrition or PA promotion	89.5	.857	.746	P < .001

**Note: Unable to compute due to lack of variability in this observation

Table 4.2 Individual characteristics by troop assignment at Time 1

	Intervention Mean (SD)	Control Mean (SD)
Demographic Variables		
Percent parents are college graduates	56.3	48.7
Percent lower socio-economic status	28.1	35.0
Percent Non-Hispanic Caucasian girls	79.4	75.0
Children per household	2.7 (1.3)	2.4 (0.8)
Parent BMI	28.8 (6.5)	29.2 (7.3)
Girl Age	10.6 (1.1)	10.5 (1.3)
Outcome Variables		
Girl's BMI	20.0 (4.1)	19.0 (2.9)
Family Meals/week (0-21)	13.8 (5.0)	14.3 (6.5)
Shared PA days/week (0-7)	1.3 (1.1)	1.8 (1.8)
Girl Days/week 60min MVPA (0-7)	4.2 (1.8)	4.5 (1.9)
Percent parents meet MVPA standard	46.7	37.1
Girl F&V servings/day (0-8)	5.0 (2.0)	3.7 (1.9)*
Parent F&V Servings/day (0-8)	4.0 (1.5)	3.6 (1.8)
Girl TV watching time scale (0-8)	2.3 (1.6)	3.1 (2.2)
Mediating/Moderating Variables		
Permissive Parenting Scale (10-50)	23.2 (4.1)	23.9 (4.1)
Authoritarian Parenting Scale (10-50)	31.2 (4.1)	32.9 (4.4)
Authoritative Parenting Scale (10-50)	38.7 (3.4)	38.6 (3.7)
Social Support for PA scale (0-7)	3.70 (2.1)	3.21 (1.8)
Family Cohesion Scale (15-80)	65.7 (4.7)	66.0 (6.1)
Parent Monitoring Scale (0-4)	2.8 (0.6)	2.7 (0.7)
Parent Limit/Promotion Scale (0-4)	3.0 (0.6)	2.8 (0.5)
Child Self Regulation Scale (0-4)	2.4 (0.8)	2.0 (0.8)
Child Asking Efficacy Scale (0-2)	1.7 (0.3)	1.3 (0.5)
Child Helping Efficacy Scale (0-2)	1.8 (0.4)	1.6 (0.5)

*Note: significant difference between intervention & control, $p < .05$

Table 4.3 Troop time in Active Content (4,280 minutes total observed time)

	Total minutes active content	Total observed minutes	Percent of minutes in active content	Mean minutes active content per meeting
Intervention Troops*				
IT1	99	824	12.0	14.1
IT2	131	562	23.3	18.7
IT3	175	566	30.9	25.0
Control Troops				
CT1	0	394	0	0
CT2	8	585	1.4	1.1
CT3	30	742	4.0	4.3
CT4	10	607	1.6	1.4

*intervention troops > control troops, $F(1,4276) = 367.9$, $p < .001$

Table 4.4 Examples of foods accessible during girl scouts troop meetings by food type

Fruits and Vegetables

All fruits (including juices): fruit salad, apples, banana, orange, pineapple, raisins, strawberries

Fruit juices: coconut juice, cranberry juice, apple juice, lemon juice, grape juice, orange juice

Vegetables (including juices): carrots, salsa, marinara sauce, celery, cauliflower, cucumber

Vegetable juices: V-8 juice, V-8 Fusion light

Drinks

Drinking water: plain water, water with splashes of fruit juice

Sugar-sweetened beverages: Hawaiian punch, sweetened tea, Coke, lemonade, Gatorade

Other drinks: unsweetened tea, skim milk, 1% milk, whole milk, diet Pepsi, club soda

Other food items

Salty Snacks: tortilla chips, buttered popcorn, Cheez-it crackers, PB pretzels, Chex mix, crackers

Dairy products (including milk): queso, cream cheese, whole milk, 1% milk, veggie dip, yogurt

Candy: mini Reese's PB cups, mini candy bars, chocolate syrup, sugar-coated fennel seeds, M&M's

Cakes and cookies: GS cookies, cupcakes, brownies, chocolate chip cookies, white cake

Breads: wheat thins, bagels, bread bowl, yeast bread

Meat, nuts, legumes: Li'l Smokies, pepperoni pizza, trail mix, peanut butter

Condiments: vinegar and oil salad dressing

Table 4.5 Raw frequency count of observed food accessibility in troop meetings by condition (41 troop meeting observations)

	Intervention Troops (21 observations)	Control Troops (20 observations)
Fruits and Vegetables		
All fruits (including juices)	53	17
Fruit juices	14	9
Vegetables (including juices)	33	6
Vegetable juices	2	0
Drinks		
Drinking water	12	0
Sugar-sweetened beverages	2	9
Other drinks	2	3
Other food items		
Salty Snacks	6	8
Dairy products (including milk)	13	7
Candy	1	13
Cakes and cookies	2	23
Breads	2	7
Meat, nuts, legumes	6	10
Condiments	4	0

Table 4.6 Actual food exposures[ǂ] in troop meetings by condition (442 total exposures)

	Intervention Troops (179 exposures)	Control Troops (263 exposures)
Fruits and Vegetables		
Fruits (including juices)	359	68
Fruit juices	94	39
Vegetables (including juices)	225	30
Vegetable juices	11	0
Drinks		
Drinking water	89	0
Sugar-sweetened beverages	2	48
Other drinks	19	13
Other food items		
Salty Snacks	47	51
Dairy products (including milk)	93	51
Candy	6	72
Cakes and cookies	10	182
Breads	18	42
Meat, nuts, legumes	48	60
Condiments	30	0

[ǂ]Note: accumulated number of girls eating food type in 41 troop observations

Table 4.7 Troop environment and troop leader behavior by condition

	Intervention Troops	Control Troops	F (1,4267)	Significance
Percent meeting time structured	97	90	43.6	P < .001
Percent Physical Activity Content	6	0	50.5	P < .001
Percent Nutritional Content	12	0	101.9	P < .001
Percent Family Connection Content	3	0	60.9	P < .001
Percent Any PA promotion	19	0	130.7	P < .001
Percent Any HE Promotion	17	1	175.7	P < .001
Percent No promotion	65	99	409.2	P < .001
Percent Any PA discouragement	0.2	0.6	4.8	P = .002
Percent Any HE discouragement	0	0.3	9.8	P < .001

Table 4.8 Main outcomes from time 1 to time 2 by condition

	Time 1	Time 2	ΔScore	Significance
Intervention Troops				
BMI z-score	0.57	0.55	-0.02	p = .615
Parent BMI	29.1	29.5	0.4	p = .274
Girl family meal frequency	11.6	10.9	-0.7	p = .455
Parent-child shared PA	2.8	2.3	-0.5	p = .144
Girl F&V servings/day	5.0	4.9	-0.1	p = .603
Girl TV viewing	2.3	1.9	-0.4	p = .375
Girl eating with TV	1.1	0.8	-0.3	p = .280
Family cohesion	64.4	64.6	0.2	p = .286
Parent-child bonding	3.3	3.4	0.1	p = .652
Control Troops				
BMI z-score	0.38	0.36	-0.02	p = .729
Parent BMI	30.0	30.4	0.4	p = .094
Girl family meal frequency	8.8	8.7	-0.1	p = .961
Parent-child shared PA	1.8	1.9	0.1	p = .243
Girl F&V servings/day	3.7	3.7	0	p = .318
Girl TV viewing	3.2	3.1	-0.1	p = .714
Girl eating with TV	1.1	1.1	0	p = .973
Family cohesion	60.1	65.0	4.9	p = .063
Parent-child bonding	2.9	3.0	0.1	p = .569

Figure 4.1 Percentage of troop meeting time spent in each general content area by control troops

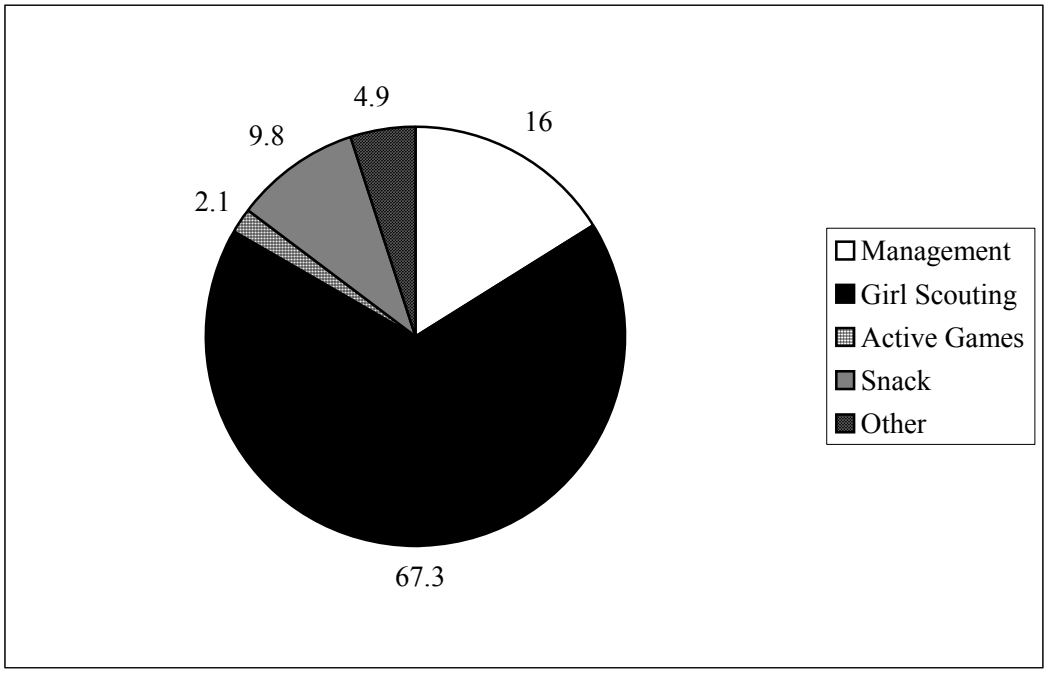


Figure 4.2 Percentage of troop meeting time spent in each general content area by intervention troops

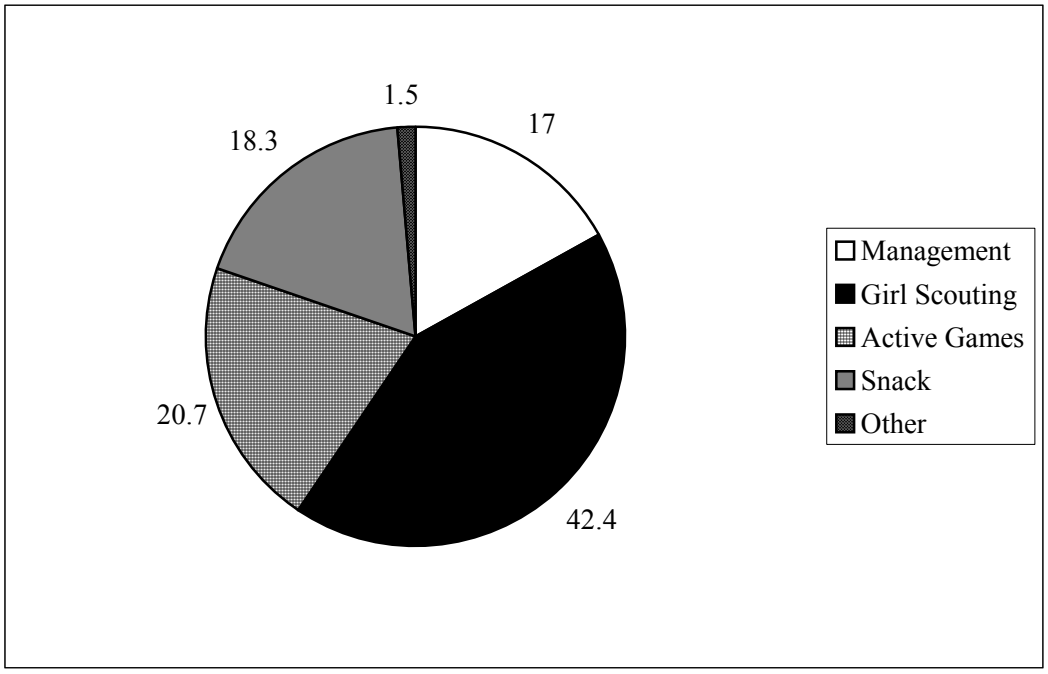
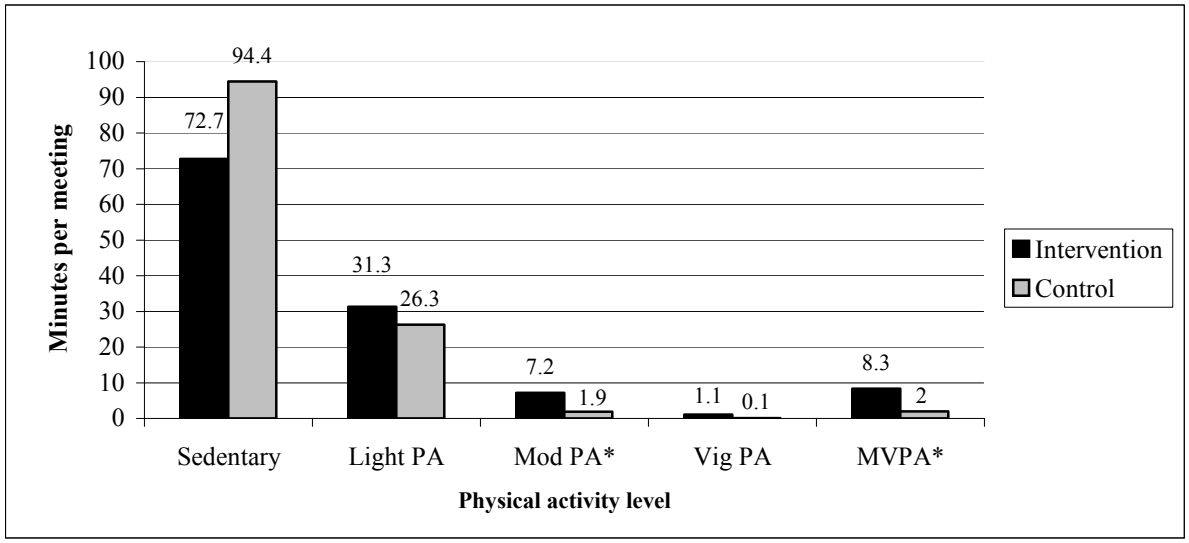


Figure 4.3 Mean minutes of physical activity per troop meeting at various intensity levels by condition



*Significant difference by condition, $F(1,5) > 10.0$, $p < .025$

Appendix A - SNAP Session Form

SESSION FORM DATE: ________________________ TROOP: __________________ OBSERVER:____________________

START/END TIME	LOCATION (Room)	CONDITION U	 S	 O	 E	SESSION (Select One)	ACTIVITY (Name of Primary Activity)
__ __: __ __ __ __: __ __		N Y	N Y	N Y	.N Y	□ Opening/closing/troop business □ Non-Active Recreation □ Active Recreation □ Snack □ Girl Scout Curricular Activity □ Other _______________	____________________________ Staff N= Girls N=
__ __: __ __ __ __: __ __		N Y	N Y	N Y	.N Y	□ Opening/closing/troop business □ Non-Active Recreation □ Active Recreation □ Snack □ Girl Scout Curricular Activity □ Other _______________	____________________________ Staff N= Girls N=
__ __: __ __ __ __: __ __		N Y	N Y	N Y	.N Y	□ Opening/closing/troop business □ Non-Active Recreation □ Active Recreation □ Snack □ Girl Scout Curricular Activity □ Other _______________	____________________________ Staff N= Girls N=
__ __: __ __ __ __: __ __		N Y	N Y	N Y	.N Y	□ Opening/closing/troop business □ Non-Active Recreation □ Active Recreation □ Snack □ Girl Scout Curricular Activity □ Other _______________	____________________________ Staff N= Girls N=
__ __: __ __ __ __: __ __		N Y	N Y	N Y	.N Y	□ Opening/closing/troop business □ Non-Active Recreation □ Active Recreation □ Snack □ Girl Scout Curricular Activity □ Other _______________	____________________________ Staff N= Girls N=

Start & End Time = Using the timer provided, write down when each session starts and ends. A session starts when at least 50% of the group are engaged in an activity. There may be transition periods between sessions, with time lost to management, travel, or other reasons.

Location = Describe the room or area. For example, main room, gymnasium, outside, playground, kitchen, etc.

Condition…
U= Useable: Area is useable for physical activity (not excessively wet, muddy, dusty, windy).

S= Supervised: Area is supervised by designated personnel (troop leader and/or assistant). Personnel must be in or adjacent to that specific area but does not have to be instructing, officiating, or organizing activities.

O= Organized: Organized physical activity such as a game, warm-up, cool-down where the personnel control the activity.

E= Equipped: Equipment is provided for the activity if necessary- do not count permanent equipment such as jungle gyms

Session = Classify the type of session according to categories listed. If none fit well, use other and describe it.
□ Opening/closing/troop business = This includes taking attendance, collecting forms, discussing future activities, as well as girl scout troop rituals at the beginning or end of meetings- such as pledges, songs, etc.
□ Non-Active Recreation = This includes games and activities done for fun or diversion, without much physical activity. Examples are playing music, boardgames, word games, charades, checkers, chess, and computers.
□ Active Recreation = This includes physically active games, dancing, fitness, or sports activities.
□ Snack = receiving and eating food. If actual food preparation is done by girls, do not include that time in snack session.
□ Girl Scout Curricular Activity = Doing activities toward badges, from a curricular book, or activities clearly arising from girl scouts programs or traditions.
□ Other _____ Arts and crafts, special events, guest speaker, etc.

Activity = Written description of what activity occupies at least 50% of the children in the observation period. For example, if the children are playing soccer, the word "soccer" will be written in the space.

Appendix B - SNAP Snack Form

SNAP Snack Observation Form

Date:_____Troop:_____OBSERVER:_____

Girls required to have snack? (check one) □ Yes □ No

Provision of snack (check one)

□ Each girl brought snack herself
□ Troop provided snack for girls
□ Girl/parent brought snack for all girls
□ Other (Describe)

# of girls_____ # of girls eating snack _____
 # staff women _____ # staff men _____
 # staff eating snack with the girls_____
 # girls eating second snack _____

Foods and drinks present at snack (include all accessible to girls & staff)

Snack Item (Description)	Quantity Served (#, oz, cups)	Serving size (#, oz, cups)	Total Calories per serving, if known	Number of girls eating this snack item

Continue on back if necessary

Appendix C - SNAP Session Form

DATE: _____ TROOP: _____ LEADER: _____

OBSERVER:_____ LOCATION: _____START TIME:_____ STOP TIME:_____

NUMBER OF GIRLS: _____ SNAP Curriculum Used? YES NO OTHER SOURCE: _____

Interval	Session Context			Leader Promotion		
	Structure*	General Content*	Knowledge Content	PA	Nutrition	None
1	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
2	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
3	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
4	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
5	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
6	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
7	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
8	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
9	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
10	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
11	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
12	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
13	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
14	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
15	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
16	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
17	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
18	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
19	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
20	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
21	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
22	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
23	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
24	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
25	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
26	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
27	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
28	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
29	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
30	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
31	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
32	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
33	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
34	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
35	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
36	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
37	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
38	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
39	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
40	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
41	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N
42	F S	M GS Ag Sn O	PA Nu FC	VPI PPI PO	VNI PNI NO	N

CODE SUMMARY

Phase 1. **Session context level** decision. What is the context of the session? How is time allocated for the class as a whole (at least 51% of the students)?

General structure- *momentary time sample (circle one only)
(F) Freetime, freeplay- no defined task from leader(s)
(S) Structured activity- there is a defined task from leader(s)

General content- *momentary time sample (circle one only)
(**M**) Management, Transition, Break- Opening & closing rituals, time spent cleaning up from one activity or other time between activities
(**GS**) Girl Scouting- Content related to specific Girl Scout programs, activities, upcoming events
(Ag) Physically active games, exercise, dancing, fitness activity, etc.
(Sn) Snack- girls have received food and are eating
(O) Other- Not management, Girl Scouting, Active session, or Snack

Knowledge content- presence/absence in past minute (circle one or more only if educational information presented)
(**PA**) Physical Activity, Sedentary behavior- educational information is being conveyed to girls on the benefits of physical activity (PA) or risks of sedentary behavior (SED), what things girls can do to be physically active or reduce SED, how to do PA, how to get support for PA, how to plan for PA, etc.
(**Nu)** Nutrition, Foods, Family Meal- educational information is being conveyed to girls on nutrition, foods, or family meals (Nu), including benefits of Nu or risks of poor diet, what things girls can do to eat better, prepare foods, or improve family meals, how to get support for good nutrition, how to plan for Nu, etc.
(**FC**) Family Connection- educational information is being conveyed to girls on activities that families can enjoy together to build bonds within the family. This may include benefits of FC, or risks of activities that may detract from FC. This would include the FC benefits of family meals & shared physical activity or similar, not nutritional or physical benefits.

Phase 2. **Leader(s) promotion** decision.
What is the leader doing? Observe presence or absence of promotion/discouragement in past minute

Physical Activity (Draw line through for discouraging physical activity, encouraging to be sedentary)
(**VPI**) Verbal promotion of PA in troop meeting- encouragement, praise, instruction for PA
(PPI) Physical promotion of PA in troop meeting-
role modeling, offering opportunities, other ways to get girls more physically active
(PO) Promotes PA, shared PA, or reduction of sedentary behavior outside of troop meeting

Nutrition (Draw line through for discouraging good nutrition, encouraging poor dietary habits)
(**VNI**) Verbal promotion of healthful eating, fruit/veg, water consumption in troop meeting
(PNI) Physical promotion of healthful eating, fruit/veg, water in troop meeting- role modeling, offering opportunities, things to get children to improve nutrition
(NO) Promotes healthful eating, family meals, fruit/vegetable, water consumption outside of troop meeting

No promotion
(N) No promotion