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Effects of childcare on parents' attitudes and behaviors in shaping their child's food habits

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Effects of childcare on parents' attitudes and behaviors in shaping their child's food habits

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Dedication

To Larry. I could not have done it without you.

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I would like to acknowledge my advisor Dr. Margaret Briley for her support, flexibility, persistence, and unwavering enthusiasm. I also would like to thank my husband, Larry, for supporting me in so many ways. And to my mom and Valerie, thank you for lending me an ear and giving me words of encouragement.

Effects of childcare on parents' attitudes and behaviors in shaping their child's food habits

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The purpose of this study was to determine whether parents of children who attend childcare centers have different attitudes and behaviors toward shaping their child's eating habits than parents of children who stay at home, and whether these attitudes and behaviors affect their child's dietary intake and weight. Fifty parents of 3- to 5-year-old children who attended childcare centers and fifty parents of 3- to 5-year-old children who stayed at home in Central Texas participated in the study. Parents completed questionnaires designed to measure the factors they considered when choosing food for their child, and their perceived influence on, satisfaction with, responsibility for, and control over their child's eating habits. After receiving training and measuring utensils, parents completed 3-day dietary records for their child. A researcher recorded the children's food intake when they were at the childcare center. Children's height and weight were measured, and body mass index was plotted on the CDC BMI-for-age growth charts (2000). Twelve percent of childcare children were obese compared to 2 percent of stay-at-home children ($p<0.05$). Children in childcare consumed more energy, vegetables, fat, saturated fat, and sweetened beverages than stay-at-home children ($p<0.05$), mostly due to consumption at the center. Both groups met requirements for all food groups and nutrients except grains, vegetables, and vitamin E. Their diets were too high in fat, contributing 32 percent of total energy. There was no evidence that parents of children in childcare felt less responsible for, less influential on, more satisfied with, or exerted less control over their child’s diet than stay-at-home parents. Parents of childcare children believed that they and the childcare center shared responsibility for their child’s nutrition. They felt that time was a more important factor in choosing food for their child than did stay-at-home parents. Parents who perceived lack of time to be an obstacle had children who consumed less energy, iron, and fat during the evening hours. Parents of overweight children felt more influential on and were more satisfied with their child’s diets than parents of normal weight children. No other parental attitudes were predictive of children’s food intake or weight status.

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Chapter 1: General Introduction

Despite well established national guidelines for nutrition in the United States, preschool children's diets are less than optimal. Ongoing national surveys of children's diets have found them to contain excess fat and saturated fat and to be lacking in important nutrients such as vitamin E, iron, calcium, folate, and zinc [1-3]. Furthermore, 99 percent of preschool children do not meet all of the recommendations from the United States Department of Agriculture's Food Guide Pyramid [2, 4, 5]. Poor nutrition during childhood is not without consequence. Currently over 20 percent of children are at risk for obesity, while nearly 11 percent are clinically obese [6]. Childhood obesity is the major risk factor for adult obesity and is associated with increased risk for heart disease and early onset of non-insulin dependent diabetes mellitus [7-12]. For these reasons, it is particularly important that children receive proper nutrition.

Eating habits are established at an early age. Research has shown that infants experience flavors before birth, and that early experience with flavors influences their food preferences later [13-15]. Children's preferences for particular foods increase as their exposure to those foods increases [16, 17]. Parents influence their child's diet in a variety of ways. They buy groceries, choose which restaurants to frequent, serve as role models, and directly control their child's eating habits by restricting access to certain foods and by encouraging their child to eat more food or more quickly [18-24]. The most important role that parents play is probably the role of "gatekeeper" controlling the types of food available to the child.

As more mothers have entered the workforce, many children are relying on childcare centers to provide them with good nutrition. Currently, over 6 million toddlers and 7 million preschool children attend some type of childcare center, making nutrition in childcare an important area of research [25, 26]. Unfortunately, studies of nutrition in childcare have not yielded positive results. Research has repeatedly shown that children in childcare are not consuming enough energy, iron, niacin, zinc, vegetables, and grains to meet recommendations and are consuming too much total fat and saturated fat [27-31]. Other studies also have found childcare centers to be lacking in vitamin E and calcium [28, 32-35]. Because of the inadequacy of childcare center menus, it is important that children have healthy diets while at home. Children could conceivably meet dietary recommendations if their diets at home compensated for their diets during childcare.

Research by Briley, *et al,* found that children consumed enough food at home and at the childcare center to met their needs for energy, vitamin A, vitamin C, niacin, riboflavin, thiamin, calcium, fruit, dairy products, and meat [29]. Diets were still lacking in iron, zinc, vegetables and grains. Children also consumed too many fats and sweets at home, prompting the authors to describe the children's diet as an "upside down Food Guide Pyramid." From their research, Briley, *et al,* concluded that parents might have been relying on childcare centers to provide good nutrition to their children, freeing them to feed their children less healthful food in the evenings.

Other researchers also have suggested that childcare has a negative impact on parents' attitudes about nutrition and consequently their child's food intake at home [36, 37]. Wright and Radcliffe found that many parents felt themselves and childcare centers to be equally responsible for providing good nutrition to their child and teaching their child about nutrition [36]. Campbell and Sanjur found that the more satisfied mothers were with the meals at their child's childcare center, the worse the child's diet was at home [37]. This body of research led to the research question addressed in the present study: Does childcare have an effect on parents' attitudes and behaviors in shaping children's food habits, and do these attitudes and behaviors correlate with children's food intake and weight? The hypothesis was that parents of children who attend childcare would feel more satisfied with, less influential on, less responsible for, and exert less control over their child's eating habits than parents of children who stayed at home. This would in turn result in less healthful eating habits during the evening and a greater rate of obesity in children who attend childcare.

Chapter 2: Review of Literature

INTRODUCTION

This chapter is a review of current literature relevant to the topic of study divided into four sections. Section I describes the current status of child nutrition including information about dietary recommendations for preschool children and actual food intake by preschool children. The food intake data is divided into segments regarding macronutrient, vitamin and mineral, and food group intake. Section II is comprised of studies about childhood obesity and includes studies regarding the definition, prevalence, epidemiology, causes, outcomes, and treatments of childhood obesity. Section III discusses the role of parents in shaping the eating habits of young children and includes research on how parents influence food preferences and intake by children, and how parental attitudes and child-feeding strategies relate to child nutrition. The final section, section IV, discusses the role of childcare centers in child nutrition including information regarding licensing and standards set for childcare centers, the quality of childcare center menus, the actual food intake by children in childcare, the role of the caregiver in child nutrition, and the influence of childcare on parental attitudes.

SECTION I: CURRENT STATUS OF CHILD NUTRITION

Introduction

Good nutrition plays a vital role in the health and development of children. For this reason, much research has been devoted to the development of dietary recommendations for young children. Ongoing national surveys and research studies have contributed to the knowledge of how children's diets compare to the recommendations for macronutrients, vitamins, minerals, and food groups. These studies have highlighted the positive aspects of child nutrition today as well as the areas which need improvement.

Dietary Recommendations for Young Children

The efforts of several government agencies and research institutions have resulted in comprehensive recommendations to meet the dietary needs of young children. The Food Guide Pyramid for young children and the Dietary Reference Intakes (DRI) specifically address the needs of this population. The Dietary Guidelines for Americans 2000 are general guidelines and goals for all Americans, including preschool children.

The Food Guide Pyramid for Young Children was developed by the United States Department of Agriculture (USDA) Center for Nutrition Policy and Promotion and patterned after the original Food Guide Pyramid released in 1992[5, 38]. The artwork and language were changed to be more appealing to young children and their caregivers, and the foods shown on the Food Guide Pyramid for Young Children are common to children[5]. The names of the food groups have been shortened to one word each, and only one number is listed for each recommended serving instead of a range. For example, the Food Guide Pyramid for Young Children recommends 6 servings of grains rather than 6-11 servings of bread, cereal, rice, and pasta. It also recommends two servings of fruit, three servings of vegetables, two servings of meat, and two servings of milk, and encourages children to eat less fat and sweets. Serving sizes for four- to six-year-olds are listed with instructions that two- to-three-year-olds be given approximately 2/3 of those amounts. The only exception is milk. It is recommended that all children aged two to six consume two eight ounce glasses of milk or the equivalent each day.

The recommendations given by the Food Guide Pyramid for Young Children came from actual consumption patterns of children in national surveys [5]. USDA researchers calculated the amount of each type of food needed to provide adequate nutrients each day. Versions of the pyramid were evaluated by parents and caregivers via focus groups, and revisions were made based on their recommendations[5] .

Unlike the Food Guide Pyramid, the Dietary Reference Intakes (DRI), published jointly by the National Academy of Science's (NAS) Food and Nutrition Board and Health Canada, give recommendations of the amounts of individual nutrients that should be consumed daily [39]. Two of the populations included in the recommendations are children ages one to three, and children ages four to six. The DRI include four major types of values: the Estimated Average Requirement (EAR), which indicates an amount that meets 50 percent of the healthy population’s needs; the Recommended Dietary Allowance (RDA), which indicates an amount that meets 97 percent of healthy population’s needs; the Tolerable Upper Intake Level (UL), the maximum level of a nutrient that can be consumed each day without adverse consequences; and the Adequate Intake (AI), a value that is estimated when there is not enough data to determine an RDA. The DRI’s replace the formerly used RDA’s. The first RDA’s were published in 1941, and the last RDA’s were published in 1989. While the original RDA’s represented amounts needed to prevent clinically observable deficiencies, the new DRIs represent amounts needed to reduce risk of future diseases. The DRI’s also establish safe upper limits of intake. As of the 2001 report from the National Academy of Sciences, DRI’s for macronutrients, electrolytes, and water had not been established. When a DRI has not been established for a nutrient, the 1989 RDA is used instead.

While the Food Guide Pyramid for Young Children and the Dietary Reference Intakes specifically address the needs of young children, The Dietary Guidelines for Americans, published jointly by the Department of Health and Human Services (DHHS) and USDA, give recommendations for the American population as a whole [40]. They are general recommendations for food choices and health behaviors aimed at preventing disease, and include maintenance of a healthy weight, physical activity, consumption of plant-based foods, food safety, moderate intake of sugar, fat, sodium, and alcohol, and adherence to the Food Guide Pyramid. Initially published in 1980, the Dietary Guidelines are revised and published every five years in adherence to federal law [41].

Monitoring the diets of young children: National Surveys

In order to determine whether Americans are meeting current nutritional guidelines, ongoing information about their dietary habits is needed. This has led to the creation of two large scale nutritional surveys: the National Health and Nutrition Examination Survey (NHANES), and the Continuing Survey of Food Intakes by Individuals (CSFII).

NHANES is a joint project of USDA and DHHS administered by the Centers for Disease Control and Prevention (CDCP) National Center for Health Statistics. NHANES includes data on diet, nutritional status, health outcomes, and demographics, and monitors changes in this data over time [3]. There have been three completed surveys: NHANES I (1971-1974), NHANES II (1976-1980), and NHANES III (1988-1994). As of March 1999, NHANES became ongoing with data releases every two years. The most recent data was released in January 2002, but as of September 2002, there were no published papers reporting the results of food intake by young children in the latest NHANES. For the purpose of this review, NHANES III will be regarded as the most recent data.

NHANES III included 40,000 subjects for which one-day 24-hour recalls of food intake were obtained [42]. These recalls included information about portion sizes, brand names, ingredients, and preparation methods for all foods eaten on the previous day from midnight to midnight. Health examinations included blood screenings performed at a Mobile Examination Center. The population surveyed included non-Hispanic whites, non-Hispanic blacks, and Mexican-Americans. Individuals aged 2-5 years were over-sampled in order to get more reliable data on their food consumption. Their 24-hour recalls were reported by proxy, usually by a parent.

The Continuing Survey of Food Intakes by Individuals (CSFII), a project of USDA, has been used to collect data on the dietary habits of Americans since 1985. To date, three surveys have been completed: CSFII 1985-1986, CSFII 1989-1991, and CSFII 1994-1996, 1998 [2]. The dietary information collected included two days of dietary records and one day of 24-hour recall for a demographically representative population. From this information, CSFII estimated nutrient intakes as well as average servings per day of foods from the Food Guide Pyramid. Beginning in January 2002, NHANES and CSFII were combined into one survey entitled National Food and Nutrition Survey [42] The purpose was to link the advantages of the 2-day dietary records used by CSFII with the health status information provided by NHANES.

The Framingham's Children's Study, though not a national survey, is another major source of information about preschool children's diets. The Framingham Children's Study is an ongoing longitudinal study of children in Framingham, Massachusetts. The data reported here was collected by Singer, *et al*, and represents 77 non-Hispanic white three and four-year-old children [43]. Four sets of three-day diet records provided the dietary information analyzed by Singer and colleagues.

Energy, Protein and Fat Intakes

According to the national surveys and the Framingham Children's study, energy intake in preschoolers has not changed significantly since 1971 (Table 1). An analysis of CSFII (1989-1991) by Subar, *et al* found that the major sources of energy in preschool children's diets were milk (15.4 percent of kcal), bread (8.7 percent), cakes, cookies, and quick breads (5.8 percent), and ready-to-eat cereals (5.3 percent) [44]. Preschool children are consuming close to recommended amounts of energy. The intake for three- to five-year-olds ranged from 1466 to 1676 kcal compared to the RDAs of 1300 and 1800 kcal for three- and four-year-olds, respectively. The CSFII (1994-1996, 1998) found that three- to five-year-olds are consuming an average of 103 percent of the RDA for energy [2]. Furthermore, 44.6 percent met 100 percent of the 1989 RDA for energy. The median intakes reported in NHANES III, Phase I (1988-1991) for non-Hispanic white children were 83% of the RDA. Non-Hispanic black children and Mexican-American children consumed a median of 89 and 82 percent of the RDA, respectively [1].

Table 1: Comparison of macronutrient intakes reported by national surveys and Framingham children's study

Macronutrient	**RDA** Age 2-3/4-6	**NHANES I**[a] 1971-1974	**NHANES II**[b] 1976-1980	**NHANES III**[c] 1988-1991	**NHANES III**[d] 1988-1994	**CSFII**[e] 1989-1991	**CSFII**[f] 1994-1996, 1998	**Framingham**[g] 1995
Energy (kcal)	1300/1800	1676	1569	1591	1553	1466	1658	1528
% energy from fat	30	36	36	32.9	32.8	33.3	32.7	33.0
% energy from SFA	10	13.7	13.0	-----	12.4	-----	12.3	12.4
SFA (g)		26	23	23	-----	22	22.6	21
% energy from MUFA	10	-----	-----	-----	12.2	-----	12.3	11.7
MUFA (g)		25	22	22	-----	22	22.7	19.9
% energy from PUFA	10	-----	-----	-----	5.9	-----	5.6	5.3
PUFA (g)		6	8	10	-----	9	10.4	19.9
Cholesterol (mg)	<300	290	245	194	193	201	197	192
Protein (g)	16/24	61	56	57	-----	55	58.3	52.8
Carbohydrate (g)	----	209	200	215	-----	192	227.3	-----
Fiber (g)	Age + 5g	-----	-----	-----	-----	-----	11.4	-----

[abc] Ages 3-5 [1]
[d] Ages 2-5 [45]
[e] Ages 3-5 [4]
[f] Ages 3-5 [2]
[g] Ages 3-4 [43]

There is some question as to how accurately the national surveys assess energy intake in children as well as the appropriateness of the current RDAs for energy. The NHANES use 24-hour recall to estimate intake, while the CSFII use a combination of 24-hour recall and 2 day dietary intakes. Twenty-four hour recalls and diet records have been validated for use in estimating mean energy intakes in large groups of children [46, 47]. However, the validation studies of the 24-hour recall included between ten and fourteen days of recall [46, 48]. The study of diet records included seven days of diet records, not just two days [47]. It is not known how accurate large scale surveys are in estimating energy intake in children, though underreporting has been found in studies of energy intake in adults [49].

Recent research has suggested that the RDA for energy may be set too high. Goran, *et al* reviewed several studies in which total energy expenditure in young children was measured by doubly-labeled water [50]. Goran's group concluded that the current recommendations for energy may be as much as 25 percent higher than the actual energy needs of preschool children. A study of energy expenditure in thirty four- to six-year-old children by Goran, Carpenter, and Poehlman found that the average daily energy requirement for these children was 1379 kcal per day [51]. This is considerably lower than the recommended 1800 kcal per day for this age group. For this reason, caution must be taken before assuming that children who are not meeting the RDA for energy are not consuming enough energy to meet their needs.

Preschool children appear to be consuming more than enough protein. In fact, the mean intakes reported by the national surveys and the Framingham Children's Study are more than twice the RDA for protein (Table 1). Fat intake as a proportion of total energy is also higher in young children than is recommended. The American Academy of Pediatrics (AAP) recommends that 20 to 30 percent of total energy come from fat [52]. According to the national surveys, fat intake among 2-5 year olds is around 33 percent (Table 1). According to the CSFII (1994-1996, 1998), only 33 percent of 2- to 5-year-olds had a fat intake below 30 percent of their energy intake [2]. Percentage of calorie from fat has declined since the 1970's from about 36 percent to the current 33 percent. The primary source of fat reported in CSFII (1989-1991) was milk, which provided an average of 19% of the fat in their diets [44]. Other major sources included beef (7.5 percent), margarine (7.7 percent), cheese (7.1 percent), cakes, cookies, and quick breads (6.5 percent), nuts and seeds (5.1 percent), and hot dogs (4.3 percent).

Contribution of saturated fat to the diets of young children exceeds recommendations. Saturated fat provides approximately 12 percent of their total energy intake (Table 1). The AAP recommends that no more than 10 percent of energy come from saturated fat [52]. According to CSFII (1994-1996, 1998), only 22.6 percent of children aged 3 to 5 had saturated fat intakes less than 10 percent of total kilocalories [2]. The major sources of saturated fat in the diets of young children reported by CSFII 1989-1991 were milk (29.8 percent), cheese (11.3 percent), beef (7.2 percent), margarine (5.3 percent), cakes cookies, and quick breads (4.9 percent), and hot dogs (4.4 percent.). The proportions of energy from monounsaturated fat and polyunsaturated fat are approximately 10 percent and 6 percent, respectively (Table 1). According to the American Heart Association, each of these types of fat should represent 10 percent of total energy intake. Young children appear to be meeting AAP's recommendations of no more than 300 mg of cholesterol per day [52]. The mean intake of cholesterol is approximately 200 mg (Table 1). Primary sources of cholesterol reported by CSFII 1989-1991 were eggs, milk, beef, poultry, and cheese [44].

Vitamin and Mineral Intakes

According to the national surveys, the mean intakes of vitamin A, thiamin, riboflavin, niacin, folate, vitamin B_6, vitamin B_{12}, vitamin C, iron, calcium, phosphorus, and potassium by preschool children are well above the RDA/AI (Tables 2 and 3). The only survey including vitamin E intake was the CSFII, 1994-1996, 1998. The mean value, 5.9 mg per day, was close to the recommendations of 6 mg for children 1-3 years and 7 mg for children 4-8 years[2, 39]. Information regarding intakes of vitamin K, pantothenic acid, magnesium, selenium, and zinc was not available from the national surveys.

Two other studies of vitamin and mineral intakes in preschool children have found different results [53, 54]. Zive and colleagues studied the vitamin and mineral intakes of 351 Anglo-American and Mexican-American preschoolers from low- to middle-income families based on data from the Study of Children's Activity and Nutrition (SCAN), a longitudinal study of the diet and physical activity habits of Mexican-Americans and Anglo-Americans [53]. Data was collected every six months starting when the children were four years old and

Table 2: Mean daily vitamin intakes of young children 1971-1998

Vitamin	**RDA/AI** Age:3/4,5	**NHANES I**[a] **1971-1974**	**NHANES II**[b] **1976-1980**	**NHANES III**[c] **1988-1991**	**CSFII**[d] **1989-1991**	**CSFII**[e] **1994-1996, 1998**	**Zive, *et al***[f] **1998-1991**		**Skinner, *et al*** [g] **1999**	
							Mex-Am	Anglo-Am	Boys	Girls
Vitamin A (IU)	300/400RE	3753 (IU)	4008 (IU)	4275 (IU)	4122 (IU)	832 (RE)	981.2	862.3	635	761
Thiamin (mg)	.5/.6	.97	1.14	1.38	1.27	1.41	----	----	1.21	1.12
Riboflavin (mg)	.5/.6	1.70	1.74	1.81	1.76	1.90	1.6	1.6	1.61	1.56
Niacin (mg)	6/8	11.20	13.92	16.00	15.5	16.9	11.5	13.8	13.5	13.9
Vitamin B_6 (mg)	.5/.6	----	----	----	----	1.54	1.2	1.3	1.20	1.23
Vitamin B_{12} (μg)	.9/1.2	----	----	----	----	3.70	5.4	3.9	3.3	3.2
Vitamin C (mg)	15/25	82	100	102	85	103	77.0	83.7	90	81
Vitamin D (μg)	5/5	----	----	----	----	----	----	----	4.6	4.7
Vitamin E (mg)	6/7	----	----	----	----	5.9	----	-----	3.2	3.7
Vitamin K (μg)		----	----	----	----	----	----	----	----	----
Folate (μg)	150/200	----	----	----	----	275	188.3	208.0	166	168
Pantothenic Acid (mg)	2/3	----	----	----	----	----	----	----	3.2	3.1

[a bc] Ages 3-5 [1]
[d] Ages 3-5 [4]
[e] Ages 3-5 [2]
[f] Ages 4-7 [53]
[g] Age 4 [54]

Table 3: Mean daily mineral intakes of young children 1971-1998

Mineral	**RDA/AI** Age:3/4,5	**NHANES I**[a] **1971-1974**	**NHANES II**[b] **1976-1980**	**NHANES III**[c] **1988-1991**	**CSFII**[d] **1989-1991**	**CSFII**[e] **1994-1996, 1998**	**Zive, *et al***[f] **1998-1991**		**Skinner, *et al*** [g] **1999**	
							Mex-Am	Anglo-Am	Boys	Girls
Calcium (mg)	500/800	921	818	855	836	865	809	817.6	848	756
Iron (mg)	7/10	8.58	10.02	11.86	11.1	13.2	8.9	9.8	9.8	10.4
Magnesium (mg)	80/130	----	----	----	----	----	184.7	200.3	195	170
Phosphorus (mg)	460/500	1100	1164	1054	1033	1085	944.4	990.4	1071	1036
Potassium (mg)	1400	1937	1912	2040	1951	2157	----	----	2057	1947
Selenium (μg)	20/30	----	----	-----	----	----	65.0	71.2	----	----
Sodium (mg)	----	1925	2173	2531	2376	2602	----	----	2097	1974
Zinc (mg)	----	----	----	----	----	----	7.8	7.6	7.4	7.3

[a bc] Ages 3-5 [1]
[d] Ages 3-5 [4]
[e] Ages 3-5 [2]
[f] Ages 4-7 [53]
[g] Age 4 [54]

ending when they were seven (1988-1991). A researcher observed lunch and dinner meals on one day each six-month period and interviewed the mother regarding breakfast and snacks that day. Again, the mean intakes were greater than the RDA/AI for vitamin A, thiamin, riboflavin, niacin, vitamin C, folate, vitamin B6, vitamin B12, calcium and phosphorus. However, the mean intake of iron was less than those reported in the national surveys and less than the RDA. The intake of folate by Mexican-American children was also lower than the RDA. Additional nutrients included in this study were magnesium, selenium, and zinc. The mean intakes of these were above their respective RDAs.

Another longitudinal study of vitamin and mineral intakes of preschool children was conducted by Skinner and colleagues [54] In this study, 72 white children from middle and upper income families were followed from the age of two until the age of five. Dietary information consisted of two days of diet records and one 24-hour recall completed by the mother. This was repeated six times throughout the course of the study. Tables 2 and 3 list the results at the 48-month interview. As in the previously mentioned studies, the means for vitamin A, the B vitamins, calcium, and phosphorus were above their respective RDAs. Iron intake by boys was below the RDA, while iron intake for girls was above the RDA. The mean intake of folate was below that reported by Zive, *et al*. This may be related to differences in ages of the subjects. The study by Zive and colleagues averaged intakes from four- to seven-year-olds. The results from Skinner's study are from four-year-olds only. The vitamin E intakes reported by Skinner for four-year-old boys and girls were 3.2 mg and 3.7 mg, respectively. This is lower than those reported for three- to five-year-olds in the CSFII, 1994-1996, 1998. One possibility for this difference is the limitation of Skinner's study to non-Hispanic white children from families of middle to upper socioeconomic status. A final difference in the study by Skinner was the inclusion of Vitamin D intake. Vitamin D intakes of 4.6 and 4.7 micrograms for boys and girls were below the RDA of 5 micrograms.

While comparing mean intakes of macronutrients, vitamins, and minerals to their RDA/AI values is useful for evaluating groups of children, it does not provide information about individual children are meeting recommendations. For this reason, data about nutrient intake is often summarized as the percentage of children meeting the RDA/AI for each individual nutrient. Table 4 lists the percentage of children meeting 100 percent of the RDA for energy, protein, and selected vitamins and minerals according to CSFII 1994-1996, 1998. As shown in the table, only 44.6 percent of the children met the RDA for energy, while 99.1 percent met the RDA for protein. At least 75 percent of children met the requirements for the major vitamins and minerals with the exception of vitamin E (25.2%), iron (65.7%), calcium (48.4%), and zinc (30.4%) [2].

Food Guide Pyramid Compliance

The 1989-1991 and 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) reported mean intake of servings from the Food Guide Pyramid for boys and girls ages 2-5 [2, 4]. Table 5 lists these results in addition to those of two other studies that evaluated intakes of individual food groups. Table 6 lists the percentage of children who met the pyramid recommendations for each

Table 4: Percentage of 3- to 5-year-old children meeting 100% RDA for selected nutrients[a]

Nutrient	Percent
Macronutrients	
Energy	44.6
Protein	99.1
Vitamins	
Vitamin A	75.5
Thiamin	89.6
Riboflavin	93.1
Niacin	82.7
Vitamin C	79.6
Vitamin E	25.2
Folate	99.1
Vitamin B_6	75.7
Vitamin B_{12}	98.0
Minerals	
Iron	65.7
Calcium	48.4
Magnesium	95.2
Phosphorus	75.3
Selenium	99.2
Zinc	30.4

[a] CSFII 1994-1996, 1998 [2]

Table 5: Mean number of servings per day from the Food Guide Pyramid by children ages 2 to 5.

Food Group	Rec. # of servings	CSFII[a]		CSFII[b]		Dennison, *et al*[c]		Fisher, *et al*[d]
		Aged 2-5		Aged 2-5		Age 2	Age 5	Age 5
		Boys	Girls	Boys	Girls	Boys and Girls		Girls
Grains	6	5.2	4.9	6.6	6.0	-----	-----	-----
Vegetables	3	1.9	2.0	2.1	2.0	.58	.80	1.5
Fruit	2	1.5	1.5	2.5	2.2	1.8	1.5	1.5
Meat	2	2.8	2.7	3.0	2.8	-----	-----	-----
Dairy	2	2.0	1.9	2.0	1.9	-----	-----	-----

[a]1989-1991 [4]
[b]1994-1996,1998 [2]
[c]1998 [55]
[d]2002 [56]

Table 6: Percentage of 2- to 5-year-old children meeting pyramid recommendations

Food Group	CSFII[a]		CSFII[b]	
	Boys	Girls	Boys	Girls
Grains	39	34	53	43
Vegetables	26	28	24	21
Fruit	41	41	50	46
Meat	25	25	22	18
Dairy	65	63	45	41

[a]1989-1991[4]
[b]1994-1996, 1998 [2]

food group according to CSFII. Data on overall compliance with the food guide pyramid indicates less than 1 percent of children ate the recommended numbers of servings for all the food groups in the CSFII, 1989-1991, and only 5 percent met the recommendations for four or more groups [4]. Overall compliance with the food guide pyramid was not reported in CSFII 1994-1996, 1998.

Grains

The Food Guide Pyramid recommends consumption of six servings of grains daily. The mean intake for boys and girls rose in the 1994-1996, 1998 CSFII, from 5.2 to 6.6 for boys and from 4.9 to 6.0 for girls (Table 5) [2, 4]. The percentage of children consuming the recommended six servings increased significantly as well. In the 1994-1996, 1998 survey, 53 percent of boys and 43 percent of girls were reported to be meeting or exceeding the pyramid recommendation (Table 6) [2]. No children were reported to consume less than one serving of grains each day in the later survey [2].

Fruits and Vegetables

Because of mounting evidence that fruits and vegetables may reduce the risk of cancer and cardiovascular disease [57, 58] nutrition experts have recommended that children adhere to the recommendations made by the Food Guide Pyramid [49]. According to the Food Guide Pyramid, young children should eat at least 2 servings of fruit and 3 servings of vegetables daily [5]. The national surveys and smaller studies have found that children are not eating the recommended amounts of fruits and vegetables [2, 4, 55, 56].

Differences in the population characteristics, geographical locations, and data collection methods make it difficult to compare results from the national surveys and the smaller studies. Dennison, *et al* studied fruit and vegetable consumption by two groups of children, 116 two-year-olds, and 107 five-year-olds [55]. Ninety-seven percent of the population was non-Hispanic white, and middle to low income. Mean dietary intakes were determined using seven days of dietary records for each child. Fisher and colleagues studied fruit and vegetable consumption of 197 five-year-old girls and their parents, 99 percent of whom were non-Hispanic white [56]. Dietary information was collected via three 24-hour recalls, including one weekend day. Table 5 lists the findings of the studies by Dennison, *et al* and Fisher, *et al*, and the fruit and vegetable intakes reported in the 1989-1991 and 1994-1996, 1998 Continuing Survey of Food Intakes by Individuals. The number of reported servings of vegetables and fruit rose in the second survey. Vegetable servings for girls remained the same. Fruit servings increased by 50 percent for boys and 35 percent for girls. Mean number of servings of fruit for boys and girls exceeded Food Guide Pyramid recommendations. This is in contrast to the results of the other studies. Dennison reported an average consumption of 1.8 servings of fruit for two-year-old boys and girls, and 1.5 for five-year-old boys and girls. Fisher reported an average of 1.5 servings per day for 5 year-old-girls.

Vegetable servings for both boys and girls were consistently lower than recommended three servings in all of the studies. The two CSFII surveys reported a range from 1.9 to 2.1, while Fisher's study reported a mean of 1.5 servings. Dennison, *et al* reported means that were much lower: 0.58 for 2-year-olds and 0.80 for 5-year-olds. The major difference in methodology between this study and the others was the use of seven days of dietary records instead of 24-hour recalls. Dennison's group also found that when potatoes and legumes were excluded from vegetable counts, the mean daily vegetable consumption decreased to 0.40 and 0.60 servings for 2- and 5-year-olds, respectively.

Table 6 shows the percentages of children meeting pyramid recommendations for each food group according to the 1989-1991 and 1994-1996, 1998 CSFII [2, 4, 59]. Only 24 percent of boys and 21 percent of girls consumed at least three servings of vegetables each day. More boys than girls ate two servings of fruit, 50 percent versus 46 percent. Not only were many children not meeting the recommendations, a significant percentage consumed less than one serving per day from individual food groups.

For instance, 27 percent of boys and 29 percent of girls ate less than 1 serving of fruit per day, while 24 percent of boys and 23 percent of girls ate less than 1 serving of vegetables per day according to the CSFII, 1994-1996, 1998 [2].

Dairy

Dairy products are an important dietary source of calcium in young children, and daily servings of dairy have been shown to be associated with lower body fat in preschoolers [59]. The Food Guide Pyramid for Young Children recommends daily consumption of two eight ounce glasses of milk or the equivalent for children ages 1 to 6 [5]. As shown in Table 5, the two CSFII surveys report the mean servings of dairy to be 2.0 and 1.9 for boys and girls respectively [2, 4]. The percentage of children meeting the recommendations increased considerably in the second survey for both boys and girls (Table 6). In the later survey, 45 percent of boys and 41 percent of girls reported two servings of dairy per day compared to 34.8 percent and 25.3 percent in the 1989-1991 survey. Seventeen percent of boys and 19 percent of girls consumed less than one serving of dairy per day according to the later survey [2].

The lack of dairy products in the diets of preschool children could have serious long-term consequences. A longitudinal study of children from birth to five years of age by Lee and colleagues found that calcium intake during the first five years of life was significantly correlated with bone mineral content at the age of five ($r = 0.235$, $p= 0.0133$) [60]. A study by Black, *et al* found that children who avoided drinking milk had low calcium intakes (420 ± 228 mg/day for girls and 478 ± 234 mg/day for boys) compared to milk drinkers (1179 ± 332 mg/day for girls and 1278 ± 618 mg/ day for boys) [61]. They also had lower total body bone mineral content (705 g for girls and 834 g for boys) than children who drank milk ($p = 0.01$) Teegarden, *et al*, found that milk intake during childhood was correlated with milk intake during adolescence ($r=0.66$) and young adulthood ($r=0.26$) [62]. Furthermore, milk intake during adolescence was positively correlated with total body bone mineral content ($r = 0.21$) during adolescence.

Meat/Meat Alternates

Various types of meat and eggs are significant sources of energy, protein, fat, saturated fat, cholesterol, iron and zinc in the diets of young children [44]. The Food Guide Pyramid recommends two servings of 1-2 oz of meat or the equivalent for children ages 1 to 3 and two servings of 2-3 oz for children ages 4 to 6 [5]. As shown in Table 4, the mean intake of meat servings increased slightly in the later CSFII, from 2.8 to 3.0 for boys, and from 2.7 to 2.8 for girls. However, only 25 percent of children aged two to five consumed the recommended servings of meat in the first CSFII, while 22 percent of boys and 18 percent of girls consumed sufficient servings in the second CSFII (Table 6). Low consumption of meat and meat alternates may be contributing to the lack of iron and zinc in the diets of preschool children. Furthermore, fried chicken and hot dogs, the meat products most commonly eaten by preschool children, are not good sources of iron and zinc [54].

Sources of Nutrients

Munoz, *et al* evaluated the eating patterns of two- to five-year-old children who participated in the 1989-1991 CSFII [4]. The two most common patterns of food group compliance were as follows: 1) only met recommendations for dairy; 2) failed to meet recommendations for any food group. The previously described study by Skinner, *et al* evaluated the foods most commonly eaten once per day by white preschool children between the ages of two and five [54]. The ten most common foods in order were fruit drinks, carbonated beverages, milk, French fries, apple juice, margarine, American cheese, pasta, candy, and catsup.

The only vegetables commonly eaten were French fries, green beans, and corn. The most common main dishes were pizza, fried chicken, and hot dogs. This is similar to the food preference patterns found by Skinner, *et al* in their longitudinal study of the food preferences of young children [63]. They found that the foods children liked most were breads, pasta, desserts, snack foods, and meats from fast food restaurants. Furthermore, 17 of the 24 foods disliked most were vegetables. Many different types of legumes and vegetables had never been tasted by the children. Skinner and colleagues also found that the children's food preferences were very stable over the course of the eight-year study.

Summary

Despite the specific guidelines outlined by the Food Guide Pyramid and the Dietary Reference Intakes, preschool children may not be consuming sufficient quantities of several nutrients and food groups. Their diets appear to be adequate for energy, particularly when compared to daily energy expenditure rather than the RDA for energy. However, too great a proportion of their kilocalories are being provided by fat and saturated fat. The most problematic vitamins and minerals are vitamin E, iron, calcium, folate, and zinc. Over 99 percent of preschool children do not meet recommendations for every food group prescribed by the Food Guide Pyramid for Young Children. All of the food groups are lacking, though the dairy requirements tend to be met more often than the recommendations for the other groups. Analysis of commonly eaten foods and food preferences suggests that preschool children are eating foods that are energy-rich but not nutrient-dense [54, 63].

SECTION II: OUTCOMES OF POOR NUTRITION-OBESITY

Introduction

The studies reviewed in the previous section demonstrated that preschool children are not meeting all of the current dietary recommendations. In particular, there seems to be a lack of important nutrients such as iron and zinc, and an excess of fat in their diets [2, 4, 43, 45, 54]. The question remains as to how these nutritional inadequacies are affecting the health and well-being of young children in America. In the past, researchers were concerned about malnutrition and underweight in children. However, according to the CDC Pediatric Nutrition Surveillance Surveys (PedNSS), the fact that only 1.9 percent of children are underweight is an indication that severe malnutrition is not a public health problem at this time [64]. This does not mean that no children in America experience hunger. According to the 2000 census, 0.8 percent of children under the age of 18 lived in households which reported experiencing moderate to severe hunger (roughly ½ million children) [65]. Eighteen percent of households with children reported food insecurity without hunger. Food insecure households have difficulty obtaining food and often use emergency food services, but do not report experiencing hunger. While true hunger might not be a public health problem at this time, food insecurity is associated with childhood obesity, a serious threat to the health of young children in America. [66]. Childhood obesity is a complex disease with numerous causes, few effective treatments, and serious consequences.

Prevalence and Risk Factors of Overweight in Children

Obesity in children is usually determined by comparing body mass index (BMI), a ratio of weight to height (kilogram/meter^2), to standardized BMI-for-age growth charts published by the CDC. Body Mass Index is used because it was found to be reasonable predictor of adiposity in children [67, 68]. According to the CDC, a child whose BMI is between the 85th and 95th percentile is at risk for obesity and a child whose BMI meets or exceeds the 95th percentile is obese [69]. This is a conservative definition. The international definition for obesity proposed by Cole, *et al*, and adopted by the World Health Organization defines overweight as a BMI≥ 85th percentile and obesity as a BMI≥ 95th percentile [70]. The growth curves drawn by Cole colleagues were based on nearly 200,000 children worldwide. These curves passed through the adult cut-off points for overweight (BMI≥ 25) and obesity (BMI≥30). A committee of pediatric experts convened by the Department of Health and Human Services recommended that all children with a BMI equal to or greater than the 95th percentile and children with a BMI greater than or equal to the 85th percentile with obesity-related complications be treated [71].

Analysis of data from NHANES 1999-2000 by Ogden, *et al* revealed that 20.6 percent of two- to five-year-olds had BMI≥85th percentile, while 10.4 percent had ≥95th percentile [6]. This increased from the 7.2 percent of children with a BMI ≥95th reported in NHANES III (1988-1994), and the 5.0 percent reported in NHANES II (1976-1980). According the CDC National Center for Health Statistics, obesity among six- to eleven-year-olds was stable in the 1960's and early 1970's (4 percent), rose in the later 1970s (7 percent), and had doubled by the year 2000 (15 percent) [72]

Currently, the greatest rates of obesity in preschool children are in Mexican-American children (11.1 percent) and non-hispanic white children (10.1 percent) [6]. The prevalence of obesity in black preschool children is 8.4 percent [6]. A study of black, white, and Mexican-American schoolchildren in San Antonio, Texas by Park and colleagues found that Mexican-American boys and girls and non-Hispanic black girls were more often overweight than other groups [73]. They also found that the rate of overweight among schoolchildren in San Antonio, Texas was significantly higher than the rates reported in NHANES III. The prevalence of overweight among low-income preschool children in eighteen states was studied by Mei, *et al* using data from the PedNSS [74]. Data from the 1983 PedNSS was compared to data from the 1995 PedNSS. Mei and colleagues found that the rate of overweight (BMI$\geq$85th percentile) among 0- to 5-year-old children increased from 18.6 percent in 1983 to 21.6 percent in 1995, a rate 2 percent greater than that reported by Ogden, *et al* [6]. This could be due to differences in the populations studied. The PedNSS included more black and Hispanic children than did NHANES III. Mei's group found that the prevalence of overweight was significantly higher in Hispanic children than non-Hispanic black children. The rate of overweight in non-Hispanic black children was in turn higher than that of non-Hispanic white children. It is unclear whether low-income children in general are at a greater risk for obesity.

Though certain populations appear to be at greater risk for obesity than others, researchers are debating whether family income is related to overweight in young children. A study of children in France by Locard, *et al*, found no relationship between obesity in five-year-old children and family socioeconomic status [75]. Analysis of NHANES III data by Troiano and Flegal found no relationship between family income and overweight prevalence in young Mexican-American children, non-Hispanic black children, and non-Hispanic white children [76]. The only relationship found was in non-Hispanic white adolescents. In this case, overweight was negatively associated with family income. Similar results were found in the analysis of NHANES III data by Alaimo, *et al* [66]. Both of these studies used the standard definition of overweight as a BMI≥95th percentile. An analysis of NHANES III data by Wang found that children from low-income families were more likely to have a BMI≥85th percentile than children from higher-income families [77].

A longitudinal study of 2918 normal weight children by Strauss and Knight examined the association between the home environment and socioeconomic factors on the development of obesity in children [78]. The children, aged zero to eight years, were followed over a six-year period. All were initially of normal weight-for-height. Strauss and Knight found a significant relationship between socioeconomic status and development of obesity (BMI≥ 95th percentile). Children from low income families were 2.84 times more likely to become obese during the six year period than children from high-income families ($p<0.001$).

Strauss and Knight identified other risk factors associated with the development of obesity in children. Maternal obesity was the most significant predictor of childhood obesity. Children with overweight ($BMI \geq 25$) or obese ($BMI \geq 30$) mothers were 1.5 times and 3.0 times more likely to become overweight, respectively ($p<0.05$, $p<0.001$). Obesity in children was also related to education level of the mother, unemployment of parents, and marital status of the mother. Interestingly, a retrospective study of 854 adults by Whitaker, *et al* found that children with obese parents were more likely to be obese as adults, regardless of whether they had been obese as children. [7]. This may be due largely to genetic rather than environmental factors. A study by Stunkard, *et al,* evaluated the body mass index values of 93 pairs of identical twins reared apart and 154 pairs of identical twins raised together [79]. The correlation between the body mass index values of identical twins was striking for men ($r = 0.70$) and women ($r = 0.66$). The values for twins raised together were not much higher ($r = 0.74$ for men; $r = 0.69$ for women). The authors concluded that childhood environment had little or no influence on body mass index. This finding is difficult to reconcile with the conclusions by Strauss and Knight that income, maternal education, and employment status are associated with childhood obesity [78]. However, Stunkard's group did not evaluate the environments in which the twins were raised. It is possible that even though the twins were raised apart, they lived in the same geographical areas with families of similar ethnicity and socioeconomic status. This would make it impossible to exclude environment as a factor in childhood obesity. Other studies have investigated the environmental causes of childhood overweight such as diet and physical activity.

Dietary Causes of Childhood Overweight

Weight gain in any population is thought to stem from ingestion of more kilocalories than are expended through activities of daily living and exercise. Therefore it would be expected that the rising rate of obesity would be paralleled by either an increase in daily energy intake or decrease in physical activity by preschool children. However, as shown in Table 1 of Section I, mean energy intake by preschool children has not increased since the 1970s. Many of the recent studies that have evaluated the role of energy intake and weight in children have focused on older children and adolescents, with varying conclusions. Gillis and colleagues found that in a group of 181 four- to sixteen-year-olds for which food frequency questionnaires and one day of 24-hour recall were obtained, children who were obese (BMI≥95th percentile) consumed on average 500 (25%) more calories per day, 33 percent more fat, 30 percent more saturated fat, and 25 percent more sugar than did non-obese children of similar age range and socioeconomic status ($p<0.0001$) [80]. The relationship between energy intake and obesity was stronger ($r = 0.367$) than that of fat or sugar intake and obesity. The authors acknowledged that convenience sampling of non-obese children may have resulted in a population with better eating habits than would have been found in a random sample. Also, the cross-sectional nature of this study does not rule out the possibility that obese children eat more simply to maintain their current weight. The authors controlled for activity levels, but did not control for resting energy expenditure.

Some researchers have concluded that diet composition rather than total energy intake may be associated with obesity. A study of three 24-hour recalls from 53 nine- to eleven-year-old children by Gazzaniga and Burns found that obese girls consumed less energy per kilogram of body weight (167 ± 33 kJ/kg) than did non-obese girls (205 ± 46 kJ/kg, $p<0.025$) [81]. Obese boys also consumed less energy per kilogram of body weight (201 ± 33 kJ/kg) than did non-obese boys (230 ± 58 kJ/kg, $p<0.025$). Body fat, as measured by triceps skinfold thickness, was positively associated with intakes of fat ($r = 0.55$, $p<0.0001$) and saturated fat ($r = 0.41$, $p<0.01$) independent of total energy intake. In this case, the authors controlled for both resting energy expenditure and physical activity. Similar results regarding energy and fat intake were found in a study by McGloin, *et al* [82]. McGloin and colleagues compared the nutrient intakes of three groups of five- to eight-year-old children: obese, high-risk, and low-risk. Children were considered at high-risk for obesity if at least one parent was obese (BMI≥30). Analysis of seven days of dietary records found no significant difference in energy intake between the three groups. The obese group consumed an average of 12 grams more fat than the low-risk group ($p<0.05$). Regression analysis showed a relationship between fat intake and body fatness independent of energy intake ($r^2=0.05$, $p=0.02$).

A relationship between fat intake and body fatness independent of energy intake was not found in a longitudinal study conducted by Magarey, *et al* [83].

Magarey and colleagues investigated the relationship between children's dietary intake and their risk for becoming or remaining overweight over time. Subjects included 130 children followed from birth until the age of eleven, and 113 children followed from the age of eleven to the age of fifteen. Dietary intake was calculated from three-day dietary records at ages two, four, and six, and four-day dietary records at ages eight, eleven, thirteen, and fifteen. Anthropometric measurements included triceps skinfold thickness, subscapular skinfold thickness, and BMI. The effect of total energy intake on development of overweight was not calculated because of the natural increase of energy intake that accompanies increasing age. The researchers found that neither carbohydrate intake nor fat intake was related to BMI or triceps skinfold measurements after controlling for energy intake. Conversely, fat intake was independently and positively correlated with subscapular skinfold measurements ($p \leq 0.01$). Carbohydrate intake was negatively associated with subscapular skinfold measurements. The most significant predictors of BMI and body fatness were previous BMI ($p \leq 0.001$) and body fatness ($p \leq 0.01$). Parental adiposity also predicted BMI consistently ($p<0.05$). Unlike McGloin's study of children ages 3-8 years, there was no relationship between fat intake and body fatness independent of energy intake [82]. Magarey, *et al* conceded that a major limitation in their study was failure to control for resting energy expenditure or physical activity. They concluded, however, that current body fat and parental adiposity were greater predictors of overweight in children than dietary intake.

The lack of research focusing specifically on preschool children is concerning because children at different ages are at different risks for overweight. Typically, BMI increases during the first year of life and then decreases until a child is four- to six-years old [84, 85]. The point at which BMI starts to increase again is called "adiposity rebound." The earlier that adiposity rebound occurs, the more likely it is that a child will become an obese adult [86]. Therefore, it is particularly important to understand the factors leading to overweight in preschool children. Three recent studies have focused specifically on the role of diet in the body composition of preschool children.

Carruth and Skinner conducted a longitudinal study of 53 children from the time they were two months old until they were 96 months old [59]. This study investigated the role of diet on body composition. Three-day dietary records were collected on six different occasions for each child. Body fat was determined using a dual energy X-ray absorptiometry (DEXA) scan. The authors reported that body fat in the children was positively related to longitudinal intakes of dietary fat and negatively related to calcium intake, servings of dairy products, and intake of monounsaturated fat ($R^2 = 0.51$, $p<.001$). The authors did not report any association between energy intake and body fat, nor total fat intake and body fat.

Klesges, *et al* also conducted a longitudinal study of the eating habits of preschool children [87]. In this study, the diets and physical activity of 146 children aged three to five were evaluated once a year for three years. Dietary intake was measured with a food frequency questionnaire. Forty percent of the children were overweight (BMI$\geq$75th percentile on the 1977 CDC growth charts).

The researchers found that children's BMI over time was weakly associated with percentage of energy from fat ($r = 0.04$, $p<0.04$), but was not associated with total energy intake.

Atkin and Davies investigated whether diet composition was related to percentage body fat in 77 children aged 1.5 to 5 years [88]. Dietary intake was measured using one set of four-day dietary records. Percentage body fat was calculated by measuring total body water via ^{18}O and body weight. Data analysis did not reveal a relationship between energy intake and body fat nor any macronutrient and body fat. However, analysis of total energy expenditure by way of the doubly-labeled water technique did show that physical activity was significantly and negatively associated with body fat ($r = -8.18$, $p<0.001$). The authors concluded that energy expenditure may have a greater impact on body composition than does diet composition or energy intake.

The studies of macronutrient intake and overweight in children have reported conflicting results. While some researchers have found that obese children consume more fat and kilocalories than normal weight children, others have found no relationship. In particular, the two studies of preschool children did not find any evidence that energy and fat consumption were related to body composition, other than a possible protective role of monounsaturated fats. In an attempt to link the diets of children with childhood obesity, other researchers have focused on the role of fruit juice and other sweetened beverages in the development of overweight in children [89-92].

The Role of Fruit Juice and Sweetened Drinks in Childhood Overweight

Dennison and colleagues studied the relationship between preschool children's intake of fruit juice and obesity [89]. Seven-day dietary records were collected for 168 children aged two or five years. Obesity was defined as BMI≥ 75th percentile on the 1977 CDC growth charts. The mean intakes of 100 percent fruit juice by two-year-olds and five-year-olds were 5.9 and 5.0 fluid ounces, respectively. The mean intakes of other beverages, excluding milk, were 1.9 ounces for two-year-olds and 3.1 ounces for five-year-olds. Milk consumption was not related to fruit juice consumption. Eleven percent of the children consumed at least twelve ounces of juice per day. These children did not have higher total energy intakes than children who drank less juice, but they did have higher energy intakes per kilogram of body weight, 47.1 kcal/kg versus 41.9 kcal/kg ($p<0.05$). The prevalence of overweight was greater among children who consumed more than twelve ounces per day of juice (32%) than among those who consumed less (9%, $p<0.01$).

Skinner, *et al* failed to find the same relationship that Dennison found between fruit juice consumption and overweight [90]. Skinner, *et al's* study of 105 two- to three-year-old children included three days of dietary intake (two diet records, one 24-hour recall) collected twice, four months apart. The collection periods were separated by four months. The authors used the same standards of overweight used by Dennison's group and found intakes of 100 percent juice to be similar to those reported by Dennison, *et al*, but found no relationship between fruit juice intake and overweight. They also did not find an increased prevalence of overweight in children who consumed more than twelve ounces of juice per day ($p=0.51$). They did find, as expected, that these children had higher intakes of potassium ($p=0.03$), vitamin C ($p=0.05$), folate ($p=0.02$), and sugar ($p=0.006$) than children who consumed less juice. As in Dennison's study, juice intake was not associated with milk intake ($p=0.32$), but soft drink consumption was negatively associated with both milk intake ($r = -0.23$, $p=0.008$) and fruit juice intake ($r = -0.28$, $p=0.0001$). This is similar to results of the study by Fisher, *et al* reviewed in Section III [93].

Clearly a definitive relationship between fruit juice intake and obesity in young children has not been established. The American Academy of Pediatrics Committee on Nutrition has called for more research to be conducted on the topic, and in the meantime has recommended that children ages one to six years drink no more than four to six ounces of fruit juice each day [94].

Studies of older children have found an association between consumption of sweetened beverages and overweight. A nineteen-month, longitudinal study of 11-year-old children conducted by Ludwig, *et al* found that for every additional serving of sweetened beverages consumed beyond the baseline amount, BMI increased by 0.24 kg/m^2 [91]. In other words, children who increased their mean daily consumption during the study also increased their BMI. Their odds of becoming overweight increased 1.6 times for each additional serving consumed daily ($p = 0.02$). Baseline intake was also positively associated with weight ($r = 0.18$, $p = 0.02$). The authors speculated that obesity in children might result in excess energy consumption in the form of beverages. An analysis by Harnack and colleagues of soft drink consumption reported in the 1994 CSFII confirmed the finding that children who drink soft drinks have higher mean energy intakes than children who do not [92]. Harnack's group found that 38.9 percent of children aged two to five years drank between 0.1 and 0.89 ounces of soft drinks per day, while 11.7 percent drank at least 9 ounces per day. The mean daily energy intake was 1448 kilocalories for non-consumers, 1483 kilocalories for children who drank between 0.1 and 0.89 ounces per day, and 1704 kilocalories for children who drank more than 9 ounces per day. These differences were statistically significant ($p \leq 0.05$). Also, soft drink consumption was negatively associated with daily milk and fruit juice intake. For example, preschool children who consumed between 0.1 and 0.89 ounces of soft drinks daily were 3.82 times more likely to consume less than 8 ounces of milk each day and 2.57 times more likely to consume less than 4 ounces of fruit juice than were non-consumers.

The results from the studies reviewed above highlight the lack of consensus about the contribution of diet to the development of overweight in young children. It is not clear whether overweight children consume more total energy or fat than normal weight children. It is also not clear whether fruit juice contributes to overweight in young children, though it does appear that soft drinks and other sweetened drinks may contribute to overweight in older children. At the very least, consumption of soft drinks is associated with decreased consumption of milk in young children. Due in part to the lack of support for the theory that overweight children eat more than other children, researchers have begun to investigate the other side of the energy balance equation, physical activity.

The Role of Physical Activity in Childhood Overweight

Physical activity can be difficult to measure in young children. Steinbeck reviewed the currently available methods in 2001 and concluded that there was no one simple, practical, validated method to assess physical activity in children of any age [95]. The methods reviewed included direct observation by a researcher, parental completion of a diary or questionnaire, motion monitoring, heart rate monitoring, and fitness testing.

Eck and colleagues used the direct observation method to evaluate the association between obesity and physical activity in 187 four-year-old children [96]. Children were categorized as "high-risk" for obesity if at least one parent was overweight, and "low-risk" if neither parent was overweight. Diet intake was measured using a food frequency questionnaire, and activity was recorded by a researcher who directly observed the children in their homes after the evening meal. The high-risk group gained slightly more weight during the following year (5.5 lbs) than the low-risk group (4.9 lbs, $p=0.05$). The high-risk group also exhibited slightly more sedentary behavior ($p = 0.07$) and less total activity ($p = 0.06$) than did the low-risk group. A study by Davies, *et al* estimated physical activity in preschool children by calculating basal metabolic rate from body weight and subtracting it from total energy expenditure determined by the doubly labeled water technique [97]. Body fat was calculated using total body water determined by the ^{18}O method. The correlation between body fat percentage and physical activity was very high ($r=0.48$, $p<0.001$).

Several recent longitudinal studies have evaluated the association between physical activity and body fat over time [87, 98, 99]. The previously reviewed longitudinal study by Klesges and colleagues evaluated the diet and physical activity habits of 3- to 5-year-old over a three year period [87]. Physical activity was determined using a physical activity questionnaire completed by both the parents and the child. Aerobic activity and leisure activity were negatively associated with BMI over time ($r = -0.316$, $p = 0.0333$; $r = -0.319$, $p = 0.0867$).

Moore, *et al* followed 97 preschool children enrolled in The Framingham Children's Study until they entered first grade [98]. Physical activity was assessed twice each year with an accelerometer (motion monitor). Children wore the accelerometer for five consecutive days each time. Adiposity was assessed using triceps skinfold measurements. Girls who were more active gained 1.0 mm less fat from baseline to entry into first grade than did inactive girls. Active boys showed a 0.75 mm decrease in their triceps skinfold, while inactive boys showed a 0.25 mm increase in their triceps skinfold measurement. Children with the highest initial body fat combined with inactivity were 5.8 times more likely to gain rather than lose fat during the study than the other children. Children with the lowest initial body fat combined with inactivity were 2.9 times more likely to gain fat during the study. This suggested that not only is inactivity associated with increased body fat in children, children who have higher baseline body fat are at an even greater disadvantage.

Trost, *et al* used an accelerometer to compare the activity levels of obese ($BMI \geq 95^{th}$ percentile) and non-obese children whose average age was 11.4 years

[99]. The accelerometer was worn on a belt around the waist by 187 children for seven consecutive days. The monitor measured minute-by-minute activity counts and the results were tabulated to determine how much time was spent in moderate and vigorous activities. The authors reported that the obese children showed significantly lower total activity counts, 28.3×10^4, compared to non-obese children, 37.7×10^4 ($p = 0.003$). Obese children also participated in fewer sessions of vigorous and moderate activity ($p<0.01$). They concluded that lack of activity may be an important factor in the maintenance of childhood obesity.

There is some evidence that television viewing alone is associated with obesity in children. For this reason, among others, the American Academy of Pediatrics Committee on Public Education recommends that children be limited to no more than one to two hours per day of media time and that children under the age of two years not be allowed to watch television at all [100]. A study of low-income preschool children by Dennison, *et al* looked for a relationship between television watching and overweight [101]. The study population included 2761 one- to four-year-old children whose families participated in the WIC program. Parents answered a survey that included items about television and video viewing habits. Thirty-seven percent of the children were classified as overweight (BMI$\geq$85th percentile), a number substantially higher than the 20.6 reported by Ogden, *et al* in their analysis of NHANES 1999-2000 data [6]. The mean television/video viewing time was 15.0 hours per week in the first year of the study, and 14.5 hours per week in the second year. Non-Hispanic black children watched 17.5 hours per week compared to 15.0 and 12.7 hour per week by

Hispanic and non-Hispanic white children, respectively. Children who had televisions in their bedrooms watched an average of 4.8 more hours of television/videos per day than children who did not have televisions in their bedrooms. After controlling for demographic variables, the amount of time children spent watching television was significantly and positively associated with prevalence of overweight ($r = 0.06$, $p<0.03$). The odds of a child being overweight increased by a factor of 1.06 for each additional hour of television watched.

Reducing television viewing has been introduced as a means for preventing obesity in older children with modest success. Robinson conducted a study to determine if an educational intervention aimed at reducing television viewing could cause weight loss in 192 third and fourth grade students [102]. The education included an eighteen-lesson, six-month classroom curriculum. Children were encouraged to avoid television, videos, and video games for a period of ten days, and to limit themselves to seven hours per week after that. Each household was given an electronic monitor to assist parents in helping children to budget their time. Over the course of the school year, children in the intervention group watched significantly less television (8.86 hours/week) as reported by parents than did children in the control group (14.75 hours/week, $p <0.001$). They also showed 0.45 kg less weight gain ($p = 0.002$) and 1.47 mm less gain in triceps skinfold thickness ($p = 0.002$). The authors concluded that reducing the amount of time spent viewing television, videos, and video game was a promising approach to preventing childhood obesity.

An evaluation of data from NHANES III by Crespo and colleagues also found a relationship between television watching and obesity in children eight to sixteen years old [103]. Children who watched the most television ($\geq$ 4 hours per day) had the highest prevalence of obesity, even after controlling for race, ethnicity, and family income. Furthermore, girls who watched five or more hours of television daily also consumed an average of 175 kilocalories more than girls who watched one hour or less. This suggests that television may be associated with increased energy intake in addition to decreased physical activity.

The studies of diet and physical activity in preschool children indicate that both play a role in the development of overweight. There appears to be more evidence for the role of physical activity, but diet should not be discounted. Several studies found a relationship between diet and obesity [59, 80-86, 89, 91, 92]. It is conceivable that very small increases in energy intake might lead to overweight in small children. Since all of the studies rely on parental report of food intake, it is possible that small differences in energy intake are being masked due to reporting error. Whatever the cause, overweight in children is a serious, growing problem with long-term health and financial costs.

Outcomes of Childhood Obesity

Recent studies have demonstrated that obesity in childhood tracks into adolescence and adulthood [7, 8, 104]. A study of five-year-old Pima Indian children by Salbe and colleagues found that obesity at the age of five was the greatest predictor of obesity five years later ($r = 0.75$, $p = 0.0001$) [104]. According to a retrospective study by Whitaker, *et al*, the longer obesity lasts in childhood, the more likely a child is to become an obese adult [7]. Among obese three- to-five-year-old children with normal weight parents, 24 percent remained obese in young adulthood (21- to 29-years old). Whitaker's group found that 50 percent of children who were obese past the age of six became obese adults. The risk was greatly increased if either parent was overweight. Sixty-two percent of obese three- to five-year-old children with at least one obese parent remained obese in young adulthood. An obese child aged six to nine years was over three times more likely to become an obese adult if the mother was obese. Similar trends were found by Guo and colleagues in their analysis of data from a longitudinal study of 347 subjects from the age of 3 until the age of 39 [8]. The probability of a five-year-old boy at the 95^{th} percentile for BMI becoming an overweight adult was 0.72. The probability for a girl in the 95^{th} percentile was 0.65. Overweight five-year-old boys and girls had a 0.31 and 0.37 probability of becoming obese adults, respectively. The probabilities increased the longer the children remained overweight. For instance, thirteen-year-old children in the 95^{th} percentile for BMI had a 0.91 probability of becoming an overweight adult. These studies demonstrate a strong link between childhood obesity and adult obesity. However, adult obesity and its health risks are not the only consequence of childhood obesity. Obesity is also associated with health problems during childhood.

Childhood obesity is associated with a variety of health problems including cardiovascular risk factors, non-insulin dependent diabetes mellitus (NIDDM), sleep apnea, and gallstones [105]. A longitudinal study by Williams, *et* *al* investigated the relationships between childhood adiposity and blood pressure, serum cholesterol, and lipoprotein ratios in children [9]. They found that increased body fatness was associated with increased blood pressure and low density lipoprotein (LDL) cholesterol in children between the ages of five and eighteen years. Children in the highest percentile for body fat were as 7.0 times more likely to have elevated blood pressure and 3.46 times more likely to have elevated LDL cholesterol. They were almost twice as likely to have elevated levels of total cholesterol. A one-year longitudinal study of five and six-year-old children by Tershakovec, *et al* confirmed the finding that obesity in children is associated with hypertension [10]. The relationship was more significant for girls ($r = 0.30$, $p \leq 0.01$) than boys ($r = 0.27$, $p \leq 0.05$). A study by Dwyer and colleagues of nine-year-old children enrolled in the Child and Adolescent Trial for Cardiovascular Health (CATCH) found that overweight children (BMI$\geq$ 85th percentile) had significantly lower high density lipoprotein (HDL) cholesterol, a protective agent against atherosclerosis ($p<0.01$) [11]. Dwyer's group also found that overweight children had a mean systolic blood pressure of approximately ten points higher than normal weight children ($p<0.05$). These studies taken together suggest that obesity in children is associated with increased risk factors for cardiovascular disease such as hypertension, elevated cholesterol, and high proportion of LDL relative to HDL cholesterol.

Obesity is also associated with NIDDM, or type-2 diabetes, in children. Though once considered to be "adult-onset" diabetes, NIDDM is a rising threat to children. According to the American Diabetes Association, between 8 and 45 percent of newly diagnosed cases of diabetes in children are NIDDM [12]. This wide range is due to the different populations sampled in the studies reviewed by the American Diabetes Association. Native Americans, particularly Pima Indians, have the highest rates. The estimated rate in San Antonio, Texas for white and Hispanic children ages 0 to 17 years is 18 cases per 1000 children [106]. According to the American Diabetes Association, 85 percent of children with NIDDM are overweight or obese [12]. Furthermore, although diabetes is usually diagnosed in children ten years and older, the American Diabetes Association predicts that diabetes will become more prevalent in young children due to early onset of obesity.

The increase of obesity and its related diseases in children has not occurred without economic impact. According to a survey of hospital discharge records by Wang and Dietz, childhood obesity-related hospital costs increased from $35 million in 1979-1981 to $127 million during 1997-1999. This underscores the need for a public health initiative to prevent and treat obesity. Unfortunately, as with adult obesity, childhood obesity is difficult to treat. Treatments that incorporate a family-based approach to weight loss have been moderately successful. An intervention designed by Epstein, *et al* that targeted both the child and the obese parent with diet, exercise, and behavior modification strategies resulted in less weight gain and decreased prevalence of overweight five and ten years later. The experimental group gained 34.0 kg during the ten years compared to the control group which gained 46.6 kg ($p < 0.05$). The experimental group also showed a 7 percent decrease in overweight prevalence

[107]. The intervention designed by Epstein's group was modified and used with severely obese children and their families by Levine, *et al* [108]. Levine's group found the family-based treatment to be moderately successful for short-term weight loss. However, one-third of the study participants dropped out. Of the children who completed the study, mean weight decreased during the treatment period from 80.7 kg to 78.2 kg but increased again during the seven-month follow-up period back to pre-treatment levels. The authors concluded that this approach might be useful in slowing weight gain, but was unsuccessful in causing long-term weight loss.

Summary

The prevalence of overweight has increased over the past three decades. Approximately 20 percent of American children are at risk for overweight (BMI≥85^{th} percentile) while close to 11 percent are overweight (BMI≥95^{th} percentile). Hispanic children, black children, and children with overweight parents are at increased risk for overweight. Obesity in children is thought to be due both to diet and lack of physical activity, although the evidence for physical activity is stronger. Overweight children are at increased risk for developing heart disease and non-insulin dependent diabetes mellitus as well as other health problems such as sleep apnea and gallstones. Family-based diet and exercise interventions have been shown to be moderately successful in treating overweight in children, but more research is needed. Until successful prevention and treatment strategies are found, obesity will likely be a growing problem for America's children.

Section III: The role of parents in child nutrition

Introduction

The studies reviewed in Sections I and II indicate that the diets of preschool children may not be ideal and may be contributing to the development of childhood obesity. In order to help children develop healthy eating habits, one must understand the factors that influence those eating habits. While genetics certainly play a role in child food preferences, appetite, and body composition, it is the complex interaction between genetic predisposition and environment that shape eating behaviors in children. In the very young child, the environment is largely composed of parents, siblings, peers, and possibly childcare providers outside of the home. The means by which parents shape their children's eating habits include control of exposure to flavors and novel foods during gestation, infancy, and early childhood, role-modeling, control over availability and accessibility of foods, the use of food as reward or punishment, and the use of coercive strategies to either increase or decrease consumption of a particular type or quantity of food [13, 15, 16, 18, 19, 21-24, 56, 93, 109-115].

Development of Food Preferences

Human preferences for certain tastes appear to be genetically predetermined. Newborns have been shown to prefer sucrose solutions over water as evidenced by increased consumption of the test solution as the concentration of sucrose increased [116]. The extent of the response to sweetness may vary by the gender and size of the infant. Nesbitt and Gurwitz found that female infants and heavier infants showed increased responsiveness to sweetness when compared to male infants and lighter infants.[117]. By four to six months, infants can distinguish between sweet, sour, bitter and salty [118] Attraction to saltiness and aversion to bitterness and sourness are characteristic of young children [118]. Infants tend to be either indifferent or averse to saltiness at birth but grow to prefer salty foods by the time they are eight months old [119] Preference for salted foods among two-year-olds has been demonstrated [120]. Engen and Gasparian found that toddlers showed less preference for candies laced with bitter compounds than for candies with other flavors[121]. In adults, the physiological basis for the disliking of bitter substances has been hypothesized. Adults with increased density of fungiform papillae show decreased preferences for cruciferous vegetables and bitter beverages[122]. Individuals who are sensitive to 6-n-propylthiouracil also show decreased acceptance of cruciferous vegetables [123]. These studies point to genetic differences in human's ability to taste and hence their differences in acceptance of bitter flavors.

While innate preferences dictate initial reaction to a new food, studies show that repeated exposure to a food increases preference for that food [13-17, 124]. One way that parents contribute to the development of their child's eating habits is by controlling their exposure to different foods. This exposure begins earlier than one might expect. Specialized taste cells begin to form in embryos at 7-8 weeks gestation. Mature taste buds are formed at 13-15 weeks gestation.[109]. Amniotic fluid takes on the odors of the mother's diet, a fact particularly noticeable in mothers who eat spicy, pungent foods [110, 111]. A study by Mennella, Jagnow and Beauchamp of 46 women and their infants demonstrated that infants exposed to carrot juice either in utero during the last trimester of pregnancy or via breast milk preferred cereal mixed with carrot juice over plain cereal upon weaning [13]. Infants who had not been exposed to carrot juice did not prefer the cereal containing carrot juice.

Sullivan and Birch studied whether exposure to a variety of flavors via breast milk would affect food acceptance by infants when first exposed to solid foods. [15]. The thirty-six infants studied were divided into two groups: breast-fed infants and formula-fed infants. They were then given either salted or unsalted versions of peas or green beans. Acceptance was determined by amount of intake and adults' perceptions of the infants' responses. After ten days of exposure to the food, the children doubled their mean intake of both the salted and unsalted vegetables. Breast-fed infants initially had the same levels of intake as formula-fed infants, but increased their intake at a much greater rate during and after the exposure period. The authors hypothesized that this might have been due to the exposure to a variety of flavor experienced by breast-fed infants through human milk. Birch and colleagues then sought to determine the number of exposures needed to increased the acceptance of new foods in infants ages four to seven months [16]. This study of thirty-nine infants found that they doubled their intake of the target foods, peas and bananas, after just one exposure. They also increased their intake of similar foods, other pureed fruits and vegetables, but were not any more likely to accept other novel foods such as beef or fruit and vegetables cut into pieces. This suggests that only one exposure may be necessary to increase food preferences in infants.

The experiences with flavors early infancy may impact flavor preferences later in childhood. Mennella and Beauchamp grouped four- and five-year-old children into three groups based on the type of formula they had consumed as infants: milk-based, soy-based, and protein hydrolysate [14]. The children were asked to taste and smell three differently flavored apple juices and rate them as "good" or "bad." The juices were flavored in such a way as to reflect the tastes of the different formulas. The children were asked to smell or taste protein hydrolysate formula also. Children fed protein hydrolysate formula as infants were more likely to prefer the sour-flavored apple juice while children fed soy formula were more likely to prefer bitter-flavored apple juice. Children fed milk-based formula only liked the plain apple juice. Children in the protein hydrolysate group were the only ones to approve of the odor of the hydrolysate formula. The authors concluded that early exposure to flavors might have long-lasting effect on flavor preferences.

Exposure to flavor during infancy is important, but repeated exposure to new foods can reduce neophobia in preschool children as well. A study by Birch and Marlen in 1982 investigated whether exposure would increase the preference for food that had never been seen before by a group of two-year-old children [17]. The target novel foods included a variety of cheeses and dried fruits. Parents verified that their children were unfamiliar with the foods assigned to them. Each child received different numbers of exposures to five different foods, i.e. twenty exposures to the first food, fifteen exposures to the second food, ten exposures to the third food, et cetera via exposure to two foods each day. Following the exposure period, children were presented with pairs of all the possible combinations of the five foods and were asked to choose the food they liked most. Results consistently showed that the preference for a particular food was directly proportional to the numbers of exposures to that food ($p<0.02$). Another study of preschool children by Birch and colleagues determined that simply looking at a food was not enough to increase preference for the taste of the food [124]. In this study forty-three children with a mean age of 43 months were exposed to seven novel foods by three different methods. Three foods were tasted by the children, three foods were observed and smelled by the children, and one food was neither tasted nor smelled. After being exposed to two foods each day for thirty days, the children participated in two types of paired comparison trials. In one type of trial, they looked at the two foods and decided which was preferred. In the other type of trial, they tasted the two foods and decided which they preferred. Taste exposure was positively associated with taste preference ($r=0.94$, $p<0.05$) and visual preference ($r=0.97$, $p<0.01$). Visual exposure was positively associated with visual preference ($r=0.91$, $p<0.05$), but not with taste preference ($p=0.45$). The authors concluded that repeated tasting rather than simply looking at food was more likely to increase preschool children's preferences for the foods. This reinforces the utility of the "one-bite" rule often used by parents to encourage their children to taste new foods.

One might assume that because parents are choosing the foods to which their children are exposed, children's food preferences would be similar to their parents' food preferences. A study by Birch in 1980 looked for a relationship between children's food preferences and their parents' preferences [125]. The study sample included 128 families ranging from lower- to upper-middle-class who members included at least one child aged two to five. Parents and children were asked to taste and rank eight fruits and eight types of sandwiches. The mothers also ranked and their own preferences and their perceptions of their families' preferences for nine vegetables and eight snack foods. Birch found that neither the mothers' nor the fathers' food preferences were significantly correlated with their children's preferences. Only 10 percent of the mother-child and 6 percent of the father-child correlations were significant ($p<0.05$). A similar study was published in 1986 by Pliner and Pelchat [126]. However, in this research, fifty-five mothers provided the only information about their children's food preferences. This was done via a questionnaire containing 139 different foods, a sample much larger than the sample of foods tested by Birch. To validate the instrument, the authors compared mothers' perceptions of their children's preferences with reports by the children themselves on a sub-sample of the questionnaire. The agreement between mother and child was 74 percent. After the mothers completed the questionnaire in full, the researchers compared the mothers' perceived preferences of the children to the mothers' perceived preferences of the fathers and siblings, and to the preferences of unrelated individuals in the same geographical area. Pliner and Pelchat found that children's food preferences more closely resembled those of their families than those of unrelated individuals ($p<0.001$), but correlation with siblings was stronger ($\phi = 0.50$, $p<0.001$) than that of either parent ($\phi = 0.200$, $p<0.01$).

The most thorough research on the relationship between children's and mothers' food preferences to date was conducted by Skinner, *et al,* in an eight-year longitudinal study [63]. Mothers reported their own and their children's food preferences via a questionnaire containing 196 foods when the children were 2-3 years old (Time 1) and 4 years old (Time 2). The children reported their own preferences when they were 8 years old (Time 3). Unlike the studies by Birch and Pliner and Pelchat, results indicated a significant relationship between mothers' and children's likes ($r = 0.37$, $p=0.0014$), and dislikes ($r = 0.25$, $p=0.03$). All of the mother-child pairs agreed on at least 50 percent of the foods. Children who liked the most foods at Time 1 also liked the most foods at Times 2 and 3 ($r=0.86$, $p<0.0001$). However, children disliked more foods at Time 2 ($p \leq 0.05$) and Time 3 ($p \leq 0.001$). The authors concluded that the number of foods liked by children did not increase with time as they had previously suspected. They suggested that children needed to be exposed to a variety of foods early in life in order to develop preference for the greatest number of foods.

Preference has been shown to influence food choices in adults and children. However, adults choose foods for reasons in addition to their taste preferences. Factors such as perceived healthfulness, cost, convenience, and availability play a role in their consumption patterns [127]. In fact, taste preference has been reported to account for only 25-50 percent of the variance in consumption by adults [128]. This is not the case in preschool children, however. The correlation between preference and consumption in preschool children has been estimated at 74 percent [129]. Given the evidence, however limited, that children's food preferences are similar to that of their parents, and that preferences dictate consumption, it is reasonable to predict that children's food and nutrient intakes would resemble those of their parents.

Similarity between parents' and children's food and nutrient intakes

The most comprehensive study of the relationship between parent and child nutrient intakes to date was conducted by Oliveria, *et al* [130]. This research examined the nutrient intakes of families with three- to five-year-old children who participated in the Framingham Children's Study in Framingham, Massachusetts. A total of 91 white, middle class families completed four sets of 3-day dietary records for the child and each parent. The records included in each set were staggered so that the parents recorded their child's intake one week before they recorded their own intake. Food records were analyzed and mean intakes were calculated for energy, protein, carbohydrates, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, sodium, potassium, and calcium. Further analysis showed that the intakes of all the nutrients by mothers and fathers were somewhat correlated (r values ranging from 0.34 to 0.56; $p \leq 0.001$), with the exceptions of potassium and sodium. Father-child correlations were significant ($p \leq 0.01$) only for protein ($r=0.34$), saturated fat ($r=0.34$), and cholesterol ($r=0.34$). Mother-child correlations were significant ($p \leq 0.01$) for protein ($r=0.29$), carbohydrates ($r=0.30$), total fat ($r=0.37$), saturated fat ($r=0.48$), polyunsaturated fat (r=0.43), cholesterol (r=0.37), sodium (r=0.30), and calcium (r=0.29).

Odds-ratios were calculated to estimate effect of nutrient intakes of parents on their child's nutrient intake. Results showed that when both parents had high total fat intakes, the child was 2.8 times more likely to have a high fat intake than a child whose parents did not have high fat intakes. A child was 5.5 times more likely to have a high intake of saturated fat if both parents did, and 6.3 times more likely to have a high cholesterol intake if both parents had a high intake of cholesterol. The authors concluded that nutrient intakes were similar in young children and their parents. They acknowledged that some reporting bias might have strengthened mother-child correlations (mothers completed the children's food records), but they ultimately concluded that the mother had more environmental influence on the child's nutrient intakes.

The mother-child relationship of nutrient intake was further explored by Lee, *et al* and Fisher, *et al* [131, 132]. The study by Lee, *et al* compared three 24-hour recalls of 197 white five-year-old girls and their mothers [131]. The girls were assigned to a "high-fat" category if their fat intake comprised more than 30 percent of their energy intake and a "low-fat" category if it did not. The mothers completed a Child Feeding Questionnaire to assess their attitudes and level of control in feeding their child. Results from this questionnaire will be discussed in a later part of this section. The diets of the mothers and daughters were analyzed and compared. The authors found that children in the high-fat group were more likely to have mothers with high fat and low carbohydrate intakes ($p<0.05$). The fat intakes of the mothers and daughters were positively correlated ($r=0.31$, $p=0.0001$). Daughters in the low-fat group were more likely to have mothers with low fat intakes and higher intakes of vitamins C, A, riboflavin, magnesium, and calcium ($p<0.05$). Similar patterns of nutrient intakes between mothers and daughters were found in both groups.

A study by Fisher, *et al* of 5-year-old girls and their mothers examined the relationship between their milk and soft drink consumption [132]. Dietary data was collected on 180 white 5-year-old girls via three 24-hour recalls, and their mothers via a food frequency questionnaire. The authors did not explain why two different data collection methods were used. Fisher and colleagues found that mothers' milk intakes and soft drink intakes were positively associated with their daughters' milk ($r=0.22$, $p<0.05$) and soft drink intakes ($r=0.17$, $p<0.05$). High intakes of soft drinks were associated with low intakes of milk and total calcium in both mothers and daughters ($r= -0.20$, $p<0.05$). It is possible that similarities in beverage consumption are at least partially responsible for the similarities in protein, fat, carbohydrate, and calcium intakes reported in the studies by Oliveria, *et al*, and Lee, *et al* [130, 131].

The three studies described above point to similarities in the food and nutrient intakes by parents and their preschool children. This research has been limited to white, middle-class families and thus cannot be assumed to represent all American families or any universal truth about child nutrition. However, it is interesting to speculate as to why these similarities exist, at least in some families. Similarities in food and nutrient intakes by parents and their preschool children are probably due to other factors in addition to shared preferences for certain foods. Parents presumably control the availability and accessibility of food in the household and may serve as role models also. Availability and accessibility of fruits and vegetables at home and at school have been shown to be related to fruit and vegetable consumption by fourth and fifth grade students [21]. Unfortunately, to date there has been limited research as to how availability and accessibility influence the nutrition of preschool children.

There is some evidence that parental role-modeling influences eating habits of young children. Early work by Harper and Sanders demonstrated that preschool children were more likely to try an unfamiliar food if their mother ate it ($p<0.0001$) [18]. They were more likely to taste a food offered by their mother rather than a researcher ($p<0.05$). A study of African-American families by Tibbs, *et al* investigated the extent to which African-American parents reported modeling dietary behaviors for their children and whether these behaviors were associated with dietary intake by the parents [24]. A total of 456 parents answered two questionnaires that measured six specific modeling behaviors such as, "Child learns to eat low-fat snacks from me," and the frequency of performing low-fat eating behaviors such as avoiding fried foods, replacing high-fat foods with fruits and vegetables, etc. Dietary information was collected using a telephone-administered food frequency questionnaire. Parents reported that they most often ate foods they wanted their child to eat. They also limited their child's high-fat snacks, showed their child that they liked fruits and vegetables, and sat with their child at mealtimes. Parents were less likely to report that they set rules about eating fruits and vegetables or that their child learned to eat low-fat snacks from them. The most common low-fat behavior was avoidance of fried foods. However, they also reported that they rarely substituted low-fat food for high-fat food. Most of the low-fat eating behaviors were only reported as being used only "sometimes." Parents who reported high levels of modeling used more low-fat eating strategies ($r = 0.48$, $p<0.001$), had lower fat intakes ($r = -0.30$, $p=0.001$) , and ate more daily servings of fruits and vegetables ($r = 0.18$, $p<0.001$). Interestingly, the mean percentage of energy from fat was 38.8 percent, and the mean daily intake of fruits and vegetables was 4.7. The authors concluded that despite the parents' belief that they were modeling good dietary habits, their actual diets suggested they might not be good role models for nutrition. There is a growing body of research that seeks to understand how parents' attitudes and child-feeding strategies influence the diets of young children.

Parents' Attitudes and Child-Feeding Strategies

Qualitative research by Kirk and Gillespie identified factors affecting the food choices of working mothers with young children [127]. The women met in focus groups and answered a questionnaire designed to elicit the reasons for their food choices for their families. Answers were grouped into categories according to theme. The major themes uncovered included health, nutrition, socialization, budget, time, and management/organization. The mothers chose food to improve the physical, mental, and dental health of their children. Mothers were also interested in the age-appropriateness of foods and their nutritional value. Other themes such as ease of preparation and convenience occasionally overtook health and nutrition concerns. Mothers chose foods that were easy to prepare and convenient. Individual family members' desires and creation of a positive mealtime environment were also important. The mothers regarded themselves as managers of other family resources in addition to time and money. They associated "baking goodies" with being good mothers and felt guilt when unable to provide special foods, monitor children's eating, or shop and prepare nutritious foods. This study emphasized the challenges that mothers face in meeting the nutrition needs of their children while balancing the other needs of their families. It also demonstrated how mothers may value feeding their children foods they like rather than foods that are healthy.

Two other recent studies have surveyed parents to determine the general levels of control over nutrition, the level of satisfaction, and perceived influence on their child's diet. A study by Seagren and Terry collected information from low-income mothers of three- and four-year old children who participated in the Supplemental Food Program for Women, Infants, and Children (WIC) in Iowa. [112]. The questionnaires developed for the study contained items that measured the mothers' control over, satisfaction with, and perceived influence on the time, frequency, amount, and type of food eaten by the children. Most of the mothers reported controlling the time and frequency that meals and snacks were eaten, the location within the house food was eaten, and the types of foods offered for meals and snacks. Interestingly, while parents reported they did not encourage their child to eat more than the child wanted, they did frequently encourage their child to clean his or her plate. The children in general were not allowed to eat meals while watching television, but many were allowed to eat snacks while watching television. Parents rarely reported using food as a reward for good behavior, but often reported allowing children to eat sweets on the condition that they eat a "good meal" first. Most mothers were either neutral or satisfied with the time and frequency of meals and snacks, as well as with the types and amounts of food eaten for meals and snacks. They generally felt that children spent too much time playing while eating. The mothers tended to believe that their own behaviors influenced the time and frequency of their child's eating as well as the types of food eaten, the location of eating in the home, and the involvement in other activities while eating. The mothers disagreed that their own behavior influenced the amount of food eaten by their child.

In the same study by Seagren and Terry, the behaviors and attitudes of mothers with overweight children differed from those with normal weight children [112]. Mothers of overweight children were less controlling but more dissatisfied with the types of food eaten for snacks. They also were less likely to report encouraging children to clean their plates or to eat as much food as they liked, and more likely to agree that their children ate too much food between meals. There were no statistically significant differences between the groups with respect to perceived influence.

Very similar questions were asked of the parents of children attending preschools in a study by Burroughs and Terry [113]. The major differences between the two studies were the populations surveyed. The second study was conducted in rural Iowa with a well-educated population who worked outside the home. Although most of the questions were similar, the study by Burroughs and Terry did not ask about the location of meals or activities while eating. Despite some differences in the populations, the participants tended to report similar attitudes and behaviors. Parents in Burroughs and Terry's study in general controlled the frequency of meals and snacks but not the amounts of food eaten. Parents reported that they did not encourage their child to eat more than the child wanted, but did encourage their child to clean his or her plate. They were in general satisfied with most aspects of their child's diet and agreed that their own behavior influenced the time, frequency, and type, but not the amount of food eaten by their child. The major difference between the two groups was that the parents in Burroughs and Terry's study were less likely to control the types of food their child ate than were parents in Seagren and Terry's study. Parents of the higher weight-for-height children were less likely to encourage their children to eat more than they wanted ($r = -0.13$, $p \leq 0.05$) or clean their plates ($r = -0.14$, $p \leq 0.05$). Unlike the parents in Seagren and Terry's study, parents of heavier children more frequently controlled the amount of food their children ate for snacks ($r = 0.20$, $p \leq 0.01$).

The issue of control in child-feeding has been the focus of several studies with varying conclusions. As noted in the studies reviewed above, parents use a variety of strategies to mold their children's eating habits. These include encouraging their children to eat more or less of certain foods, restricting access to foods, and using bribes and rewards to increase consumption of certain foods. Parents also contribute to children's eating habits by using food to pacify, entertain, or reward them. While generally used with the best of intentions, these strategies can backfire and result in children's decreased preference for healthy foods and loss of ability to self-regulate food intake.

An early study by Klesges and colleagues investigated the relationship between child feeding strategies, mealtime behaviors and weight in fourteen children aged twelve to thirty months [23]. Researchers observed the children eating dinner at home with their parents and recorded the behaviors of both the parents and the children. The parental behaviors observed included presenting of food by parents, encouragement to eat, and discussion about the food. The children were weighed and measured on a separate occasion. The observation dinners were repeated one month later. Analysis of the interactions showed that parental offers of food and encouragements to eat were positively correlated with the weight of the child ($r = 0.82$, $p<0.001$) and speed of eating ($r = 0.79$; $p<0.001$). Parents of overweight children gave a mean of 15.75 encouragements to eat and 7.0 offers of food each meal compared to the 3.5 encouragements to eat and 3.0 offers of food by parents of normal weight children. Parental prompts to eat resulted in the child eating 88 percent of the time. The authors acknowledged that while it appeared encouragement to eat and offers of food were associated with overweight in children, more research with a larger sample size was needed. Since this study was completed, there have been several more studies of parental control of child feeding.

One such study was conducted by Drucker, *et al* in 1999 [22]. This study examined whether maternal prompts to eat were associated with increased consumption and speed of eating by 77 three-year-old children. The children and their mothers were videotaped eating a buffet-style lunch in a laboratory. The total numbers of calories eaten by the children were recorded, as were their heights and weights. Videos were coded with respect to controlling actions by mothers, supporting actions by mothers, and prompts to eat by mothers. The authors found that the number of food offers and prompts to eat were positively correlated with total calories ($r = 0.443$, $p \leq 0.0001$; $r = 0.398$, $p \leq 0.001$). Higher frequency of prompts to eat was associated with increased rate of eating ($r = 0.423$, $p \leq 0.001$). However, unlike Klesges and colleagues, Drucker, *et al* did not find any relationship between these factors and the children's weight. Both studies acknowledged that causality could not be determined due to the cross-sectional nature of the research. Results did not make it clear whether the mothers were controlling the children's behaviors or merely reacting to them.

A third study of prompts or pressure to eat, this one by Fisher [56], *et al* investigated the effects of pressure on fruit and vegetable consumption in 191 five-year-old girls. The parents of white, non-Hispanic, five-year-old girls answered a questionnaire designed to measure the extent to which they pressured their children to consume foods. Parents' fruit and vegetable intake was assessed using a Food Frequency Questionnaire. The mean fruit and vegetable intake by parents was 1.9 servings per day. This may have been underestimated, however, because fruits and vegetables as part of mixtures, fruit juices, and potatoes were not included in the questionnaire, nor were potatoes or fruit juices. Dietary intake of the children was collected via three 24-hour recalls. All forms of fruits and vegetables were included in their records. The mean intakes of the daughters were 1.5 fruits and 1.5 vegetables per day. Parents who had greater intakes of fruits and vegetables had daughters with greater intakes of fruits and vegetables ($r = 0.23$, $p<0.05$), and they tended to use less pressure in feeding their daughters ($r = -0.18$, $p<0.05$). Parents who had lower intakes of fruits and vegetables had daughters with lower intakes of fruits and vegetables, and they tended to use more pressure in feeding their daughters. Parents in the highest percentile for pressure in feeding had daughters who consumed 1.6 fewer servings of fruits and vegetables. The authors suggested that parents' pressure on children to eat might actually cause their children to eat less. An alternative suggestion is that parents are responding to children's lack of fruit and vegetable consumption by pressuring them to eat. Though the direction of causality could not be determined from this study, the authors found parental pressure to be negatively associated with diet quality in young children ($r = -0.18$, $p<0.05$).

Restriction of access to foods perceived as unhealthy is another way parents attempt to control their children's food intake. A survey conducted by Casey and Rozin found that 40 percent of parents believed that restricting access to certain foods would decrease their children's preference for those foods [114]. Klesges, *et al* found that children ate fewer calories and fewer unhealthful foods during individual meals in which parents monitored their children or in which children were threatened with parental monitoring [115].

Research shows that restricting access to foods might not be a successful long-term strategy. Fisher and Birch hypothesized that restricting children's access to foods would actually cause children to desire those foods more and consume more of them when they became available [19].They conducted two experiments to test this hypothesis. In the first experiment, children's food preferences and intakes were measured three weeks before and three weeks after a five week period in which access to a particular snack food was restricted. The children were allowed unlimited access to a very similar control food during the study. There was initially no difference in the children's preferences for the target and control foods. The children were essentially neutral about both foods. During the experiment, the children exhibited more interest in the restricted food, showed greater preference for it, asked for it more, and made more attempts to obtain it than the control food, despite the fact that the two foods were very similar ($p<0.01$). A second experiment tested whether an individual food would be more or less preferred based on whether access to the food was unlimited or restricted. Fisher and Birch found that children chose a food more often in snack sessions where it had been off-limits for a period of time than in snack sessions where it had been freely available ($p<0.001$). They concluded that restricting access to foods might increase children's responses to foods and increase rather than decrease their intakes over time.

A survey of the parents of the children in the Fisher and Birch's study found some differences in their reported child-feeding practices at home. Parents' reported levels of restriction of access to foods at home were associated with their child's weight and response to the experimental foods. The higher a child's weight-for-height ratio, the more likely the parents reported a high level of restriction at home ($r = 0.42$, $p<0.05$). The children whose mothers exercised the most restriction at home also had the greatest responses to the restricted foods ($r = 0.41$, $p<0.05$). They were even more likely to increase their intake of and preference for the restricted food than were the children whose access had not been restricted. The authors theorized that restricting access to palatable foods on a long-term basis would likely make children choose to eat more of the restricted foods whenever they became available.

Another study by the same authors tested this theory [19]. In this investigation, Fisher and Birch questioned mothers to determine which experimental foods (n=10) had been limited at home. Before being allowed unlimited access to the restricted foods, the children were asked to indicate their hunger level and rank the foods in order of preference. Only children who were not hungry were allowed to participate in the experiment. The children were then left alone with the foods and a roomful of toys with instructions to play and eat as much as they liked. Upon analysis of the data, the researchers found that restriction of access to the experimental foods at home was positively correlated with consumption of the same foods in the laboratory by girls ($r = 0.59$, $p<0.001$). Higher levels of restriction at home were also associated with higher caloric intake by girls during the session ($p<0.05$). Interestingly, these relationships were not found in boys. There was no difference between boys and girls in the extent to which mothers reported restricting their access to foods at home. It appeared that girls were more sensitive to restriction than were boys. For both boys and girls, mothers' reported restriction of access to foods at home increased as the weight of the children increased ($r = 0.56$, $p<0.01$; $r = 0.46$, $p<0.05$).

In their next study, Birch and Fisher specifically examined whether mothers' own weight and their perceptions of their daughters' risk of overweight predicted their level of control in feeding [133]. Results again indicated mothers who perceived their daughters to be overweight were more likely to restrict their daughters' diets ($\beta = 0.30$). Daughters with restricted diets showed less ability to self-regulate energy intake and were more likely to eat when they were not hungry ($\beta = 0.26$). This suggested that mothers' belief that their daughters were overweight might cause them to be more controlling with their daughters' diets, which might in turn lead their daughters to overeat. However, the cross-sectional nature of this study made it impossible to determine whether childhood overweight was a cause or effect of maternal restriction. A longitudinal study was needed to determine whether restriction of access to foods leads to overeating and weight gain over time.

Hood, *et al* conducted a longitudinal study of the families enrolled in the Framingham Children's Study [134]. They examined whether parents' own dietary restraint (dieting) and disinhibition (eating past the point of satiety) were associated with weight gain by their children. They followed ninety-two three- to five-year-old children for six years. At least one parent of each child completed Stunkard and Messick's Three Factor Eating Questionnaire that was designed to measure dietary restraint, disinhibition, and behaviors related to hunger. Anthropometric measurements of the children and their parents were taken once per year. Dietary information was collected via multiple dietary records. Hood and colleagues found that parents who showed higher levels of dietary restraint also showed higher levels of disinhibition. Children whose parents showed high levels of disinhibition gained more body fat over the six years than those whose parents had lower levels of disinhibition ($p=0.012$). However, parents with high levels of dietary restraint coupled with high levels of disinhibition led to the greatest gains in fat by the children ($p=0.042$). Unlike the study by Birch and Fisher, dietary restraint alone was associated with lower body fat increases in children. However, to compare these studies, one would have to assume that dietary restraint in parents was associated with greater levels of restriction of children's diets. Hood, *et al* did not report whether or not this was the case. Taking all of these studies together, it would appear that parents' own weight, dietary practices, and perceptions of their children's risk of overweight influence the level of control they exert over their children's diets. Strict control of children's diets may actually cause the children to overeat and gain extra weight over time.

Nutrition Messages

While child-feeding practices obviously have an effect on the preferences and diets of young children, it is interesting to speculate how they might influence children's beliefs about nutrition. Anliker and colleagues conducted a study to determine the types of knowledge that three-year-old children have about nutrition, and how parental messages affect this knowledge [135]. Non-Hispanic white children (n = 104) from middle-to-upper income families were asked a variety of questions in a developmentally appropriate way to determine how much they knew about nutrition. Questions were asked about food groups, food origins, food transformations, energy balance in relation to eating and exercising, and nutrition quality of different foods. On average, the children answered 64 percent of the questions correctly. The parents were asked open-ended questions about the nutrition messages they gave to their children. Categories of responses included general nutrition information ("this food will make you big and strong"), specific nutrition information about a particular food ("this food has vitamin C"), encouragement about the quality of the food, examples of other people who eat and like the food, nonverbal messages such as serving a disliked food less often, use of bribes and rewards, and authoritarian behaviors ("you can't leave the table until you eat"). Parents reported giving general and specific nutrition information most often during the interview, 5.87 times and 1.83 times, respectively. They reported using examples only 0.19 times, bribes and rewards 0.05 times, and authoritarian behaviors 0.13 times. The use of specific nutrition information by parents was associated with the highest knowledge scores among children ($r = 0.339$, $p \leq 0.001$). The use of general information was also positively associated with knowledge scores ($r = 0.265$, $p \leq 0.01$). Positive messages (this is what you should do) were more affective ($r = 0.265$, $p \leq 0.01$) than negative messages (this is what you shouldn't do) ($r = 0.219$, $p \leq 0.05$). The authors concluded that these preschool children had a working knowledge of nutrition and that this knowledge was directly related to the number of positive nutrition messages they received from their parents.

Summary

Parents have a direct impact on the eating habits of young children. Children experience flavors early in life and have innate preferences for certain tastes. Repeated exposure to foods increases children's preferences for those foods even when they were initially rejected. One way that parents influence their children's eating habits is by moderating their children's exposure to different foods. Children's food preferences and nutrient intakes tend to be similar to those of their family members. Parents also impact their children's eating habits by serving as role models and through their direct child-feeding practices. Restriction of access to food and pressure to eat are two common practices employed by parents. Strict control can result in loss of ability to self-regulate energy intake and contribute to overeating in children. Parents' own attitudes toward food influence their child-feeding practices and the nutrition messages received by their children.

SECTION IV: THE ROLE OF CHILDCARE IN CHILD NUTRITION

Introduction

The studies reviewed in Section III highlighted the role of parents in child nutrition. Many of the studies focused on mothers in particular as the primary caregivers of their children. Over the past few decades as more and more mothers have entered the workforce, the daily care of the nation's youngest children has been transferred to individuals outside of the home. According to the Children's Defense Fund, 6 million infants and toddlers and 7 million preschoolers attended some type of childcare each day in 2000 [26]. In Texas, 53.3 percent of children under the age of six have both parents in the workforce. This translates into over 1 million young Texas children in childcare each year. The effects of childcare on all aspects of child development are being investigated, and child nutrition is no exception.

The decisions childcare centers make regarding menus and child-feeding practices impact the health and well-being of millions of children every day. Recent studies suggest that while childcare has the potential to be a positive influence on child nutrition, the reality may be much different. Despite state and federal guidelines and programs, children may not be receiving good nutrition while they are at childcare centers. There is some evidence that childcare also influences parents' own behaviors regarding nutrition at home.

Government Regulation of Nutrition in Childcare

Center-based childcare facilities in Texas are required by the State to be licensed [136]. Home-based centers, also known as family daycares, have the option of licensure. The Texas Administration Code outlines general guidelines for nutrition in licensed childcare centers. The guidelines are as follows: 1) Children receiving 4-7 hours of care must be offered 1/3 of their daily food needs; 2) Children receiving over 7 hours must be offered ½ of their daily food needs; 3) Regular meals and morning and afternoon snacks must be served; 4) Eating problems must be discussed with the child's parent; 5) Special diets require approval by a physician or registered dietitian; 6) Children may be encouraged, but not forced to eat; and 7) Daily menus for all meals and snacks must be kept for thirty days [137]. The State of Texas does not regulate the types of individual foods served to children in childcare. However, childcare centers that participate in the USDA Child and Adult Care Food Program (CACFP) must adhere to regulations set forth by that program.

Originally called the Special Food Service Program for Children, CACFP was started as a pilot study in 1968 and was made permanent by Public Law 96-627 in 1977 [138]. In 1989, it was renamed CACFP to reflect the inclusion of adult-care centers. The CACFP is administered by USDA through grants to states. Childcare centers are given cash reimbursements for serving meals and snacks that meet nutrition guidelines. They also receive donated commodities from USDA. In order to receive full reimbursements for meals, childcare centers must serve a population in which at least 25 percent of the enrolled families are at or below 130 percent of the poverty level. Partial reimbursement is given when 25 percent of enrolled families are between 130 and 185 percent of the poverty level. Participating centers can be public or private. Though originally for non-profit centers only, Congress authorized the inclusion of for-profit centers in 2001, subject to yearly extension by Congress. All Head-Start centers automatically qualify.

In order to be reimbursed, childcare centers must serve meals and snacks that fit into the meal patterns prescribed by USDA. The meal patterns include four major components: fluid milk, fruits/vegetables, grains/bread, and meat/meat alternate. Breakfast must include fluid milk, one fruit or vegetable, and one serving of grains/bread. Lunch or supper must include one fluid milk, two fruits/vegetables, one grain, and one meat/meat alternate. Snacks must contain two of the four categories. Serving sizes are specified according to age group, and lists of acceptable substitutions are also provided. Minimum serving sizes do not necessarily reflect those recommended by the Food Guide Pyramid for Young Children. For instance, CACFP prescribes ½ cup of milk for children ages 3 to 5. According to the Food Guide Pyramid, 1 cup of milk is a serving for children ages 3 to 5 [5]. The serving sizes for breads, cereals, pasta, and meat/meat alternates are also different. In every case, CACFP minimum servings are smaller than the serving sizes recommended by the Food Guide Pyramid. According to the American Dietetic Association, full-day childcare centers should provide appropriate food to meet ½ to 2/3 of children's daily energy and nutrient requirements [139]. It is theoretically possible that a child could consume enough

CACFP servings to meet Food Guide Pyramid Recommendations and the 2/3 of the RDAs for energy and nutrients each day. However, studies of actual childcare menus suggest that this is difficult, if not impossible.

Childcare menus

A study by Briley and colleagues evaluated the quality of thirty days of menus from forty childcare centers that participated in CACFP in Texas [27]. The analysis assumed that the childcare centers were serving CACFP portion sizes of all the foods listed on the menu. According to the analysis, if the children ate all of the food that was served to them, they could expect to receive at least 2/3 of their daily requirements for protein, riboflavin, vitamin C, and vitamin A. However, the menus were inadequate for energy, iron, niacin, thiamin, and calcium. The children would receive on average 44 percent of the RDA for energy, and 47 percent of the RDA for iron. The foods appearing most often on the menus were milk, beef, bread, potatoes, apples, and cookies. There was an acceptable variety of vegetables and meats, but variety in fruits was lacking. In a second study, the researchers evaluated three weeks of lunch menus from thirty childcare centers in which serving sizes were specified. The menus were scored according to CACFP guidelines: one point was given each time one of the four meal components was served in the appropriate amounts. Thus, four was a perfect score. The menus scored on average 2.59, meaning that food groups either were not being served in large enough portions or were not served at all. Seventy percent of menus were inadequate in at least one component.

Briley's group extended their research to include childcare centers from seven different states [28]. The 171 participating centers were chosen to reflect a variety of ethnicities. Ten days of menus were analyzed for food frequencies and nutrient content. The foods most commonly served were milk, bread, apples, oranges, crackers, cheese, beef, cookies, and cold cereals. The only vegetables to appear more than once in ten days were potatoes. Green leafy vegetables were reported less than 0.5 times in ten days. Fats and sweets were rarely reported. The menus were found to be adequate in protein, vitamin B_{12}, riboflavin, and vitamins A and C. The menus provided less than 2/3 of the RDA for thiamin, calcium, niacin, and vitamin B_6, and less than fifty percent of the RDA for energy and iron. The mean percentage of energy from fat was 34.2. The researchers concluded that childcare centers were providing too much fat and not enough kilocalories and iron-rich foods. They were pleased that fats and sweets were not being used excessively, but recommended that more cruciferous vegetables and fruits other than apples be served. They also reported that CACFP appeared to be helping childcare centers provide good nutrition.

Drake evaluated ten days of menus from 46 childcare centers in Missouri [33]. Menus were analyzed assuming minimum CACFP serving sizes. The menus were found to provide close to 2/3 of the RDA for calcium, thiamin, vitamin C, riboflavin, B6, and B_{12}. The menus did not provide adequate energy, iron, zinc, magnesium, vitamin A, folic acid, or protein. Furthermore, green leafy vegetables were served less than once a week or not at all. The major sources of meat were hot dogs and lunch meat, neither of which are good sources of iron and zinc.

While the above studies assumed that portions were served according to CACFP guidelines, a similar study by Briley, *et al* involved the weighing of foods served at nine childcare centers in Texas on two days to determine the actual portion sizes given to the children [30]. This information was used to determine whether the childcare centers were serving appropriate portion sizes according to CACFP standards. When the childcare centers were scored based on actual servings provided, they averaged 2.8 out of a possible 4. Menus from ten days were analyzed for food frequencies and nutrient content also. The menus were found to be adequate for protein, vitamin A, vitamin C, vitamin B_{12}, and folate, but were lacking in total energy, niacin, zinc, and iron. Energy from fat provided 27 to 36 percent of total energy. Food frequency analysis determined that the most common foods were milk, bread, cereal, pasta, apples/apple juice, oranges/orange juice, frankfurters, crackers, and cereal. More than fifty percent of the menus reported no fresh produce.

A study by Oakley and colleagues compared the lunch menus of childcare centers in Mississippi that participated in CACFP to the menus of childcare centers that did not participate [32]. They found that childcare centers who did not participate were actually doing a somewhat better job in providing good nutrition. Participating centers had fewer foods on the menus and provided less energy, protein, carbohydrates, vitamin A, thiamin, niacin, vitamin B_6, pantothenic acid, vitamin E, and zinc than non-participants. The menus from participants provided 41 percent of energy from fat compared to 38 percent by non-participants. Neither met the recommendations for 30 percent of energy from fat. Both groups also failed to provide enough energy, vitamin B12, vitamin E, iron, zinc, and calcium, though participants provided more calcium than non-participants. The majority of childcare centers (60%) reported having "nutrition coordinators" plan their menus. Others reported that directors (10%), cooks (6.5%), school food service administrators (1%), or other staff members planned the menus (21%). Over half stated that they used the Dietary Guidelines for Americans in planning the menus. The authors observed that while the centers might report that they had consulted the Dietary Guidelines for Americans, their menus did not reflect it.

Actual Intake at Childcare Centers

The studies reviewed above have only considered the quality of the menus and have assumed for the most part that the foods are being served in the minimum portions required by CACFP. In order to draw conclusions about the nutrition of the children attending these centers, one would have to assume that the children ate all of the foods given to them in those exact quantities. Reality is probably much different. Children may refuse to eat some foods and eat extra servings of others. For this reason, studies are needed to determine what children actually eat in childcare.

One such study was published by Briley, *et al* in 1999 [29]. In this study, researchers observed fifty-one children eating meals and snacks at twelve childcare centers over a three-day period. Parents kept records of the children's food intake at home on the same three days. Total nutrient intake was averaged across the three days. Results showed that children on average received 92 percent of their daily energy needs, 207 percent of vitamin C, 164 percent of vitamin A, 121 percent of niacin, 175 percent of riboflavin, 136 percent of thiamin, 107 percent of calcium, 95 percent of iron, and 70 percent of the required zinc. Twenty-two percent of children received less than 2/3 of the RDA for iron, while 45 percent received less than 2/3 of the RDA for zinc. This reinforces the previous findings that iron and zinc may be a problem for children in childcare, but challenges the idea that diets of children who attend childcare are lacking in thiamin, calcium, and niacin. One possible explanation is that children were eating more than the minimum serving sizes of foods during childcare. The results showed that the childcare centers were meeting 50 to 67 percent of the requirements for all nutrients except energy, niacin, iron, and zinc. It also may be that the children were eating enough food after childcare to make up for the deficiencies in the childcare menus. The researchers found that the foods provided at home were meeting 33 to 50 percent of the requirements for all nutrients except calcium, iron, and zinc.

The authors further analyzed the diets of the children to see if they were consuming proportions of foods in compliance with the Food Guide Pyramid. A computer program generated the frequency at which different types of food were consumed. For ease of analysis, foods were assumed to have been consumed in age-appropriate portion sizes each time they were listed. The number of servings desirable in childcare was calculated as ½ to 2/3 of the servings recommended by the Food Guide Pyramid. The goal for servings at home was 1/3 of the numbers recommended by the Food Guide Pyramid. According to the analysis, less than ten percent of children ate enough servings of breads and grains during childcare, while 40 percent ate enough at home. Eighty percent ate appropriate amounts of fruit and dairy at childcare, while 70 percent and 80 percent ate appropriate amounts of fruit and dairy at home, respectively. Forty percent consumed enough vegetables during childcare, and 50 percent consumed enough vegetables at home. The majority of children ate appropriate amounts of meat and dairy at childcare and at home, 70 percent and 90 percent respectively. It would appear from these results that the home environment is doing a better job at meeting its share of the daily nutrients than are childcare centers.

As for overall compliance with the Food Guide Pyramid, the children more often met the requirements for dairy, meat, and fruit than for vegetables and breads. The authors concluded that the children ate too many fats and sweets, averaging 4 servings per day, most of which were consumed at home. Thus, the researchers described the diets of the children as an “upside down” Food Guide Pyramid. The authors caution that these results are based on the assumption that children are consuming age appropriate serving sizes. It is entirely possible that children consume more or less than the specified amounts. Despite these limitations, however, the authors concluded that neither the parents nor the childcare centers were successful in providing foods that met the Food Guide Pyramid recommendations or the daily requirements for iron, zinc, and energy.

A study by Drake also evaluated the dietary intake and weight-for-height status of children in childcare [31]. This study included biochemical iron indices. Subjects included 58 white children who were four- to six-years old. Dietary intake was measured at childcare by the researcher and recorded at home by the parents for five consecutive days. The mean nutrient intakes of the children while at the childcare center are presented in Table 7. The children consumed at least 67 percent of the RDA for all the nutrients studied at the childcare center with the exceptions of iron, folate, zinc, and energy. Analysis of their total daily intake found them still lacking in iron, folate, and energy. They consumed approximately 50 percent of their daily needs of iron and folate and 70 percent of the RDA for energy. Anthropometric measurements found most of the children (93 percent) to be within normal ranges for their age. However, twelve percent of the children had low iron values indicative of iron-deficiency anemia.

Though the negative aspects of childcare are easy to pinpoint, it is also important to recognize the positive influence of childcare on child nutrition. A study by Bruening and colleagues sought to determine the impact of CACFP on the diets and health outcomes of 40 non-Hispanic black children in two childcare centers in New York [35]. The health outcomes studied included weight-for-height status, dental caries, and days of illness. Two groups of children were studied: those at a center that provided meals according to CACFP guidelines, and those at a center in which all meals were brought from home. The children's food intakes were recorded by researchers at the childcare center for five days. Parents recorded children's food intake at home before and after childcare, and on weekend days. Two sets of seven-day dietary records were kept: one in the spring, and one in the fall. Information regarding number of days missed due to illness were kept throughout the school year. A dentist examined the children for dental caries, and a researcher measured the height and weight of the children.

Table 7: Dietary intake from meals and snacks consumed during childcare[a]

Nutrient/Food	**67% RDA**	**Bruening, *et al*[b]** (n=20)	**Drake[c]** (n=58)	**Bollela, *et al*[d]** (n=358)
Energy(kcal)	1206	549	985	523
Carbohydrate (g)	----	82	140.7	72.4
Protein (g)	16.1	25.8	28.5	20.8
Fat (g)	----	15.2	34.8	17.8
Vitamin A (RE)	335	606	342	----
Thiamin (mg)	.40	.50	.51	----
Riboflavin (mg)	.40	.86	.90	----
Niacin (mg)	5.36	5.33	7.8	----
Pyridoxine (mg)	.40	.56	.90	.50
Vitamin C (mg)	30	53.5	37.6	.34
Vitamin E (mg α-TE)	4.69	1.70	---	2.4
Folate (μg)	134	68	32.2	77
Vitamin B12	----	---	.7	1.21
Calcium (mg)	536	504	642	366
Iron (mg)	6.70	4.30	4.2	4.3
Magnesium (mg)	87	106	----	80.4
Zinc (mg)	6.70	3.50	6.1	2.8
Milk/Alternatives (no. of servings)	----	2.2*	----	----
Meat/Alternatives (no. of servings)	----	.8*	----	----
Fruit (no. of servings)	----	2.0*	----	----
Vegetables (no. of servings)	----	1.0*	----	----
Grains (no. of servings)	----	3.0*	----	----

[a] Serving sizes based on CACFP guidelines, not the Food Guide Pyramid.
[b] median values for boys aged 3-5 years [35]
[c] mean values for boys and girls aged 4-6 years [33]
[d] mean values for boys and girls aged 4-6 years[34]

Analysis of the diet records showed that the two groups of children did not differ in energy, carbohydrate, and fat intake at the childcare centers. Children at the center participating in CACFP consumed significantly more protein, vitamin A, thiamin, riboflavin, vitamin B6, folate, calcium, iron, and magnesium than children at the non-participating center. They also consumed more servings of milk and vegetables and less fats and sweets at the center than the children who brought their food from home. The dietary intake of children in the participating childcare center is listed in Table 7. The diets of both groups of children provided on average less than 67 percent of the RDA for vitamin E, folate, calcium, iron, zinc, and energy. Children in the non-participating center were also lacking in vitamin A, niacin, vitamin B6, and magnesium. Despite the difference in food intake, there was no significant difference in weight-for-height percentiles or in number of dental caries between the two groups. The children in the non-participating center had significantly more absent days due to illness than the other children. The authors speculated that while this could be due to differences in nutrition, it might also reflect differences in sanitation procedures.

While it is apparent that childcare centers are not always meeting the goal of 2/3 of the RDA for energy and nutrients, the question remains whether total day intake of the children is meeting the RDA. According the study by Briley, *et al* reviewed previously, children in general received more than enough of all nutrients except energy, iron, and zinc [29]. Their home environments were meeting 33 to 50 percent of the requirements for all nutrients except calcium, iron, and zinc. They were consuming too many fats and sweets at home also. A study by Bollela and colleagues evaluated the nutrient intakes of 358 Head Start children at home and at the childcare centers. Results for nutrient intake while at the center are listed in Table 7. Once again, children were not consuming recommended amounts of energy, folate, calcium, iron or zinc at school. This study also found intake at childcare centers lacking in vitamin E and magnesium. However, when intake reported by parents at home was added, the children's diets looked much better. Although energy intake was still low, 1477 kilocalories compared to 1800, intakes of calcium, zinc, A, C, E, B6, B12, folate, and magnesium met or exceeded recommendations. This indicates that children may be eating enough at home to make up for shortcomings in the menus provided by childcare centers.

It is interesting to note the differences in the results reported by Bruening *et al*, Drake, and Bollela *et al* (Table 7). The children in Drake's study appear to be consuming more of most of the nutrients with the exceptions of vitamin A, vitamin C, and folate. One explanation is the number of eating opportunities provided by the centers. The childcare centers studied by Bruening's group and Bollela's group served two meals and one snack each day. The centers in Drakes study served two meals and two snacks. Also, the centers studied by Bollela and Bruening provided care to low-income families and participated in CACFP. Drake does not report whether the centers in her study participated in CACFP. As was noted by Oakley, differences may exist in the menus of centers that participate in CACFP and centers that do not participate [32].

Caregiver Knowledge, Attitudes, and Child-Feeding Practices

Much of the research regarding nutrition in childcare centers has focused on the menus prepared by the centers and the food consumption by children at the centers. As noted previously, parents' nutrition knowledge, attitudes, and child-feeding practices influence child food preferences, intake, weight status, and nutrition awareness. Considering the amount of time many children spend in childcare, it is reasonable to predict that the knowledge, attitudes, and behaviors of the caregivers in childcare centers also influence children. Though the research in this area has been limited, several recent studies have investigated caregiver attributes and their influences on child nutrition.

In one of Briley's studies, efforts were made to determine what obstacles might prevent childcare centers from offering good nutrition [30]. After interviewing the childcare center employees, the researchers identified a range of attitudes about nutrition. Many employees were aware of CACFP requirements but did not know how to fulfill them. They lacked knowledge of nutrition and food preparation principles. They often perceived that their job was to "fill up the kids." When questioned about the reasons behind their practices, they responded in essence, "we've always done it this way."

Drake measured the nutrition knowledge of 179 menu planners at childcare centers in Missouri [33]. A questionnaire containing fifteen multiple choice items designed to measure knowledge of food sources of nutrients and knowledge of the nutrient needs of preschool children was developed. The menu planners scored an average of 9.1 out of 15. Fifty-six percent correctly identified food sources of vitamin C, while 48 percent and 24 percent correctly identified food sources of vitamin A and folic acid, respectively. Few (28.5 percent) knew that milk was not a good source of iron, while 78 percent knew that meat was a good source of iron. Only 32.2 percent knew how to plan a meal to maximize iron absorption. Menu planners had a good understanding of enriched foods and sources of complete proteins. However, 32 percent did not know the appropriate serving size for vegetables. Most of the menu planners, 88 percent, understood why dietary variety was important. From this research, Drake concluded that more education was needed for menu planners, specifically regarding sources of nutrients and appropriate serving sizes.

Nahikian-Nelms studied the whether caregivers' nutrition knowledge and attitudes toward nutrition affected their behavior at mealtimes [140]. The nutrition knowledge of 118 caregivers was assessed using a questionnaire that included items about common nutrition problems in childhood, food sources of nutrients, recommendations by the Food Guide Pyramid, RDAs, and CACFP. Attitudes were measured using an instrument that included questions about caregiver roles in child nutrition, the role of childcare in child nutrition, beliefs about child nutrition, and rules used during mealtimes. Finally, a panel of experts observed caregivers during mealtimes and completed a checklist regarding compliance with the optimal caregiver behaviors established by the American Dietetic Association (ADA), the National Association for the Education of Young Children (NAEYC), and others.

Nahikian-Nelms found that the caregivers generally scored highly on the attitude survey. They answered the questions in a way that should have had desirable effects on their behavior and on child nutrition. They believed that child nutrition was important to child health, and that they influenced children's eating habits. The overall nutrition knowledge scores were low, however (10.9 out of a possible 20). Commonly missed questions included the application of RDAs and food sources of different nutrients. Also, only 49 percent knew that the childcare center should be meeting 2/3 of the nutrition needs of the children. There was a positive correlation between level of education and nutrition knowledge. Nutrition knowledge was in turn positively correlated to caregiver behavior at mealtimes. Positive attitudes did not always correspond with behavior at mealtimes, however. Caregivers reported in general that role-modeling was important, but only half of them actually sat down and consumed the same foods as the children. They agreed that mealtimes were a good time for nutrition education, but only half of them said anything about nutrition during the meals. In other situations, their attitudes did match their behaviors. Most did not think that children should be rewarded with a sweet for eating a particular food and only 7 percent actually used food as a reward. The desired behaviors most likely to be lacking were the use of family-style meals, nutrition education during meals, and conversation with the children during meals. The author concluded that appropriate education is needed to not only increase caregivers' knowledge of nutrition and child development, but also to teach them how to incorporate this knowledge into their own behaviors during mealtimes.

Results from a study of caregivers in Head Start centers by Gable and Lutz were more promising [141]. In this study, researchers observed meals noting the same categories of behaviors and activities used by Nahikian-Nelms [140]. They found five of the behaviors occurring consistently: 1) teacher sitting with children during meals, 2) teacher eating same food as children, 3) children serving themselves, 4) children assisting with set-up of meals, and 5) children assisting with clean-up afterwards. Teachers also told the children the names of different foods fairly frequently (3.0 times every five minutes). The most common negative behavior was the reprimanding of the children for poor behavior. This occurred an average of 1.5 times every five minutes. General conversation, encouragement to taste foods, and nutrition teaching each appeared less than one time every five minutes. Hurrying children, requiring them to taste food, and using food as a reward did not occur at all. This study suggested that caregivers in Head Start Centers were doing a good job of modeling good eating habits, but were not interacting with the children as much as might be desirable. There is some evidence, however, that modeling by caregivers may not have as much influence on children's eating as originally thought.

A study by Hendy and Raudenbush challenged the belief that modeling by caregivers influences food acceptance by preschool children [142]. Once again, the caregivers themselves reported that role-modeling was an effective way to encourage children to accept foods. They rated it as more effective than giving children limited choices, insisting that they taste a food, giving a reward for tasting a food, or offering repeated exposures to a food. When acceptance of novel foods was actually measured, the authors found that silent modeling by caregivers was no more likely to cause children to accept a new food than was simple exposure. Modeling in which the teacher was verbally enthusiastic about a food did result in increase acceptance of new foods, but only when not in competition with modeling by a same-sex peer. In other words, when a same-sex peer enthusiastically responded to a different food, children were more likely to accept that food and reject the food eaten by the teacher. This suggests that while teacher modeling is important, it may be overshadowed by the behaviors of children's peers.

Though limited in scope, the above studies do indicate that caregivers' behaviors during mealtimes might influence the eating patterns of young children in childcare. Furthermore, these behaviors are influenced by the knowledge level of the caregivers and to a lesser extent their attitudes. More research needs to be done to assess the specific kinds of behaviors that would facilitate good eating habits in children, and the types of training that would most likely elicit these behaviors. It is important to note, however, that the childcare centers are not solely responsible for the eating habits of children. As reviewed in the previous sections, parents play an important role. Recent studies have explored the nature of the interplay between parents and childcare centers and have investigated the effects of this relationship on child nutrition.

The Effects of Childcare on Parents Attitudes and Behaviors

Burroughs and Terry found that parents of children in childcare exhibited slightly different attitudes toward their child's eating behaviors than other parents

[113]. Parents whose child spent more hours in childcare tended to be more dissatisfied with the speed at which the child ate and the types of food the child ate. They also tended to feel they had less influence on the types of food the child ate.

Wright and Radcliffe studied parents' perceptions of the influence of childcare on children's eating habits [36]. Sixty-eight parents of four- to six-year-old children enrolled in childcare five days a week completed a series of interviews. The majority of parents were married mothers who were employed full-time. Their children spent an average of 8.5 hours per day in childcare. Twenty-eight percent of the children brought lunches from home, while 69 percent ate lunches prepared by the center. When asked who was responsible for making sure their child ate appropriately while at the center, 11 percent of the parents who sent lunch from home, and 59 percent of the parents whose children ate school meals responded that it was the teacher's responsibility. When questioned about their child's learning about new foods, over half reported that the home environment was more important. Approximately 40 percent believed that home and school were equally important in the development of likes and dislikes of specific foods, but over 50 percent believed that the home was more important. In general, parents felt that the home had more influence over learning table manners, learning to use utensils, and learning to sit still while eating, but a considerable number felt that home and childcare were equally influential in these areas. Many parents believed that the center was more influential on children's learning about nutrition. As for responsibility, parents tended to agree that they and the childcare center were equally responsible for providing good nutrition and for teaching children about nutrition. This study demonstrated that while parents still felt responsibility toward their child's eating behaviors, they were starting to relinquish some of their control and influence to childcare centers.

It has been speculated by other researchers that parents relinquish too much of the control and responsibility for feeding their child to childcare centers. A survey of single working mothers in Canada by Campbell and Sanjur found that mothers' satisfaction with the childcare centers was negatively correlated with the diet quality of their children at home [37]. The authors wondered if mothers who were happy with their childcare arrangements might be less concerned with their child's diet at home because they felt their child received good nutrition during childcare. After noting the excess of fats and sweets served to children in the evenings after childcare, Briley, *et al* also speculated that parents might feel justified in feeding children these foods because the children had eaten healthfully at the childcare centers [29]. More research is needed to determine if parents of children in childcare actually feel less inclined to feed their children a healthy diet because of childcare, or if other factors are involved. Kirk and Gillespie, for instance, found that some working mothers reported feeding children unhealthy foods they liked because the mothers felt guilty about not spending enough time with the children [127]. Cooking according to family preferences was one way that mothers tried to create a positive family environment.

Summary

Despite guidelines from the American Dietetic Association and the Child and Adult Care Food Program, childcare centers may not be serving enough appropriate foods to meet ½ to 2/3 of the daily nutrition needs of the children. Childcare menus in several states have repeatedly been found to be lacking in energy, iron, zinc, and niacin and to contain an excess of fat. Differences may exist between centers that participate in the CACFP and centers that do not. Fortunately, many children are consuming enough food at the childcare center and at home to meet most of their nutrition needs. Childcare center employees in general lack the necessary knowledge to plan healthful meals. The caregivers have positive attitudes regarding their role in child nutrition, but these attitudes do not always correspond with their behaviors. The institution of childcare may affect parents' attitudes about child nutrition. Parents of children in childcare may feel less responsible for their children's nutrition than parents of children who do not attend childcare. An alternative explanation is that other challenges faced by working parents influence their attitudes toward child nutrition. More research needs to be conducted in this area. Regardless of the effects of childcare on parents' attitudes, parents and childcare centers together have an enormous impact on the nutrition of preschool children.

CONCLUSION

The diets of preschool children in America are not meeting the recommendations set forth by the Food Guide Pyramid for Young Children, the Dietary Guidelines for Americans, or the Dietary Reference Intakes. Too many children do not consume enough fruits, vegetables, and grains, and have diets lacking in vitamin E, folate, iron, calcium, and zinc. In addition, their diets contain excessive fat and saturated fat. Excess fat consumption combined with inactivity may be to blame for the rising rate of childhood obesity. Thirty percent of preschool children are either overweight or at risk for overweight [6]. Excess weight in children puts them at risk for early onset of serious diseases such as diabetes and heart disease. In order to combat this trend, researchers must understand the factors that influence the eating habits of young children.

The research reviewed in this chapter has shown that parents have tremendous influence on the development of eating habits in young children. Parents control the early exposure to foods, determine the availability and accessibility of foods in the home, practice various child-feeding strategies, and serve as role-models. Parents' own weight and attitudes about child nutrition influence their choices of food for their families as well as the strategies they use to influence their children's eating habits.

For many children, childcare centers also play a role in their eating habits. Seven million 3- to 5-year-old children currently attend some type of childcare each day [26]. The studies reviewed in this chapter demonstrated that childcare center menus contain too much fat and are often lacking in important nutrients such as iron, zinc, and niacin. Furthermore, caregivers do not always have adequate knowledge and training to plan healthful meals for the children. This makes it vital that parents do all they can to ensure that their children eat healthfully when at home. Unfortunately, according to research by Briley, *et al*, children tend to consume too many fats and sweets at home and too few grains, fruits, and vegetables [29]. Briley's group speculated that parents might be relying on childcare centers to provide good nutrition for their children. Other research has suggested that parents might be relinquishing control of their children's diets to childcare centers, particularly when the childcare centers serve meals perceived by the parents to be healthy [36, 37]. Research had not been conducted specifically to test the effects of childcare on parents' attitudes about nutrition until now.

The goals of this study were to determine the effect of childcare on parents' attitudes and behaviors in shaping their children's food habits, and to determine whether these attitudes and behaviors correlated with food intake and rates of overweight in the children. The objectives were to measure 1) daily food intake for three days by children who attend childcare and children who stay at home, 2) differences between parents of children in childcare and parents of stay-at-home children with respect to attitudes and behaviors in shaping food habits, 3) general levels of physical activity, 4) rates of overweight/obesity, 5) the extent to which parents attitudes and behaviors explain differences in food intake by the children, and 6) the extent to which parents' attitudes and behaviors, and children's diet and physical activity, explain overweight in the children.

Chapter 3: Methods

INTRODUCTION

This purpose of this study was to investigate the effects of childcare on parents' attitudes and behaviors in shaping their children's food habits. The parental attitudes and behaviors measured included considerations made when choosing food for their children, perceived influence on and responsibility for their children's nutrition, and control over and satisfaction with their children's eating habits. The dietary intake, weight status, and general physical activity level of the children were evaluated also. This study was approved by the Institutional Review Board of The University of Texas at Austin prior to the recruitment of subjects.

DEVELOPMENT AND VALIDATION OF INSTRUMENTS

Instruments used in the study included a physical activity record, a demographic questionnaire, and three instruments designed to measure parents' attitudes and behaviors regarding their children's eating habits.

Physical activity record

A thorough review of literature did not reveal a simple, inexpensive method for measuring physical activity in preschool children. For this reason, a physical activity record was developed to provide general information about the types of activities in which young children participate (Appendix A). The information obtained from this instrument was not intended to compare actual energy expenditure of the two groups of children. It was developed to help explain any major differences in the weight status of the two groups of children. The physical activity record included questions about weekly organized sports and activities as well as daily activities. The daily activity section was a 24-hour log divided into fifteen minute increments. The record required that the parents list the types of activities in which their children participated in an “average” day during each given time. There were categories for sleep, television, sedentary activities, moderate activities, and vigorous activities. Examples of different types of activities were listed according to levels of energy expenditure. For example, the category of “sedentary activities” included examples such as eating, bathing, commuting by car, looking at books, et cetera.

Demographic questionnaire

The demographic questionnaire was adapted from one previously used by Briley, *et al* in their study of the diets of children in childcare [29]. It contained items regarding race/ethnicity, income, parents’ education, and size of household (Appendix B). It also included items about the type of childcare arrangements, time spent in childcare, number of meals and snacks in childcare, snacking habits at home, vitamin supplementation, and medical problems affecting food intake.

Attitude and Behavior Instruments

Three instruments were used to assess the attitudes and behaviors of the parents regarding their children’s eating habits. The first, “Ranking of factors that influence parents’ food choices and children’s eating habits,” was designed to assess the factors parents consider when choosing food for their children

(Appendix C). The parents were asked to rank in order their five most important considerations. Examples of common factors were listed to make it easier for parents to think of five answers. These examples were adapted from qualitative research by Kirk and Gillespie on the factors affecting food choices of working mothers [127]. This research is described in Section III of the review of literature. The first instrument also contained two questions designed to measure parents' perceptions of the influence and responsibility that they and other people exert on their children's eating habits.

The other two instruments, "Parents' perceived influence on and satisfaction with their child's eating habits," and "Parents' control over their child's eating habits" were adapted from the instruments designed by Burroughs and Terry in their 1992 study of parents' perspectives toward their children's eating habits (Appendices D and E) [113]. This research is described in Sections III and IV. Both questionnaires were Likert-type scales. The first was designed to measure parents' level of satisfaction with and perceived influence on the timing of meals and snacks, the rate of eating, and the types and amounts of food eaten by the children. The second instrument was designed to measure the level of control exerted by parents over the same factors.

Validation of Instruments

The instruments were reviewed by an expert panel for clarity, comprehensiveness, and redundancy. The instruments were then pilot tested with parents of children in childcare and parents of stay-at-home children in the Dallas-Fort Worth area of Texas. Two hundred copies of the instruments were mailed to childcare centers, church groups, and businesses for distribution to parents. The instruments returned were reviewed for completeness and clarity of answers. Changes were made as needed. The "Parents' perceived influence on and satisfaction with their child's food habits," and "Parents' frequency of control over their child's food habits" instruments were analyzed for reliability (internal consistency) using Cronbach's alpha.

SUBJECTS AND RECRUITMENT

Two groups of subjects were recruited: parents of children who attended childcare centers and parents of children who stayed home. In order to qualify as "stay-at-home," the children could not attend a childcare center or preschool more than 15 hours per week. They also could not attend a preschool that provided lunch. All of the children were between the ages of 3 and 5. Only one child per family was allowed to participate. Non-random, convenience sampling was used. Subjects were enrolled until fifty from each group had completed the study.

Eight childcare centers in Central Texas were contacted and invited to participate in the study. All of the centers agreed. Six of the childcare centers were in Austin. Two were in Georgetown, a smaller city outside of Austin. The centers were chosen to reflect the different geographical regions and ethnic groups of the Austin area. The centers also represented a variety of types of childcare centers. Three were none-profit, church affiliated centers. One was a private, church-affiliated school. One was part of the Georgetown Independent School District, and three were private, for-profit centers.

Researchers met with the centers' directors to explain the project and distribute materials. Fliers were placed around the centers and were sent home with parents (Appendix F). Teachers were informed of the study and were encouraged to discuss it with the parents. The following Monday, a researcher met with the parents as they picked up their children in the afternoon and asked if they were willing to participate in the study. Informed consent was obtained from the parents who agreed to participate (Appendix G). The parents also provided contact information and their child's birth date. They were then given measuring cups and spoons and the folder containing the instruments. They were also instructed on how to keep an accurate dietary record using measuring cups and spoons.

Parents of stay-at-home children were recruited through a variety of means. Fliers describing the study were distributed at Connections Resource Center, a non-profit organization that lends toys and books to parents and offers parenting classes (Appendix H). The study was featured in the Austin Family newspaper, a free newspaper offered in various locations in Austin, Texas, and in a similar paper distributed in Georgetown, Texas. Five organizations of mothers of preschool children were contacted and asked to distribute fliers to their members. A group of family practice physicians in Georgetown agreed to post the fliers and ask their patients to participate. Many of the study participants heard about the study from other participants. Every parent who agreed to participate and whose child met the age requirements was included in the study. Home visits were made by the researcher to enroll the parents of stay-at-home children in the study. After informed consent was obtained (Appendix I), parents were given the packet of instruments, the dietary record form, and a set of measuring cups and spoons.

DATA COLLECTION

Dietary intake of the children was assessed via a three-day diet record (Appendix J). The diet record was adapted from one validated by Briley, *et al* in their study of the diets of children in childcare [29]. It included detailed information about serving sizes, brand names, location of purchase, location of meals and snacks, and description of the food. Three-day diet records have been used successfully by other studies of similar populations [29, 43].

Childcare children

The children's meals and snacks during childcare were observed for three consecutive days (Tuesday, Wednesday and Thursday) by a researcher. Every effort was made to avoid interaction with the children during meals and snacks. No more than five children were observed each week. All but one of the childcare centers served their meals "family-style," allowing children to serve themselves from the communal bowls. Measuring cups were by the children and caregivers to serve food during the study. Measuring cups were also used by the researcher to estimate the amount of food remaining on the children's plates when they had finished. Visual estimation of serving sizes has been shown to be comparable to actually weighing the foods [143, 144]. Every food and beverage consumed at the childcare center was recorded, including those served during special celebrations.

The children were weighed to the nearest 0.2 lb on a Seca digital scale, model 840, in normal lightweight clothing without shoes. Their height was measured to the nearest 1/8 inch with a portable Harpenden stadiometer. Body mass index (kg/m^2) calculated from height and weight measurements was plotted on the CDC BMI-for-age growth charts (2000) [69]. In accordance CDC guidelines, a child with a BMI equal or greater than the 85th percentile was categorized as at risk for overweight [69]. A child at or above the 95th percentile for BMI was categorized as obese.

Notes were sent home to the parents on Thursday to remind them to turn in their child's diet records and the completed instruments the next day. Parents who returned their completed materials on Friday received a ten-dollar bill and a packet containing child nutrition information. Those who did not turn in their materials received a self-addressed stamped envelope in which to return their materials. The nutrition packets and ten-dollar bills were mailed to them when their materials were received. Each parent also received a complete analysis of their child's diet, suggestions for improvement, and a copy of the growth chart by mail.

Stay-at-Home Children

Home visits were made by the researcher to enroll the parents of stay-at-home children in the study. After informed consent was obtained (Appendix I), parents were given the packet of instruments, the dietary record form, and a set of measuring cups and spoons. They were instructed on how to keep an accurate dietary record for three consecutive weekdays, measuring their child's food intake with measuring cups and spoons. They were given a self-addressed stamped envelope in which to return the dietary records and the instruments. The children were weighed and measured by the same method used with the children in childcare. Telephone calls were made to remind the parents to return their forms. Once the forms were received, parents were sent a packet in the mail containing a ten-dollar bill and child nutrition pamphlets. They also received a complete analysis of their child's diet, suggestions for improvement, and a copy of the growth chart.

DATA ANALYSIS

All data was analyzed using the Statistical Package for Social Sciences (SPSS) version 11.0. A significance level of 0.05 was considered acceptable. Description of the statistical tests used to measure each research objective is presented in Table 8.

Table 8: Overview of data analysis

Objective	Measurement Method	Analysis
1. Daily food intake of young children • Number of servings from food guide pyramid • Total nutrient intake • Nutrient and food intake during evening • Intake of fruit juice and other beverage	3 dietary records from: • Children 3-5 in full-day childcare programs • Children 3-5 in full-day parental care	• FoodWorks version 2 for nutrient analysis. Mixtures divided into major components according to USDA guidelines • Servings from pyramid hand-calculated using age-appropriate serving sizes [5] • Intake of fruit juice and other beverages hand-calculated • Between groups analysis using chi-square, independent samples t-tests
2. Differences in attitudes and behaviors of parents of children in childcare and parents of stay-at-home children.	Instruments: • Ranking of factors that influence parents food choices and children's eating habits • Parents' frequency of control of their child's food behavior • Parents' perceived influence on and satisfaction with their child's food behavior	Individual item scores: • Frequencies and within-group means calculated by SPSS version 11.0 • Between groups analysis using chi-square and independent t-tests. Aggregate Scores: • Between groups analysis using independent samples t-tests.
3. Levels of physical activity: • Time spent viewing TV/video during the evening • Time spent in moderate or strenuous activity during the evening	Physical Activity Record	• Between groups analysis using independent samples t-tests.
4. Differences in weight status	• BMI • CDC BMI-for-age growth charts	• Between groups analysis using chi-square and t-tests.
5. Extent to which parental attitudes and behaviors explain children's dietary intake during the evening	• Secondary analysis of data sets	• Bivariate and partial correlations. • T-tests
6. Extent to which parental attitudes and behaviors and children's dietary intake and physical activity explain rates of overweight.	• Secondary analysis of data sets	• Bivariate and partial correlations. • Multiple regression with BMI percentile as the dependent variable.

Chapter 4: Results and Discussion

INTRODUCTION

The purpose of the present study was to determine whether parents of children in childcare exhibited different attitudes and behaviors toward their child's eating habits than parents of stay-at-home children, and whether these attitudes and behaviors were related to the dietary intake and weight of the children. The hypothesis was that parents of children in childcare would feel more satisfied with, less responsible for, less influential on exert less control over their child's diet than parents of children who stayed at home. This would in turn result in less healthful eating habits during the evening hours and a greater prevalence of overweight in the childcare children. In order to test this hypothesis, children's dietary intake and physical activity as well as parents' attitudes and behaviors were measured. Data analysis was conducted to determine differences between the two groups of children and relationships between the variables.

PILOT TESTING OF INSTRUMENTS

The instruments were pilot tested with parents of children in childcare and parents of stay-at-home children in the Dallas-Fort Worth area of Texas. Two hundred copies of the instruments were mailed to childcare centers, church groups, and businesses for distribution to parents. Thirty-two parents completed and returned the instruments. Reliability coefficients for satisfaction, influence, and control items on "Parents' perceived influence on and satisfaction with their child's food habits" (Appendix D) and "Parents' frequency of control over their child's food habits" (Appendix E) were calculated. Cronbach's alpha was 0.50 for items measuring influence, 0.75 for items measuring satisfaction and 0.60 for items measuring control.

SUBJECTS

Fifty children in full-time childcare and fifty children in full-time parental care from Austin, Texas and surrounding areas completed the study, representing a 63 percent retention rate for childcare children and a 76 percent retention rate for stay-at-home children. Demographic characteristics for both groups are presented in Table 9. The groups were closely matched on the sex and age of the children. Eighty-four percent of the stay-at-home children were white compared to 46 percent of childcare children. According to the U.S. Census Bureau, the Austin and Round Rock populations are 65.4 percent and 76.8 percent white, respectively [25]. Although efforts were made to recruit families who reflected the ethnic groups present in Austin, this effort was largely unsuccessful in the stay-at-home population. It is unclear whether this is due to sampling error or actual differences in ethnicity between children who attend childcare and children who stay at home. Only two percent of stay-at-home children were Hispanic, compared to 16 percent of childcare children. The populations of Austin and Round Rock are 30.5 percent Hispanic and 22.1 percent Hispanic, respectively [25]. Black children were overrepresented in the childcare group (16 percent) and underrepresented in the stay-at-home group (4 percent). Ten percent of the Austin population and 7.7 percent of the Round Rock population are black.

Table 9: Characteristics of study sample

Characteristic	Stay-at-Home (n=50) No. (%)	Childcare (n=50) No. (%)
Sex		
Male	25 (50)	28 (56)
Female	25 (50)	22 (44)
Age		
3 years	23 (46)	22 (44)
4 years	21 (42)	20 (40)
5 years	6 (12)	8 (16)
Race		
White	42 (84)	23 (46)
Non-white Hispanic	1 (2)	8 (16)
Non-Hispanic black	2 (4)	8 (16)
Asian-American	1 (2)	5 (10)
Other	4 (8)	6 (12)
Family Income		
<$20,000	4 (8.9)	4 (8.7)
$20,000-39,000	2 (4.4)	9 (19.6)
$40,000-59,000	11 (24.4)	9 (19.6)
$60,000-79,000	7 (15.6)	6 (13)
$80,000-99,000	8 (17.8)	6 (13)
$≥100,000	12 (26.1)	12 (26.1)
Maternal Education		
High school diploma	50 (100)	47 (100)
College degree	45 (90)	30 (63.8)
Graduate/Professional	13 (26)	13 (26)

Ten percent of childcare children and 2 percent of stay-at-home children were Asian-American compared to the 4.7 percent and 2.9 percent of the population in Austin and Round Rock.

The distribution of income among families in the two groups was similar. The majority of childcare families, 52 percent, earned $60,000 or more annually compared to 59.5 percent of stay-at-home families. However, more childcare families (19.6 percent) earned between $20,000 and $39,000 than did stay-at-home families (4.4 percent). Each group had four families who earned less than $20,000 per year. The incomes earned by the majority of families in this study reflect the median family incomes of the Austin and Round Rock areas, $54,091 and $65,471, respectively [25].

The participants in this study were highly educated. One hundred percent of the subjects who indicated an education level reported that they had earned at least a high school education. Three parents of children in childcare (6 percent) did not report an education level. Ninety-percent of stay-at-home parents and 63.8 percent of childcare parents reported a college degree. Thirteen percent from each group reported a graduate or professional degree. According to the 2000 census, forty percent of individuals living in Austin have a bachelors degree or higher, and 14.7 percent have graduate or professional degrees [25]. Thirty-three percent of the population in Round Rock had a bachelors degree and 9.1 percent have an advanced degree [25]. Thus, the participants in this study were more educated than would be predicted by geographical location.

Summary

The two groups of children in this study were closely matched in age and sex. However, the childcare group contained many more non-white children than the stay-at-home group. Both groups of mothers were highly educated, though more stay-at-home mothers had college degrees. Also, more families of stay-at-home children were in the middle- to upper-income brackets. Due to these differences in the two groups of subjects, the results from this study must be interpreted with caution. The results may not be generalizable to all groups of stay-at-home and childcare children because of the unusually high education level of the participants.

OBJECTIVE 1: DAILY INTAKE OF FOOD AND NUTRIENTS

Servings of food from the Food Guide Pyramid

The mean daily servings of foods from the Food Guide Pyramid consumed by the entire study population are shown in Table 10. The only statistically significant difference between boys and girls was in servings of meat ($p<0.001$). Boys consumed 2.2 servings of meat compared to 1.5 servings by girls. Children in this study consumed fewer servings from the Food Guide Pyramid than the national averages reported by CSFII 1994-1996, 1998 for every food group except fruit and dairy [2]. The mean intakes of bread for boys and girls were 5.1 and 4.9 compared to the CSFII average of 6.6 for boys and 6.0 for girls. Boys and girls in the present consumed fewer servings of meat than reported by CSFII, 2.2 and 1.5 compared to 3.0 and 2.8. Vegetable consumption in this study was 1.5 servings for boys and 1.3 servings for girls compared to the 2.1 and 2.0 reported by CSFII.

Table 10: Mean number of servings per day from the Food Guide Pyramid by sex

	Mean ± S.D.	
Food Group	**Boys (n=52)**	**Girls (n=47)**
Bread	5.1 ± 1.9	4.9 ± 1.6
Fruit	2.5 ± 1.8	2.2 ± 1.5
Vegetables	1.5 ± 0.9	1.3 ± 0.9
Meat	2.2 ± 1.1***	1.5 ± 0.8***
Dairy	2.4 ± 1.2	2.2 ± 0.9

***p<0.001

Dennison, *et al* reported intake of vegetables by five-year-olds to be 0.8 servings daily, while Fisher, *et al* found an average of 1.5 servings [55, 56]. The results from the present study may be more similar to Fisher's results due to similarities in the population studied. Dennison's group studied low-to middle-income families only, while this study included mostly middle- to upper-income families.. Boys and girls in the present study consumed amounts of fruit identical to the amounts reported by CSFII, 2.5 and 2.2 servings, respectively [2]. Dennison and Fisher's groups reported a mean of 1.5 servings of fruit for five-year-olds [55, 56]. Mean servings of dairy were also similar, 2.4 and 2.2 for boys and girls in this study compared to 2.0 and 1.9 for boys in CSFII 1994-1996, 1998.

The mean daily servings of foods from the Food Guide Pyramid by childcare status are shown in Table 11. The only statistically significant difference between the two groups was their intake of vegetables. Childcare children consumed an average of 0.5 more servings per day of vegetables ($p<0.01$). Both groups consumed fewer than the recommended 6 servings from the bread group and fewer than 3 servings from the vegetable groups. The childcare group consumed an average of 5.11 ± 1.91 servings of bread and 1.66 ± 0.90 vegetables per day. The stay-at-home group consumed an average of 4.97 ± 1.65 servings of bread and 1.15 ± 0.86 servings of vegetables per day. The mean intake of fruit, dairy, and meat by the childcare children met recommendations. Stay-at-home children also met recommendations for fruit and dairy but only consumed 1.70 ± 1.10 servings of meat compared to the recommended two servings.

Table 11: Mean number of servings per day from the Food Guide Pyramid by childcare status

Food Group	Mean ± S.D. Childcare (n=50)	Mean ± S.D. Stay-at-home (n=50)
Bread	5.1 ± 1.9	5.0 ± 1.6
Fruit	2.5 ± 1.7	2.3 ± 1.6
Vegetables	1.7 ± 0.9**	1.2 ± 0.9**
Meat	2.0 ± 0.9	1.7 ± 1.1
Dairy	2.4 ± 1.2	2.2 ± 1.0

**p<0.01

There were no significant differences between groups in terms of number of children meeting individual food group recommendations. Overall compliance with the recommendations was poor. None of the stay-at-home children and only three of the childcare children met recommendations for every group. Less than fifty percent of both groups reached target levels for bread, vegetables, and meat. Sixty percent of childcare children and sixty-two percent of stay-at-home children met dairy requirements. Many of the dairy servings came from fluid milk, yogurt, and cheese products. Forty-six percent of childcare children and 56 percent of stay-at-home children consumed at least 2 servings of fruit each day. Only 12 percent of childcare children and 6 percent of stay-at-home children consumed three servings of vegetables daily. Unfortunately, most of the vegetables consumed were in the form of tomato sauce on pizzas and pastas, and potato products such as french fries and potato puffs.

Food Guide Pyramid compliance by children in this study was less frequent than that reported by CSFII, 1994-1996, 1998 (Chapter 2, Table 6), with the exception of dairy and meat [2]. Approximately 60 percent of children in this study met dairy requirements compared to 45 percent of children in CSFII. Also only 20 percent of children in CSFII met meat requirements compared to 48 percent of childcare children and 32 percent of stay-at-home children in the present study. Compliance with vegetable and grain recommendations was much lower in this study. According to the CSFII, 24 percent of girls and 21 percent of boys met the recommended three servings of vegetables daily. Only 12 percent of childcare children and 6 percent of stay-at-home children consumed three servings of vegetables daily. Only about 25 percent of children in this study consumed enough grains compared to 50 percent of children in CSFII.

Evening intake

As noted previously, the only difference between the food group consumption of stay-at-home children and childcare children was in the vegetable group. This difference may be due to the composition of meals at the childcare center. At the very least, the difference does not appear to be due to differences in the evening meals. Table 12 shows a comparison of food group consumption by the two groups between 4 pm and bedtime. There were no statistically significant differences in the food consumption by the two groups during the evening hours. Children in both groups met at least 1/3 of the recommended number of servings during the evening for fruit, meat, and dairy but did not consume enough bread or vegetables. The fact that there was no statistically significant difference in vegetable consumption during the evening meal suggests that the difference was due to lunch consumption. Childcare centers tended to serve hot meals with meat and at least one vegetable. In this study, children who stayed at home tended to eat cold lunches that did not always include a vegetable. Greater availability of vegetables and peer influence may have increased consumption by childcare children. Both of these factors have been shown to increase consumption in earlier studies [21, 142].

Table 12: Mean number of servings from Food Guide Pyramid during evening hours by childcare status[a]

Food Group	Mean ± S.D. Childcare (n=50)	Mean ± S.D. Stay-at-home (n=50)
Bread	1.8 ±1.1	1.7 ± 1.0
Fruit	0.77 ± 0.80	0.65 ± 0.72
Vegetables	1.05 ± 0.71	0.82 ± 0.76
Meat/Meat Alternates	0.93 ± 0.43	0.82 ± 0.55
Dairy	0.84 ± 0.59	0.90 ± 0.60

[a] No significant differences between groups of children.

Intake during childcare

The American Dietetic Association recommends that full-time childcare centers provide enough food to meet ½ to 2/3 of the Food Guide Pyramid recommendations during an eight hour day [139]. Table 13 compares the actual intake during childcare of the children in this study to ½ and 2/3 of the recommendations. The childcare children consumed enough fruit during childcare to meet 2/3 of the Food Guide Pyramid recommendations. They consumed enough meat and dairy to meet 1/2, but not 2/3 of the recommendations ($p \leq 0.05$, $p<0.001$). They consumed significantly less vegetables, 0.55 ±0.5 than the recommended 1.5 and 2.0 ($p<0.001$). They also did not eat enough bread products to meet ½ ($p<0.01$) or 2/3 ($p<0.001$) of the pyramid recommendations. Fortunately, as noted previously, children in childcare consumed enough food at home to make up for deficiencies in childcare intake for every group except grains and vegetables.

A thorough review of published literature did not reveal a similar study of actual intake of children in childcare in comparison to the Food Guide Pyramid. Previous studies either assumed that children ate foods in recommended portion sizes or calculated servings based on CACFP portions rather than Food Guide Pyramid portions [29, 30, 35]. CACFP serving sizes are smaller than those put forth the Food Guide Pyramid, making comparisons between the studies difficult. This would explain why the mean numbers of servings reported by Bruening, *et al* (Chapter 2, Table 7) are in general larger than the averages reported here [35].

Table 13: Intake during childcare versus ½ and 2/3 of the recommendations by the Food Guide Pyramid

Food Group	**Mean intake ± S.D.**	**½ Pyramid**	**2/3 Pyramid**
Bread	2.48 ± 1.15	3.00**	4.00***
Fruit	1.36 ± 0.89	1.00**	1.34
Vegetables	0.55 ± 0.51	1.50***	2.00***
Meat/Meat Alternates	0.93 ± 0.71	1.00	1.34***
Dairy	1.14 ±0.59	1.00	1.34*

* p≤0.05
**p<0.01
***p<0.001

However, data presented here does confirm previous findings that children do not consume enough grains or vegetables during childcare [28-30, 35].

Macronutrient, vitamin, and mineral intake

Total daily intake

There were some differences between the macronutrient intake of children in childcare and stay-at-home children. A comparison of mean macronutrient intake is shown in Table 14. Children in childcare consumed significantly more kilocalories than stay-at-home children, 1563 ± 335 versus 1359 ± 275 ($p \leq 0.001$), despite similarities in age and sex. Only 50 percent of children in childcare and 32 percent of stay-at-home children met their age-specific RDA for energy. One hundred percent of children in childcare and 98 percent of stay-at-home children met the RDA for protein. Childcare children consumed on average more protein, 58.5g ± 13.7 versus 51.7g ± 14.4 ($p<0.05$), more total fat, 56.8g ± 14.9 versus 48.8g ± 12.9 ($p \leq 0.01$), and more saturated fat, 20.5g ± 6.1 versus 17.9g ± 6.2 ($p<0.05$) than stay-at-home children. There were no statistically significant differences in the amounts of monounsaturated fat, polyunsaturated fat, and cholesterol consumed by the two groups or the percentage of energy contributed by fat. Both groups exceeded recommendations for percentage of calories from saturated fat and monounsaturated fat by about 1 percent. Polyunsaturated fat was below the recommended 10 percent, 5.5 ± 2.2% of the kilocalories for childcare children and 5.1 ± 2.2% of the kilocalories for stay-at-home children. The cholesterol intakes of 177.5 ± 83.7g for childcare children and 154.5 ± 80.7g for stay-at-home children met the recommendations of no more than 200 g per day.

Table 14: Comparison of macronutrient intake by childcare status

Nutrient		Mean ± S.D. Childcare	Stay-at-home
Energy (kcal)		1563 ± 335***	1359 ± 275***
Protein (g)		58.5 ± 13.7*	51.7 ± 14.4*
Total fat			
	(g)	56.8 ± 14.9**	48.8 ± 12.9**
	(% kcal)	32.1 ± 4.4	31.5 ± 5.4
Saturated fat			
	(g)	20.5 ± 6.1*	17.9 ± 6.2*
	(% kcal)	11.8 ± 1.9	11.0 ± 2.5
Monounsaturated fat			
	(g)	19.3 ± 5.1	16.6 ± 4.7
	(% kcal)	11.1 ± 1.8	11.0 ± 2.5
Polyunsaturated fat			
	(g)	9.4 ± 4.0	7.6 ± 3.1
	(% kcal)	5.5 ± 2.2	5.1 ± 2.2
Cholesterol (g)		177.5 ± 83.7	154.5 ± 80.7

*p<0.05
**p≤0.01
***p≤0.001

Both groups consumed close to 32 percent of their energy from fat compared to the recommended 30 percent.

The amount of energy, protein, saturated fat, and percentage of energy from fat consumed by childcare children closely resembled that reported by the most recent NHANES, CSFII, and the Framingham Children's Study shown in Table 1 of Chapter 2 [1, 43, 45]. However, stay-at-home children in this study consumed approximately 200 fewer kilocalories per day, 1 to 7 fewer grams of protein, and 2 grams fewer saturated fat than the childcare children and the national surveys. There are at least three possible reasons for this. First, the stay-at-home population was largely white and from families of high socioeconomic status. It was not representative of the national population. Second, dietary information was provided entirely by the parents and underreporting might have occurred. This fact does not distinguish the stay-at-home children from the national surveys, but it does distinguish them from the childcare children in this study. Finally, characteristics of the home environment of stay-at-home children might cause them to actually take in fewer calories and less saturated fat. For instance, children who stay at home may have fewer structured meals and fewer foods offered for meals than children in childcare. Until now, research has not been conducted specifically to evaluate the diets of children who do not attend childcare centers.

The overall similarities in food group consumption by children in childcare and stay-at-home children are reflected in their intakes of vitamins and minerals. There were no statistically significant differences in the number of children meeting the RDA for the selected nutrients or the mean intake of nutrients by the two groups of children. Between 90 and 100 percent of the children in both groups met the RDAs for vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin $B_{6,}$ vitamin B_{12}, zinc, and iron.

Only 50 percent of childcare children and 46 percent of stay-at-home children achieved the RDA for vitamin E. Eighty percent of childcare children and seventy percent of stay-at-home children met the RDA for pantothenic acid, while 88 percent of childcare children and 94 percent of stay-at-home children met the RDA for folate. Furthermore, ninety percent of childcare children and 88 percent of stay-at-home children met the RDA for calcium. According to CSFII 1994-1996, 1998, only 48.4 percent of children ages 3 to 5 years nationally met the RDA for calcium, while 30.4 percent and 65.7 percent met the RDAs for zinc and iron, respectively (Chapter 2, Table 4) [2]. Similarly, only 25.2 percent met the requirement for vitamin E. This data suggests that the childcare centers and parents involved in this study were above average in providing children with the necessary nutrients.

Evening intake

Evaluation of macronutrient intake during the evening hours suggests that the extra kilocalories consumed by the children in childcare centers are being provided both by the childcare center and by parents during afternoon snacks and evening meals. A comparison of evening macronutrient intake is shown in Table 15. Childcare children consumed an average of 636 ± 201 kcal between 4pm and bedtime compared to stay-at-home children who consumed 533 ± 135 kcal ($p \leq 0.01$). By deductive logic, the other 100 kilocalories of difference must have come from the childcare centers. There were no other statistically significant differences between the evening intake of the two groups, suggesting that the extra saturated fat and protein were consumed at the childcare centers.

Vitamin and mineral intake between 4 pm and bedtime was also similar for childcare children and stay-at-home children (Table 16). The only statistically significant differences were in vitamin C and potassium intake. The average evening intake of vitamin C was 11.9 ± 13.9 mg for childcare children and 30.1 ± 26.3 mg for stay-at-home children ($p<0.05$). The average intake of potassium was 889.2 ± 342.7 mg for childcare children and 769.7 ± 218.3 mg for stay-at-home children ($p<0.05$). Since there were no differences between the evening fruit and vegetable consumption by the two groups, the differences in vitamin C and potassium may have come from the types, rather than quantities of fruits and vegetables consumed. Another possible explanation for differences in vitamin C is the consumption of fruit drinks and other fortified foods. Many fruit beverages marketed to children are fortified with vitamin C.

Table 15: Comparison of macronutrient intake during evening hours by childcare status

Nutrient	Mean ± S.D. Childcare	Stay-at-Home
Energy (kcal)	636 ± 201	533 ± 135**
Protein (g)	25.1 ± 7.7	45.6 ± 112.8
Total fat		
(g)	23.4 ± 8.7	21.0 ± 7.2
(% kcal)	33.1 ± 6.8	35.1 ± 6.9
Saturated fat		
(g)	8.6 ± 3.2	8.1 ± 3.3
(% kcal)	11.8 ± 1.9	11.8 ± 3.0
Monounsaturated fat		
(g)	8.3 ± 3.1	7.3 ± 2.9
(% kcal)	11.9 ± 3.5	12.1 ± 3.0
Polyunsaturated fat		
(g)	3.8 ± 3.1	3.2 ± 3.1
(% kcal)	5.5 ± 2.2	5.1 ± 2.2
Cholesterol (g)	70.7 ± 35.8	67.3 ± 42.9

**p≤0.01

Table 16: Comparison of vitamin and mineral intake during evening hours

Nutrient	Mean ± S.D. Childcare	Stay-at-Home
Vitamin A	416.9 ± 494.7	388.4 ± 317.7
Vitamin C	11.9 ± 13.9*	30.1± 26.3*
Vitamin E	2.0 ± 1.8	1.7±1.0
Thiamin	0.5 ± 0.2	0.4 ± 0.1
Riboflavin	0.6 ± 0.3	0.6 ± 0.2
Niacin	5.8 ± 2.1	5.3 ± 2.3
Pantothenic Acid	0.8 ± 0.4	0.8 ± 0.4
Folate	69.7 ± 39.4	72.0 ± 37.0
Vitamin B_6	0.5 ± 0.2	0.4 ± 0.2
Vitamin B_{12}	1.1 ± 0.7	1.2 ± 0.6
Iron	3.8 ± 1.6	3.3 ± 1.4
Zinc	3.0 ± 1.4	2.7 ± 1.0
Calcium	299.5 ± 167.4	328.5 ± 193.8
Potassium	889.2 ± 342.7*	769.7 ±218.3*

*p≤0.05

Intake during childcare

The average intake of macronutrients during childcare and the number of children meeting recommendations during childcare are shown in Table 17. The mean intake of energy during childcare was 741.0 ± 240.7 kcal. Only 10 percent of the children met 2/3 of the RDA for energy while at the childcare center. The mean percent of RDA consumed was 48.0% ± 16.5%. This is not surprising considering previous studies by Briley and colleagues have found that childcare centers often do not even serve enough food to meet 50 percent of the RDA for energy [27, 29, 30]. Childcare children in this study consumed on average more energy than had been reported in previous studies. Bruening, *et al* and Bollela, *et al*, reported mean intakes during childcare of 549 kcal and 523 kcal, respectively, at childcare centers that served two meals and one snack [34, 35]. Drake reported a mean intake of 985 kcal in centers that served two meals and two snacks [33]. All of the childcare centers in this study served either one meal and two snacks, or two meals and one snack. This probably accounts for the difference in energy intake between this study and Drake's study. The differences between this study and the Bruening and Bollela studies may be related to the types of childcare centers surveyed. The studies by Bruening's and Bollela's groups included only centers that participated in CACFP. The present study included centers that participated in CACFP and centers that did not. Oakley found that menus from centers that participated in CACFP had fewer foods on the menu and offered less energy than menus from centers that did not participate in CACFP [32].

Table 17: Mean intake and number of children meeting recommendations for macronutrients during childcare.

Nutrient		Mean Intake±S.D	Met 2/3 RDA or recommendations No. (%) (n=50)
Energy (kcal)		741.0 ± 240.7	5 (10)
Protein (g)		27.1 ± 9.8	48 (96)
Total fat[a]			
	(g)	27.7 ± 9.8	
	(% kcal)	33.8 ± 4.5	9(18)
Saturated fat[b]			
	(g)	10.0 ± 3.9	
	(% kcal)	12.0 ± 2.2	8 (16)
Monounsaturated fat[c]			
	(g)	9.2 ± 4.2	
	(% kcal)	11.0 ± 2.2	19 (38)
Polyunsaturated fat[d]			
	(g)	4.9 ± 2.4	
	(% kcal)	6.1 ± 2.8	3 (6)
Cholesterol (g)		80.8 ± 51.0	45 (90)

[a] Total fat should not exceed 30% of energy.
[b] Saturated fat should not exceed 10% of energy
[c] Monounsaturated fat should be 10% of energy.
[d] Polyunsaturated fat should be 10% of energy.

As in previous studies, childcare children in this study consumed adequate amounts of protein [29, 33-35]. The mean protein intake was 27.1 ± 9.8g, and 96 percent of the children met 2/3 of the RDA. The results for fat were not as promising. Children consumed an average of 27.7 ± 9.8g of fat which accounted for 33.8 ± 4.5% of their energy intake during childcare. Only 18 percent consumed 30 percent or less of their energy as fat. The mean saturated fat intake was 10.0 ± 3.9g and 12.0 ± 2.2% of energy, with 16 percent of children consuming less than 10 percent of their energy as saturated fat. Thirty-eight percent met the recommendations for monounsaturated fat, while only six percent met the recommendations for polyunsaturated fat. These results indicate that too great a proportion of foods at the childcare centers are rich in saturated fat rather than the healthier monounsaturated and polyunsaturated fats. It is interesting to compare the amount of fat consumed by this group to the means reported by previous studies. Children in this study consumed almost twice as much fat as the means reported by Breuning and Bollela (Chapter 2, Table 7). Again, this might be related to the participation of non-CACFP centers in this study.

Table 18 compares the intake of children during childcare to 2/3 of the RDA for vitamins and minerals. As in earlier studies of children in childcare, children in this study consumed more than 2/3 of the RDA for vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B_6, and vitamin B_{12} [29, 31, 34, 35]. The children consumed 79.7 ± 36.3% of the RDA for zinc, and 62 percent of children met at least 2/3 of the RDA. The average consumption of calcium was 70.9 ± 52.5% of the RDA, but only 40 percent of the children consumed at

Table 18: Mean intake and number of children meeting at least 2/3 RDA for selected nutrients during childcare.

Nutrient	Mean intake ± S.D.	RDA 3 yr./4-5 yr.	% RDA consumed during childcare	Met 2/3 RDA No. (%) (n=50)
Energy (kcal)	741.0 ± 240.7	1300/1800	48.0 ± 16.5	5 (10)
Protein (mg)	27.1 ± 9.8	16/24	135.3 ± 47.0	48 (96)
Vitamin A (RE)	395.9 ± 280.8	300/400	112.8 ± 76.9	32(64)
Vitamin C (mg)	55.6 ± 60.7	15/25	287.5 ± 352.4	40 (80)
Vitamin E (mg)	2.4 ± 1.1	6/7	37.1 ± 17.0	3 (6)
Thiamin (mg)	0.6 ± 0.2	0.5/0.6	105.0 ± 34.5	43 (86)
Riboflavin (mg)	1.1 ± 1.8	0.5/0.6	143.6 ± 49.6	47 (94)
Niacin (mg)	6.7 ± 2.3	6/8	95.2 ± 33.9	40 (80)
Pantothenic Acid (mg)	1.2 ± 0.5	2/3	47.4 ± 18.8	6 (12)
Folate (µg)	92.8 ± 48.5	150/200	52.6 ± 27.2	13 (26)
Vitamin B_6	0.6 ± 0.2	0.5/0.6	102.9 ± 45.1	42 (84)
Vitamin B_{12}	1.6 ± 0.7	0.9/1.2	156.5 ± 73.0	47 (94)
Iron (mg)	5.0 ± 2.0	7/10	59.4 ± 26.0	17 (34)
Zinc (mg)	3.1 ± 1.4	3/5	79.7 ± 36.3	31 (62)
Calcium (mg)	466.4 ± 411.8	500/800	70.9 ± 52.5	20 (40)
Potassium (mg)	1069.3 ± 373.9	1400	38.2 ± 42.7	31 (62)

least 2/3 of the RDA. Previous studies also have found calcium and zinc to be lacking, as well as iron, folate, and vitamin E [29, 31, 34, 35]. This study confirmed those findings. Only 34 percent of children consumed 2/3 of the recommended amount of iron, while 26 percent and 6 percent consumed 2/3 of the recommended amounts of folate and vitamin E, respectively.

Beverage consumption

Beverages are an important source of energy and nutrients for young children [59, 89, 90]. However, due to concerns about a possible relationship between fruit juice consumption and dental caries, the American Academy of Pediatrics recommend that young children drink no more than 4 to 6 ounces of 100% fruit juice daily [94]. The mean daily intake of beverages by childcare children and stay-at-home children are presented in Table 19. There were no statistically significant differences in the intake of fruit juice and soft drinks by childcare children and stay-at-home children. Both groups consumed approximately four ounces of 100 percent fruit juice and one ounce of soft drinks daily. The large standard deviation for both groups indicates a wide variety in the amounts of beverages consumed by the children. The intake of fruit juice ranged from 0 to 17 ounces daily, and intake of soft drinks ranged from 0 to 8 ounces. Only three childcare children and four stay-at-home children consumed 12 ounces or more of fruit juice daily, an amount found in a previous study to be related to childhood overweight [89].

Table 19: Average daily intake of beverages by childcare status

Beverage	Mean Intake ± S.D. Childcare	Stay-at-home
100% Fruit Juice (oz)	4.3 ± 4.1	3.9 ± 4.6
Soft Drinks[a] (oz)	1.3 ± 2.0	1.2 ± 2.1
Other sweetened beverages[b] (oz)	3.1 ± 3.8*	1.7 ± 2.8*
Total beverages other than milk[c] (oz)	8.6 ± 6.2	6.8 ± 5.9
Milk (oz)	16.6 ± 20.5*	10.3 ± 7.5*

[a] Excludes diet soft drinks
[b] Includes all sugar-sweetened drinks except soft drinks
[c] Includes 100% fruit juice, soft drinks, and other sweetened beverages
* $p<0.05$

Childcare children drank on average 3.1 ± 3.8 ounces of sweetened beverages other than soft drinks compared to 1.7 ± 2.8 by stay-at-home children ($p<0.05$). The total beverage intake excluding milk did not differ between the two groups. Eleven childcare children and 12 stay-at-home children consumed an average of 12 or more ounces of total beverages excluding milk daily. Childcare children drank more milk, 16.6 ± 20.5 ounces, than stay-at-home children who drank an average of 10.3 ± 7.5 ounces ($p<0.05$). There was quite a large range in milk consumption. Childcare children drank between 0.29 and 112.7 ounces of milk daily, while stay-at-home children consumed between 0 and 34.0 ounces. As in previous studies, there was no relationship between milk consumption and fruit juice consumption [89, 90]. However, while other studies have found an inverse relationship between soft drink intake and milk intake, no such relationship was found here [90, 132]. There was also no significant relationship between soft drink intake and fruit juice intake.

Summary

Of the one hundred children who participated in this study, only three met Food Guide Pyramid recommendations for every food group. The food groups most likely to be lacking were the grain and vegetable groups, though children in childcare ate an average of a half serving more of vegetables than stay-at-home children. Children in childcare also consumed 200 more kilocalories as well as more fat, saturated fat, and total beverages (excluding milk) than stay-at-home children. Dietary intake during the evening was similar for the two groups except that childcare children consumed more energy (+100 kcal), and less vitamin C and potassium than stay-at-home children. Both groups consumed less than the RDA for energy but consumed enough of every other nutrient except vitamin E. This occurred despite the fact that children in childcare did not consume enough calcium, zinc, iron, folate or vitamin E while at the childcare center to meet 2/3 of the RDA for these nutrients. These results do not support the hypothesis that the dietary intake of children who attend childcare is less healthful during the evening than the intake of stay-at-home children. Other than consuming more fat and saturated fat, childcare children did not have less healthful diets overall either. They actually consumed more vegetables than stay-at-home children.

OBJECTIVE 2: PARENTS' ATTITUDES AND BEHAVIORS

The hypothesis of this study stated that parents of children who attended childcare would feel less influential on, less responsible for, and exert less control over their child's eating habits than parents of stay-at-home children. Three instruments were used to determine the validity of the hypothesis. The first, "Ranking of factors that influence parents' food choices and children's eating habits" was designed to identify possible barriers toward good nutrition and to determine parents' perceived influence on and responsibility toward their child's eating habits (Appendix C). Table 20 compares the mean ranking of factors that parents considered when deciding what to feed their child for his or her evening meal. The factors were ranked from one (most important) to five (least important). When a factor did not appear in the list written by the participant, it was automatically coded as a six to indicate its relative unimportance to the participant.

Parents indicated that the nutritional content of the foods was the most important factor, followed by the child's food preferences and ease of preparation. Parents of children in childcare felt that time needed for preparation of the food was more important than did parents of stay-at-home children ($p<0.01$). They ranked it as more important than parent's own food preferences. Parents of stay-at-home children ranked parent's food preferences as more important than time needed for preparation of the food. Neither group felt that cost was an important issue in choosing foods for their children.

Table 20: Ranking of factors parents consider when choosing food for their child's evening meal.

	Mean Rank ± S.D.	
Factor	Parents of childcare children	Parents of stay-at-home children
Parent's food preferences	4.21 ± 1.78	4.08 ± 1.62
Child's food preferences	2.91 ± 1.64	2.80 ± 1.58
Time needed for preparation	3.77 ± 1.76**	4.65 ± 1.45**
Ease of Preparation	3.09 ± 1.61	3.51 ± 1.61
Nutritional content of foods	2.52 ± 1.55	2.12 ± 1.44
Cost of foods	5.55 ± 0.79	5.65 ± 0.75
Other	5.13 ± 1.65	4.61 ± 1.80

[a] Factors ranked from 1 (most important) to 6 (least important).
*p=0.01

The fact that nutrition was ranked as most important is not surprising. It is possible that parents who participate in nutrition studies already have an active interest in nutrition. Social acceptability bias may also have influenced their responses. The similarities in the mean ranks of nutrition and child's food preferences suggest that some parents ranked child's food preferences over nutrition. It is interesting to note that parents felt their food own food preferences were less important than their child's food preferences. Rather than choose foods they themselves liked, they chose foods based on the preferences of three- to five-year-old children. Time was more important to parents of children in childcare than it was to parents of stay-at-home children. Parents of children in childcare presumably felt that time needed to prepare foods was an important factor because they had less available time in the evenings than parents of stay-at-home children. The fact that cost was not as important may be a reflection of the higher than average incomes earned by families in this study.

This instrument also measured parents' perceptions of whom or what influenced their child's eating habits. The participants ranked items from one (most influence) to seven (least influence). Items ranked included television, childcare center, parent answering questionnaire, spouse, child's siblings, other family members, and friends of the family. The mean ranks of the seven items by the two groups of parents are shown in Table 21. The parent answering the questionnaire was ranked as the most influential by both groups, followed by the spouse. Parents of children in childcare ranked the childcare center more influential (3.17) than did parents of stay-at-home children (6.17) ($p<0.001$). This is not surprising since the stay-at-home children by definition spent no more than 15 hours per week in childcare. The stay-at-home group spent an average of 11 hours per week in some type of childcare, usually a preschool or “mothers’ day out” program. What is interesting to note is the difference between the spouse's rankings by the two groups. The parents of children in childcare ranked the spouse higher than did the parents of stay-at-home children, though the difference was not statistically significant ($p=0.067$). This similarity between rank of spouse and rank of childcare center suggests that some of the parents of children in childcare ranked the childcare center as more influential than their spouse. Both groups of parents ranked the siblings the same, but parents of stay-at-home children felt that friends of the family were more influential than did parents of childcare children ($p<0.001$). Both groups felt that television was the least influential on their child’s eating habits.

Parents’ perceptions of the responsibility of different individuals are shown in Table 22. Again, they were asked to rank factors in order of their importance. Both groups indicated that they themselves were most responsible for their child’s eating habits. However, parents of stay-at-home children ranked themselves slightly higher on average (1.02) than parents of childcare children (1.23) ($p<0.05$), indicating that parents of children in childcare sometimes ranked other factors as being more important than themselves. Given the order of their rankings, it can be assumed that they occasionally ranked the childcare center as being more responsible. In fact, further analysis

Table 21: Parents' ranking of factors that influence their child's eating habits.

Factor	**Mean Rank ± S.D.[a]**	
	Parents of children childcare	Parents of stay-at-home children
Television	5.76 ± 1.32	5.69 ± 1.43
Childcare center	3.17 ± 1.61***	6.17 ± 1.40***
Parent answering questionnaire	1.35 ± 0.90	1.18 ± 0.49
Spouse	2.85 ± 1.88[b]	2.25 ± 0.93[b]
Child's siblings	4.76 ± 2.00	4.08 ± 2.04
Other family members	5.06 ± 1.47	4.79 ± 1.50
Friends of family	5.60 ± 1.42***	4.42 ± 1.20***

[a] Factors ranked from 1 (most influence) to 7 (least influence)
[b] Difference approached significance (p = 0.067)
***p<0.001

Table 22: Parents' ranking of individuals' responsibility for their child's daily nutrition.

Factor	Mean Rank ± S.D.[a] Parents of childcare children	Parents of stay-at-home children
Parent answering questionnaire	1.23 ± 0.68*	1.02 ± 0.14*
Spouse	2.71 ± 0.54*	2.08 ± 0.54*
Childcare center	2.37 ± 1.25***	5.27 ± 1.25***
Child's siblings	5.25 ± 1.19	5.06 ± 1.16
Other family members	4.52 ± 1.13*	4.00 ± 1.25*
Friends of family	5.30 ± 1.06***	4.35 ± 1.08***

[a] Factors ranked from 1 (most responsible) to 7 (least responsible).
*$p \leq 0.05$
*** $p \leq 0.001$

showed that while 84 percent of respondents indicated themselves as being most responsible, 16 percent ranked the childcare center as most responsible.

This reinforced conclusions from Wright and Radcliffe that parents feel responsibility for their child's eating habits but transfer some of that responsibility to childcare centers [36]. As would be expected, parents of children in childcare gave the childcare center higher ranking than parents of stay-at-home children, 2.37 compared to 5.27 ($p<0.001$). Interestingly, parents of children in childcare ranked the childcare center as more responsible (2.37) than their spouses (2.71). Due to this shift in perceived responsibility, the average ranking for spouses of parents of childcare children was lower, 2.71, than that for spouses of parents of stay-at-home children, 2.08 ($p<0.05$). It is unknown how many of the spouses were parents of the children and how many were step-parents. This could influence parents' perceptions of the responsibility of their spouse for their child's eating habits. Parents in both groups ranked other family members, friends of family, and siblings as being the least responsible. The average rankings of these three items differ significantly between the two groups, presumably because the high rank of childcare centers by parents of childcare children caused the other factors to be shifted down in rank.

Two other instruments were used to measure parents' attitudes and behaviors in shaping their children's eating habits. These were developed by Burroughs and Terry in 1992 and included "Parents' perceived influence on and satisfaction with their child's food behavior" and "Parents' frequency of control of their child's food behavior" (Appendices D and E) [113]. The reliability coefficient (Cronbach's alpha), was 0.80 for influence items (n=97), 0.84 for satisfaction items (n=96), and 0.49 for control items (n=95). Aggregate scores were calculated to provide an overall measure of parents' perceived influence on, satisfaction with, and control over their child's eating habits. The scores ranged from 1 to 5 with lower scores indicating greater levels of satisfaction, influence, and control. There were no significant differences between any of the aggregate scores of the two groups of parents. Parents of children in childcare scored a mean of 2.53 ± 0.72 on influence items, while parents of stay-at-home children scored a mean of 2.48 ± 0.64. Parents of children in childcare scored 2.45 ± 0.73 compared to 2.26 ± 0.63 by parents of stay-at-home children on satisfaction. Parents perceived their control to be slightly less, 2.81 ± 0.32 for parents of childcare children and 2.80 ± 0.38 for parents of stay-at-home children.

Parents' responses to individual items on influence and satisfaction are listed in Tables 23 and 24. There were no significant differences between the two groups of parents in the distribution of responses to the questions. As for frequency and rate of eating, the majority of parents in both groups felt that the times they ate meals and snacks influenced the times their children ate meals and snacks, and were satisfied with the times their child ate. Most disagreed that the speed at which they ate meals influenced the speed at which their child ate. They also did not feel that their child should eat between meals less often. Regarding the types of foods eaten, the majority of parents in the two groups felt that their own food likes and dislikes as well as their consumption of sweets, snack foods,

Table 23: Parents' responses to items on perceived influence on and satisfaction with the rate and frequency of the meals and snacks eaten by their child.

Item	Percent: Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Rate/Frequency of eating					
The time I eat meals influences the time my child eats.	CC[b]: 42	30	6	14	2
	SH[c]: 50	34	10	4	2
If I eat between meals, it influences my child to do the same.	CC: 30	50	4	12	0
	SH: 38	38	12	12	0
The speed at which I eat influences the speed at which my child eats.	CC: 10	16	14	44	10
	SH: 10	18	22	38	12
I am satisfied with the times my child eats meals.	CC: 24	52	12	6	0
	SH: 26	30	14	0	0
I think my child should eat between meals less often.	CC: 6	14	18	44	10
	SH: 0	18	24	46	12

[a] There were no significant differences in the distribution of answers by the two groups of parents.
[b] "CC" indicates responses of parents of children in childcare
[c] "SH" indicates responses of parents of stay-at-home children

Table 24: Parents' responses to items on perceived influence on and satisfaction with the types and amounts of food eaten by their child[a]

Item	Percent: Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Types of foods eaten					
If I eat sweets and snack foods, it encourages my child to do the same.	CC[b]: 38 SH[c]: 48	42 40	0 0	12 10	4 2
If I eat a variety of foods, it encourages my child to do the same.	CC: 30 SH: 36	52 50	8 10	4 4	2 0
My food likes and dislikes influence my child's food likes and dislikes.	CC:14 SH: 20	42 44	12 20	24 14	2 2
I am satisfied with the kinds of foods my child eats for meals.	CC: 20 SH: 22	40 54	12 8	24 16	0 0
I am satisfied with the kinds of foods my child eats between meals.	CC: 10 SH: 14	46 54	16 26	20 6	2 0
I am satisfied with the variety of food my child eats.	CC: 22 SH: 18	32 46	12 14	26 22	4 0
Amount of food eaten					
The amount of food I eat for meals influences the amount my child eats	CC: 10 SH: 6	8 4	14 18	50 60	14 12
The amount of food I eat between meals influences the amount my child eats.	CC: 12 SH: 8	14 22	26 16	36 48	6 6
I think my child does not eat enough food for meals.	CC: 18 SH: 6	12 16	12 18	40 42	12 18
I think my child eats too much food between meals.	CC: 0 SH: 0	12 8	8 26	56 54	18 12
Overall, I think my child eats about the right amount of food.	CC: 22 SH: 22	50 60	4 8	16 8	4 2

[a] There were no significant differences in the distribution of answers by the two groups of parents.
[b] "CC" indicates responses of parents of children in childcare
[c] "SH" indicates responses of parents of stay-at-home children

and dietary variety influenced their child's likes, dislikes and eating habits. Most parents were satisfied with the kinds and variety of foods eaten by their children. As for amount of food eaten, most parents did not feel that the amount of food they ate for meals and snacks influenced the amount of food their child ate. The majority disagreed that their child did not eat enough for meals and snacks. They felt that their child ate about the right amount of food overall. Results from this questionnaire suggest that the parents in this study were satisfied overall with the rate, frequency, amount and types of food eaten by their children. They felt that the types but not the amount of food eaten by them influenced their children's eating habits. These results closely mirror those reported by Burroughs and Terry in their original use of this questionnaire [113].

Though no differences in the distribution of answers were found between parents of children in childcare and stay-at-home children after chi-square analysis, the two groups appear to have responded to two items somewhat differently. Due to limitations in SPSS software, differences in the number of individuals responding in a particular way, such as "strongly agree" could not be calculated. For this reason, the data were analyzed qualitatively. Seventy-six percent of parents of childcare children either agreed or strongly agreed that they were satisfied with the times their child ate meals. In contrast, only 56 percent of parents of stay-at-home children agreed with this statement. This difference may be due to the more structured timing of meals in childcare centers. Parents who stay at home may not feel they are able to schedule meals and snacks to their satisfaction. Fifty percent of childcare parents compared to 76 percent of stay-at-home parents were satisfied with the kinds of foods eaten for meals by their child. These results suggest that half of the parents of children in childcare may not be satisfied with the meals provided by the childcare center. It is unclear how many parents actually knew what the children were served because the posted menus often did not correspond with actual menus. It is interesting to note that 24 percent of stay-at-home parents were not satisfied with the kinds of foods eaten by their child. This does not necessarily mean the parents were not initially providing foods they felt appropriate. It is more likely that the children often refused to eat the foods provided by their parents. The parents may have responded by offering less healthful foods the children preferred.

Parents' responses to items on level of control over their child's eating habits are reported in Table 25. Again, chi-square analysis did not find any differences between the two groups of parents in the way their responses were distributed for each item. As for rate and frequency of eating, the majority reported deciding the time when their child ate meals, but few reported encouraging their child to eat more quickly. As for types of food eaten, most controlled both the amount and type of food eaten for snacks. The majority of parents reported fixing food they knew their child liked, and only fixed alternative items half of the time or less. This reinforced the findings of the previous questionnaire that children's food preferences often determine what parents feed

Table 25: Parents' responses to items on frequency of control over their child's eating habits

Item	Percent				
	Always	**Most of the time**	**About half of the time**	**Seldom**	**Never**
Rate/Frequency of eating					
I decide the time when my child eats meals.	CC[a]: 20 SH[b]: 20	56 60	20 18	0 2	0 0
I encourage my child to eat more quickly.	CC: 2 SH: 0	4 10	16 16	46 58	28 18
Types of foods eaten					
I allow my child to eat between meals whatever he/she wants.	CC: 0 SH: 2	14 16	42 34	30 40	10 8
For meals, I fix foods that I know my child likes.	CC: 4 SH: 2	66 58	26 38	0 2	0 0
If my child does not like what I have fixed for a meal, I give her/him something else to eat.	CC: 6 SH: 2	22 22	30 12	24 52	14 8
I allow my child to eat any foods he/she likes between meals.	CC: 0 SH: 0	12 18	28 20	42 54	12 8
I reward my child for good behavior by letting him/her eat foods he/she likes.	CC: 2 SH: 4	14 4	24 14	30 66	26 12
Amount of food eaten					
I allow my child to eat as much as he/she would like at meals.	CC: 42 SH: 54	46 38	8 6	0 0	0 0
At meals, I encourage my child to eat more than he/she seems to want.	CC: 8 SH: 4	6 18	12 22	26 44	44 10
I allow my child to have a second helping of food only after he/she has eaten all of the first helping.	CC: 28 SH: 22	42 40	12 16	10 14	4 6
I encourage my child to eat all the food on his/her plate.	CC: 24 SH: 12	22 24	16 20	18 30	16 14
I allow my child to eat as much food as he/she would like between meals.	CC: 0 SH: 0	12 10	24 24	26 48	34 18
If dessert is served, I allow my child to eat dessert only after he/she has finished all of the food on his/her plate.	CC: 22 SH: 14	36 40	14 20	22 14	2 10

[a] "CC" indicates responses of parents of children in childcare
[b] "SH" indicates responses of parents of stay-at-home children

their children. Most parents reported that they did not often reward their child with food for good behavior.

Regarding amount of food eaten, most parents reported allowing their child to eat as much as he/she wanted for meals but not for snacks. Though they reported they did not encourage their child to eat more than he/she wanted, over one third of both groups reported that they encouraged their child to eat all the food on his/her plate. Furthermore, the majority of parents required their child to finish all of the first helping before allowing them to have a second helping of food. About half of the parents required their child to finish all the food on his/her plate before eating dessert.

Several differences between responses by parents in this study and responses reported by Burroughs and Terry were noted [113]. While 53.7 percent of parents in Burroughs and Terry's study reported fixing alternative dishes other than the meals served for their children, only 28 percent of childcare parents and 24 percent of stay-at-home parents in this study reported doing so. Sixty-seven percent of parents in the Burroughs and Terry study indicated encouraging their child to eat all the food on his/her plate, compared to 46 percent of childcare parents and 36 percent of stay-at-home parents in the present study. Only 3.4 percent of parents in the previous study allowed their child to eat as much as he/she liked between meals compared to 12 percent of childcare parents and 10 percent of stay-at-home parents in the present study. This suggests that parents in Burroughs and Terry's study exerted more control over the amounts of food consumed by their children and less control over the types of food than did the parents in this study. If this measure reflects true behaviors in both groups, it may indicate a positive shift in the child feeding strategies employed by parents over the last ten years. Current recommendations to parents advocate providing a healthy variety of foods to children but allowing the children to decide how much they will eat [145]. Parents in the present study appeared to be doing this more frequently than parents in Burroughs and Terry's study.

Though chi-square analysis did not identify any statistically significant differences in the distribution of responses by the two groups, parents of children in childcare and parents of stay-at-home children appeared to respond differently to three of the items. Seventy percent of childcare parents reported preparing foods they knew their child liked always or most of the time compared to 60 percent of stay-at-home parents. Also, only 56 percent of childcare parents reported seldom or never rewarding their child with food for good behavior while 78 percent of stay-at-home parents reported not using food as a reward. Twenty-six percent of childcare parents compared to 44 percent of stay-at-home parents indicated that encouraged their child to eat more than he or she seemed to want at least half of the time. The impact of these differences in feeding strategies on nutrition and weight of the children is further explored in Objectives 5 and 6.

Summary

There were few observable differences between the attitudes and behaviors of parents of childcare children and parents of stay-at-home children. Nutrition, followed by child's food preferences and ease of preparation, was reported to be the parents' primary concern when choosing food for their child.

The time needed to prepare a food was more important to childcare parents than stay-at-home parents. Both groups perceived themselves to be the most influential on and responsible for their child's nutrition, but 16 percent parents of children in childcare felt that the childcare center was more responsible. Parents of childcare children also often felt that the childcare center was more responsible than their spouse for their child's nutrition. Though both groups of parents were generally satisfied with the rate, frequency, and amounts of food eaten by their children, parents of stay-at-home children were more often satisfied with the types of foods eaten by their children. Parents of children in childcare more often fixed foods they knew their child liked and more frequently rewarded their child with food for good behavior. They were less likely to encourage their child to eat more than he or she seemed to want.

These results indicate that there were few differences in the attitudes and behaviors of parents of children in childcare and parents of stay-at-home children. The parents of childcare children exhibited slightly more attitudes and behaviors that would have a negative impact on their child's eating habits.

OBJECTIVE 3: PHYSICAL ACTIVITY

The purpose of Objective 3 was to obtain a basic measure of physical activity that would help to explain any differences in overweight between children in childcare and stay-at-home children. The physical activity log can be found in Appendix A. Because the children were not observed during childcare before 4pm, only the activities observed by a researcher from 4 pm until close of the childcare center and those reported by parents until 9 pm were compared. Table 26 lists the mean number of hours spent watching television/videos, engaged in moderate physical activity, and engaged in vigorous activities. There were no significant differences between the two groups of children in the amounts of time engaged in moderate and vigorous activities, or in the amount time spent watching television/videos. Both groups spent approximately 0.6 hours or 36 minutes each evening watching television and videos. They participated in moderate activities such as playing inside and walking for about one hour and twenty minutes each evening. About 45 minutes were spent in vigorous activities such as playing outside or riding a bike. The rest of the evening time was presumably spent in sedentary activities such as commuting, eating, bathing, looking at books, and sleeping. The relationship between physical activity in this population and weight is explored in Objective 6.

Table 26: Mean hours spent watching television or engaged in physical activity between 4pm and 9pm[a].

	Mean hours ± S.D.	
Activity	**Children in childcare**	**Stay-at-home children**
Watching television/videos	0.60 ± 0.63	0.63 ± 0.70
Moderate activity	1.35 ± 0.74	1.28 ± 0.94
Vigorous activity	0.78 ± 0.68	0.89 ± 0.80

[a] No significant differences between groups of children.

OBJECTIVE 4: WEIGHT STATUS

Twenty-six percent of the children in this study were at-risk for obesity (BMI $\geq 85^{th}$ percentile). Fourteen percent of the children were overweight (BMI $\geq 95^{th}$ percentile). These percentages are higher than the prevalence reported by Ogden, *et al* in their analysis of NHANES 1999-2000 data. Ogden, *et al,* found 20.6 percent of children in NHANES 1999-2000 to be at or above the 85^{th} percentile for BMI and 10.4% at or above the 95^{th} percentile. These differences may be due to the geographical location of the present study. Previous studies of Texas schoolchildren found an overweight prevalence higher than that found by the national surveys [73, 146]. A study of schoolchildren in San Antonio, Texas by Park and colleagues found a greater prevalence of overweight there than was found in NHANES 1999-2000 [73].

The hypothesis of this study stated that children who attended childcare would be more likely to be overweight (BMI $\geq 95^{th}$ percentile) or at risk for overweight (BMI $\geq 85^{th}$ percentile) than children who stayed at home due to differences in parental attitudes and feeding practices. The average percentile for BMI was 62 for childcare children and 50 for stay-at-home children ($p<0.05$). This indicates that the children in childcare had greater weight for height than the stay-at-home children. The distribution of children into the different levels of percentile for BMI is shown in Table 29. The overall distribution of children into the different levels of percentile was significantly different for the two

Table 27: Percentage of children in BMI-for-age percentiles by childcare status

Percentile Range	No. (%) Childcare children	Stay-at-home children
≤10^{th} percentile	5 (10)	3 (6)
11^{th} to 25^{th} percentile	1 (2)	9 (18)
26^{th} to 50^{th} percentile	10 (20)	17 (34)
51^{st} to 75^{th} percentile	12 (24)	5 (10)
76^{th} to 84^{th} percentile	9 (18)	6 (12)
85^{th} to 94^{th} percentile[a]	7 (14)	6(12)
≥ 95^{th} percentile[b]	6 (12)*	1 (2)*

[a]At risk for obesity
[b] Obese
* $p \leq 0.05$

groups according to Pearson chi-square analysis ($p<0.05$). The percentage of childcare children in the 85^{th}-94^{th} percentile range (at risk for overweight), 14 percent, was not significantly different than the percentage of stay-at-home children in that range, 12 percent. However, 12 percent of childcare children were at or above the 95^{th} percentile for BMI compared to 2 percent of stay-at-home children ($p<0.05$). This supports the hypothesis of the study. However, due to the difference in the ethnic composition of the two groups, it cannot be assumed that all differences in weight are due to childcare status. Childcare status was not associated with BMI percentile after controlling for race and income differences.

OBJECTIVE 5: DO PARENTS' ATTITUDES AND BEHAVIORS PREDICT CHILDREN'S DIETS?

The hypothesis of the present study predicted that parents' attitudes and behaviors would be associated with children's dietary intake during the evening. Since there were few differences found in the attitudes and behaviors of parents of children in childcare and parents of stay-at-home children, the groups were combined for analysis in Objectives 5 and 6. T-tests and bivariate correlations between items on the three attitude and behavior scales and evening food intake variables were calculated. Food intake variables included servings of foods from the Food Guide Pyramid as well as mean evening intake of vitamin A, vitamin C, energy, total fat, saturated fat, iron and calcium.

Ranking of factors that influence parents' food choices and children's eating habits

In Objective 3, nutrition, child's food preferences, and ease of preparation were found to be the factors most important to parents when considering what to feed their children in the evening (Appendix C). For that reason, the effects of these factors on evening food intake were particularly interesting. The evening food intake by children of parents who ranked nutrition as their first or second considerations in choosing food for their child (n=60) was no different than children whose parents ranked nutrition lower (n=33). This is evidence that parents' belief in the importance of nutrition does not always translate into healthier diets in their children. There were two significant differences between children whose parents ranked their child's preferences as first or second and children whose parents did not. Children whose parents ranked their food preferences highly (n=46) consumed 23.7 ± 8.4g of fat and 607 ± 161 kcal of energy during the evening compared to 20.4 ± 7.3g of fat and 539 ± 161 kcal of energy by children whose parents ranked their child's food preferences lower (n=47) ($p<0.05$). There were no differences in the other food intake variables. These results suggest that the foods children prefer are high in fat and calories and are not necessarily the foods they should be served on a daily basis. By contrast, there were no differences between children whose parents' ranked ease of preparation first or second (n=34) and those whose parents felt ease of preparation was less important (n=59). There were also no differences in children's intake when adults' food preferences were ranked as first or second (n=19) and when they were not (n=73).

The parental attitude with the most impact on children's evening food intake was the consideration of time as an important factor. Children whose parents ranked time as the first or second most important consideration when making food choices (n=17) consumed less iron, 3.0 ± 0.8 mg versus 3.6 ±1.6 ($p<0.05$), less energy, 489 ± 129 kcal versus 591 ± 166 kcal ($p<0.05$), and less fat, 18.5 ± 7.5g versus 22.8 ± 8.0 g ($p<0.05$), than children whose parents felt time was less important (n=76). Differences between number of vegetable servings and calcium intake approached significance. Children whose parents considered time important consumed a mean of 0.6 ± 0.5 servings of vegetables during the evening compared to 1.0 ± 0.8 servings by the other children ($p=0.07$), and 240.5 ±143.8 mg calcium compared to 329.9 ± 187.2 mg by the other children ($p=0.07$).

It is interesting to note that children whose parents valued time over other factors appeared to consume less energy and fat than other children, suggesting that they were not eating at fast food establishments as might be expected. Perhaps they were not offered as much food or were not given time to eat as much as children whose parents are not pressed for time. Parents who ranked time as important tended to rank nutrition as less important ($r=-0.35$, $p \leq 0.05$).

Parents' attitudes toward the influence and responsibility of different individuals for their child's eating habits were generally not related to their child's dietary intake during the evening. Contrary to the hypothesis of this study, children of parents who believed the childcare center to be more responsible for and more influential on their child's nutrition did not have dietary intakes significantly different from the other children.

Parents' perceived influence on, satisfaction with, and frequency of control over their child's food habits

There were few significant findings from the bivariate correlation analysis of "Parents perceived influence on and satisfaction with their child's food habits" (Appendix D) and food intake variables or from the analysis of "Parents' frequency of control over their child's food habits" (Appendix E) and food intake variables. Parents who felt that their child ate too much between meals had children who consumed more iron during the evening ($r=-0.21$, $p \leq 0.05$). Parents who agreed that the amount of food they ate for meals influenced the amount their children ate for meals had children who consumed more iron and zinc during the evening ($r=-0.21$, $p \leq 0.05$; $r=-0.23$, $p \leq 0.05$). Parents' level of satisfaction with the variety in their child's diet increased as folate intake increased ($r=-0.20$, $p \leq 0.05$). Satisfaction with the kinds of foods eaten by the child for meals was positively associated with servings of vegetables in the evening ($r = -0.21$, $p<0.05$). Encouragement to eat more quickly was positively associated with energy and fat and saturated fat intakes during the evening ($r = -0.20$, $p \leq 0.05$; $r = -0.24$, $p \leq 0.05$; $r =-0.24$, $p \leq 0.05$) supporting earlier findings by Drucker, *et al* that prompts to eat by mothers were associated with total caloric intake in children [22]. Encouragement to eat all the food on the plate was positively associated with total fat intake ($r = -0.22$, $p \leq 0.05$), cholesterol intake ($r= -0.25$, $p \leq 0.050$ and zinc intake ($r = -0.26$, $p \leq 0.01$), further supporting findings by Drucker, *et al*[22]. Encouragement to eat all the food on the plate and energy intake also approached a significant positive relationship ($r = -0.18$, $p=0.08$). Parents who did not allow children to eat whatever they wanted between meals had children with higher cholesterol and zinc intakes during the evening ($r = 0.22$, $p \leq 0.05$; $r = -0.22$, $p \leq 0.05$). Parents who required their children to finish all of their first helpings before having second helpings had children with higher intakes of cholesterol ($r = -0.24$, $p \leq 0.05$).

Summary

Analysis of parents' attitudes and behaviors toward their child's eating habits found few relationships between specific attitudes and behaviors and children's evening food intake. It may have been that the instruments used in this study were not sensitive enough to detect subtle differences in parents' attitudes and child feeding practices. Another possible explanation is that variations in individual children's eating habits were due to many factors other than parents' attitudes and behaviors. Previous research found that preschool children's food consumption was largely determined by their food preferences [129]. Children's food preferences may have masked the effects of their parents' attitudes and behaviors on their food consumption. In any case, several important results were found. First, parents' belief in the importance of nutrition was not associated with their child's eating habits. The consideration of child's food preferences and the time needed for preparation of food as the most important factors were negatively related to the child's diet. Third, parents' satisfaction with their child's diet was positively related to their child's vegetable consumption. Finally, encouragement to clean the plate was associated with higher intake of total fat, indicating that parents' attempts to control their child's eating habits may have resulted in less healthful eating patterns. There were no significant relationships between parents' perceptions of the responsibility and influence of childcare centers and children's evening dietary intake.

OBJECTIVE 6: WHICH FACTORS PREDICT OVERWEIGHT?

The purpose of Objective 6 was to determine whether parents' attitudes and behaviors, and children's dietary intake and physical activity influenced the weight status of the children. Correlations were investigated by calculating Pearson correlation coefficients. Weight status was represented by percentile on the BMI-for-age growth charts, a measure that controls for normal fluctuations in BMI at different ages. Differences between children who were overweight or at-risk for overweight and normal weight children were investigated using t-tests. Finally, multiple regression and general linear model were calculated to determine whether these variables as a group predicted weight status of children.

Dietary Intake

Total daily energy intake was positively associated with BMI percentile ($r=0.35$, $p \leq 0.001$). Children below the 85^{th} percentile for BMI consumed an average of 1404 ± 283 kcal compared to 1690 ± 370 by children at or above the 85^{th} percentile for BMI ($p \leq 0.001$) (Table 28). This represents 20 percent more kilocalories daily. Gillis, *et al*, found that children at or above the 95^{th} percentile consumed an average of 25 percent more kilocalories than normal weight children, and that energy intake was positively associated with obesity ($r=0.367$) [80]. By contrast, other studies found that obese children consumed the same or less energy per kilogram body weight than normal weight children when resting energy expenditure and physical activity were controlled [81, 82]. The present study also found no difference in energy intake per kilogram body weight

Table 28: Significant differences between mean daily food and nutrient intake by normal weight children and children with BMI≥ 85th percentile

Food/Nutrient	Mean ± S.D. BMI<85th percentile (n=80)	Mean ± S.D. BMI ≥ 85th percentile (n=20)
Energy (kcal)	1404 ± 283***	1690 ± 370***
Total fat (g)	50.8 ± 12.7**	60.7 ± 18.2**
Monounsaturated fat (g)	17.3 ± 4.7*	20.5 ± 5.9*
Cholesterol (mg)	154.9 ± 78.5*	210.3 ± 108.5*
Fruit (servings)	2.2 ± 1.5*	3.0 ± 2.0*
Meat (servings)	1.7 ± 0.90**	2.4 ± 1.3**
Total beverages except milk[a] (oz)	6.8 ± 5.6**	11.2 ± 6.9**

*p≤0.05
**p≤0.01
***p≤0.001
[a]Does not include artificially sweetened beverages.

between normal weight children and those at or above the 85th percentile. This suggests that the extra kilocalories consumed by heavier children may be serving to maintain their weight rather than increase it.

The present study as well as others involving preschool children found a significant positive relationship between fat intake and weight status ($r = 0.31$, $p \leq 0.01$) [59, 87]. However, unlike research by McGloin, *et al*, and Gazzaniga and Burns, fat was not associated with weight status independent of total energy intake [81, 82]. However, study by Magarey, *et al*, also found no relationship between fat intake and obesity independent of energy intake [83]. From this study and others, it is unclear whether fat intake has any effect on weight aside from the fact that it is energy dense.

The present study found no relationship between saturated fat consumption and BMI percentile, polyunsaturated fat intake and BMI percentile. Monounsaturated fat and cholesterol were positively associated with weight status ($r = 0.29$, $p \leq 0.01$; $r = 0.23$, $p \leq 0.05$). There were also relationships between weight status and servings of bread ($r = 0.26$, $p \leq 0.01$), vegetables ($r = 0.19$, $p \leq 0.05$) and meat ($r = 0.22$, $p \leq 0.05$). After controlling for caloric intake, none of these relationships were significant. Interestingly, intake of vegetables was associated with energy intake ($r=0.34$, $p \leq 0.001$), despite the fact that increased consumption of vegetables is often touted in the media as a method of weight control. This may be due to the types of vegetables eaten by the children in this study. Approximately 30 percent of their daily vegetable servings came from potatoes, many of which were fried.

The present study found no relationship between consumption of 100% fruit juice and weight status, confirming the results reported by Skinner, *et al* [90]. However, total sweet beverage consumption was associated with BMI percentile ($r=0.21$, $p \leq 0.05$). Total sweet beverages included fruit juice, soft drinks, and other beverages excluding milk, water, and artificially sweetened drinks. Children with a BMI $\geq 85^{th}$ percentile consumed 11.2 ± 6.9 oz compared to 6.8 ± 5.6 oz by normal weight children ($p \leq 0.01$) (Table 28). Studies of school age children have also found a relationship between sweetened beverage intake and overweight [91, 92]. In the present study, sweetened beverage intake was not predictive of overweight independent of energy intake. Sweetened beverages may contribute to childhood overweight by providing excess kilocalories.

Unlike research by Carruth and Skinner, no relationships were found between intakes of calcium and dairy products and obesity [59]. However Carruth and Skinner conducted a much more extensive study with 18 days of dietary records over 5 years.

Physical Activity

The only relationship between overweight and the physical activity variables measured by this study was for evening television/video viewing. Interestingly, hours spent watching television between 4pm and 9pm was negatively associated with BMI percentile ($r = -0.21$, $p \leq 0.05$). This is in direct contrast to other studies on the topic, all of which found the opposite relationship between television viewing and overweight [101-103]. There are several possibilities for the discrepancy. First, the sample size studied here was small. Of the children whose parents completed the physical activity questionnaire, only 18 were at or above the 85th percentile for BMI. Also, the questionnaire asked the parents to describe a “typical” day rather than keep an actual log. This may have resulted in underreporting by some parents. Furthermore, only the television watched between 4 pm and 9 pm on weekdays was factored into the analysis. Previous studies included full weekdays as well as weekends [101-103]. An alternate explanation for the present study’s results is that parents of overweight children may have limited their child’s access to television in an attempt to correct the child’s weight problem. Parents in this study were highly educated and may have been aware of the relationship between television and childhood obesity.

Parents’ Attitudes and Behaviors

Analysis of the instrument, “Ranking of factors that influence parents’ food choices and children’s eating habits,” (Appendix C) did not reveal a relationship between the ranking of any considerations parents made when choosing food for their child and the BMI percentile of their child. Despite the fact that parents who ranked time as an important factor had children who consumed less energy, fat, and iron, perceived importance of time was not associated with weight status. It is possible that parents’ considerations in making food choices were not influential enough on children’s actual intake to affect weight status.

Interestingly, perceived influence over the child’s eating habits was negatively associated with weight status ($r=-0.21$, $p\leq0.05$). Parents with the heaviest children felt they had the most influence over their child's eating habits. Parents with heavier children also felt that friends of the family were less influential than did parents of lighter children, even after controlling for perceived influence of the parent and perceived influence of the childcare center ($r=0.24$, $p \leq 0.05$). Contrary to the hypothesis, there was no relationship between parents' belief in the influence of childcare centers and the weight status of the children. There were also no relationships between parents' perceptions of the responsibilities of different individuals for their child's eating habits and their child's weight status.

Analysis of "Parents perceived influence on and satisfaction with their child's food habits" revealed no significant relationship between aggregate scores of items measuring influence and BMI percentile or aggregate scores of items measuring satisfaction and BMI percentile. The only item significantly related to BMI percentile was "I think my child does not eat enough for meals." Parents with heavier children tended to disagree with this statement ($r=0.24$, $p \leq 0.05$). Comparison of responses by parents of at-risk/overweight children and parents of normal weight children revealed more differences. As shown in Table 29, parents of lighter children were less likely to feel that eating a variety of foods encouraged their child to do the same. They were less satisfied with the kinds of foods eaten by their child for meals and snacks. They were also more likely to agree that their children did not eat enough food for meals and that their child ate too much food for snacks. It is interesting that parents of children who were either overweight or at risk for overweight were more satisfied with the types and

Table 29: Mean rank of responses to items measuring influence and satisfaction by parents of children with BMI<85th percentile and parents of children with BMI≥85th percentile.

Item	Mean Rank ± S.D.[a]	
	BMI<85th percentile (n=80)	**BMI ≥85th percentile** (n=18)
If I eat a variety of foods, it encourages my child to do the same.	1.95 ± 0.84*	1.50 ± 0.62*
I am satisfied with the kinds of foods my child eats for meals.	2.39 ± 1.06*	1.89 ± 0.76*
I am satisfied with the kinds of foods my child eats between meals.	2.52 ± 0.95**	1.83 ± 0.38**
The amount of food I eat for meals influences the amount my child eats.	3.74 ± 0.94*	3.00 ± 1.37*
I think my child does not eat enough food for meals.	3.17 ± 1.29***	4.11 ± 0.76***
I think my child eats too much food between meals.	3.70 ± 0.84[b]	4.11 ± 0.76[b]

[a] Rank ranges from 1 (strongly agree) to 5 (strongly disagree)
[b] Difference approaches significance (p≤0.06)
*p≤0.05
**p≤0.01
***p≤0.001

amount of foods eaten by their children. It may be that these parents ascribe to the definition of a "good eater" as being a child who consumes large quantities of a variety of foods. Perhaps a more appropriate definition of a "good eater" in light of today's childhood obesity epidemic would be a child who eats a variety of healthful foods in appropriate quantities.

The overall measure of control determined by the instrument, "Parents' frequency of control over their child's food habits," was not associated with the weight status of the children. The only item significantly related to BMI percentile was "At meals I encourage my child to eat more than he/she seems to want" ($r=0.30$, $p \leq 0.01$). Parents of heavier children were less likely to report encouraging their child to eat more food. This replicates results found by Burroughs and Terry in their original use of this instrument [113]. Burroughs and Terry also reported that parents of lighter weight children less frequently controlled when their child ate snacks and more frequently encouraged their child to eat quickly. They also found that parents of heavier children frequently encouraged their children to clean their plates. None of these associations were found in the present study. The major differences between the Burroughs and Terry study and the present study were a higher education level of parents (75% college educated compared to 51.3%) and a smaller sample size in the present study ($n=100$ versus $n=208$).

Multiple Regression Analysis

Multiple regression analysis with BMI percentile as the dependent variable and average daily energy intake, hours spent watching television, and parents' perceived influence on, satisfaction with, and frequency of control over their child's eating habits as the independent variables indicated a weak, but significant relationship between these variables ($R^2 = 0.157$, $p \leq 0.05$). However, the model was not significant when energy intake was removed. Energy intake of the child and satisfaction with the child's diet contributed the most weight to the equation, $\beta = 2.196$ ($p \leq 0.05$) and $\beta = -2.478$ ($p \leq 0.05$), respectively.

Summary

In the present study, energy intake was a significant predictor of weight status. Intake of total fat, monounsaturated fat, cholesterol, bread, vegetables, meat, and total beverages (excluding milk) were predictive of weight status, though not independently of energy intake. There was no relationship between intake of 100 percent fruit juice or milk and overweight. Television viewing during the evening was negatively associated with BMI percentile, contrary to results found in previous studies [101-103]. There were no relationships found between factors parents' consider when choosing food for their children and children's weight status. Parents of heavier children perceived their own influence to be greater ($r = -0.21$, $p \leq 0.05$) and were more satisfied with their child's diet ($r = -0.30$, $p \leq 0.05$) than parents of lighter children. They also less frequently encouraged their child to eat more food ($r = 0.30$, $p \leq 0.01$). Contrary to the hypothesis, parents who felt that childcare centers were the most responsible for their child's diet were not more likely to have an overweight child than the other parents. Overall, the factors most predictive of weight status in this population were daily energy intake and parents' satisfaction with their child's eating habits.

CONCLUSIONS

Sixty percent of American children under the age of six attend some type of childcare, making nutrition at childcare centers an important area of research [26]. Because proper nutrition is necessary for optimal physical and mental development, and because long-term eating habits are established during childhood, it is imperative that the obstacles preventing children from having healthy diets are identified and overcome. Previous research has found that children who attend childcare centers may not be eating enough food during childcare to meet their daily nutritional requirements [27, 29, 31, 33-35]. Other research has suggested that parents may be relying on childcare centers to provide good nutrition to their children, freeing them to feed their children the less healthful foods their children prefer [29, 36, 37]. The purpose of the present study was to investigate the effects of childcare on parents' attitudes and behaviors in shaping their child's eating habits, and to determine whether these attitudes and behaviors influence the diets and weight status of the children.

Results of this study indicated that parents of children who attended childcare perceived that the childcare centers were more responsible for their child's nutrition than their spouse or other family members and friends, but still felt themselves to be the most responsible for their child's eating habits. However, no evidence was found to support the hypothesis that parents of children in childcare felt less responsible for, less influential on, more satisfied with, or exerted less control over their child's diet than parents of children who stayed at home. Parents of children in childcare indicated more often than parents of stay-at-home children that lack of time was an important issue in the food choices they make for their children. Parents who perceived lack of time to be an obstacle had children who consumed less energy, iron, and fat during the evening hours after childcare. For this reason, future educational interventions should address healthy foods that can be prepared quickly. Parents in both groups felt that the nutritional content of the foods and whether their child liked the foods were important considerations when choosing what to feed their child. Unfortunately, these two considerations acted against one another. Children whose parents valued nutrition did not have healthier diets than children whose parents did not value nutrition. Children whose preferences dictated the meals they were offered by their parents had diets higher in fat. More research is warranted to find ways to shape children's food preferences so that they prefer healthier foods.

This study did not support the hypothesis that children in childcare had less healthful diets than stay-at-home children. Children who attended childcare centers had similar diets overall to children who stayed at home. Both groups consumed sufficient foods to meet the daily requirements for all food groups and nutrients except grains, vegetables, and vitamin E. The children's diets exceeded recommendations for fat, with total fat contributing 32 percent of energy. Children in childcare consumed 200 more kcal of energy, ½ serving more of vegetables, 8 more grams of fat, 2 more grams saturated fat, and 1.5 oz more sweetened beverages than stay-at-home children. The majority of these differences were due to consumption during the day while at the childcare centers.

The centers served foods that averaged 34% in total fat, suggesting that additional training is in childcare centers to plan healthy menus. Childcare did not influence parents' food choices for the evening meal. The food intake of children during the evening compensated for the lack of nutrients such as calcium, zinc, iron, and folate in the childcare center menus. Both groups of children consumed less than recommended vegetables and grains. Children who attended childcare and stay-at-home children had similar diets during the evening hours, suggesting that parents' food choices for their child were not influenced by the fact that their child attended childcare.

The results of this study supported the hypothesis that children in childcare would be more likely to be overweight. Twelve percent of childcare children in this study were obese compared to two percent of stay-at-home children. However, obesity was not associated with childcare status after controlling for differences in race and family income. This suggests that differences in weight between the childcare children and stay-at-home children may have been due to demographic differences in the two groups. It is unknown whether there any national differences in the demographic characteristics of children who stay at home and children who attend childcare. More research should be conducted with children in childcare who are individually matched to stay-at-home children on factors such as race, family income, and parental education.

The hypothesis of this study predicted that parents' attitudes and behaviors would directly influence the weight status of the children. However, few parental attitudes and behaviors were associated with weight status of the children. Parents of overweight children did not often encourage their child to eat more food and were more satisfied with their child's diet than parents of normal weight children. Parents of overweight children also felt themselves to be more influential over their child's diet. Parents of normal weight children were concerned that their children were not eating sufficient food. Only parents of overweight children believed that their children were eating enough food. For this reason, educational interventions should be designed to help parents understand appropriate serving sizes for their children and estimate amounts of food to serve their child. Parents also need training in providing foods that are nutrient dense.

The present study did not find any major differences in the parental attitudes and behaviors, the diets, physical activity, or weight status of children who attend childcare and stay-at-home children. These results indicated that the two groups were actually more alike than different. The high rate of obesity, excess of fat consumption, and lack of vegetable and grain consumption indicate that parents of children in both groups need more strategies to encourage healthy eating and to prevent or reverse obesity in their children. Research should focus on the overcoming obstacles faced by all parents and childcare centers in providing children with healthy foods. In particular, parents need training in ways to influence their child's food preferences at an early age and overcome the time issue during the evening hours. Childcare centers need assistance in planning meals that are both nutritious and acceptable to children.

This study demonstrated that regardless of whether children attend childcare or stay at home, their diets are not meeting current guidelines. Parents reportedly value nutrition, but the eating habits of their children do not reflect it. Too many other obstacles including lack of time, children's food preferences, lack of knowledge about appropriate portion sizes, and poor planning of childcare center menus are preventing children from developing healthy eating habits for life. Now that these obstacles have been identified, it is time to develop specific interventions to help families overcome them. Otherwise, the childhood obesity epidemic will likely worsen, causing millions of children unnecessary physical and emotional harm.

Appendix A

PHYSICAL ACTIVITY RECORD FOR CHILDREN

PHYSICAL ACTIVITY THAT DOES NOT OCCUR EVERYDAY

Please list any activities in which your child participates that **do not** occur every day. For example, organized sports, dance class, gymnastics, swimming, etc.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Activity(s)	Activity(s)	Activity(s)	Activity(s)	Activity(s)	Activity(s)	Activity(s)
Duration	Duration	Duration	Duration	Duration	Duration	Duration

If your child does not participate in any of the above-type activities, place a check on this line:____.

DAILY PHYSICAL ACTIVITIES

Please indicate the activities that your child engages in on a regular basis for a typical weekday. Below is a sample list for coding activities according to type.

For example: a child wakes up at 7:45 am, eats breakfast from 7:45 am–8:30 am, commutes to daycare between 8:30-9:00, begins daycare at 9 am, etc.

Example

5 a.m. :30				6 a.m. :30				7 a.m. :30				8 a.m. :30				9 a.m. :30				10 a.m. :30			
A	A	A	A	A	A	A	A	A	A	A	C	C	C	C	C	X	X	X	X	X	X	X	X

TYPES OF ACTIVITIES

Daycare	**Restful**	**Television**	**Sedentary**	**Moderate**	**Vigorous**
Code **X**	Code **A**	Code **B**	Code **C**	Code **D**	Code **E**
Time spent in daycare	Sleeping Napping	TV Videos	Eating Bathing Commuting by car/bus Coloring/reading Computer games, etc.	Playing inside Walking, etc.	Playing outside Riding bike Skating, etc.

Activity Definitions

Sedentary activity is defined as any activity with little body movement; usually performed sitting.

Moderate activity is defined as any activity that engages brisk movement of the limbs and body.

Vigorous activity is defined as any activity that involves extreme movement of the limbs and body which produces rapid breathing and increased heart rate.

4 a.m. :30	5 a.m. :30	6 a.m. :30	7 a.m. :30	8 a.m. :30	9 a.m. :30	10 a.m. :30	11 a.m. :30	NOON :30	1 p.m. :30

2 p.m. :30	3 p.m. :30	4 p.m. :30	5 p.m. :30	6 p.m. :30	7 p.m. :30	8 p.m. :30	9 p.m. :30	10 p.m. :30	11 p.m. :30

Appendix B

DEMOGRAPHIC QUESTIONNAIRE

Your relationship to child: Mother Father Other (please specify) _________

Employment Mother: Unemployed Part-time Full-time Father: Unemployed Part-time Full-time
Occupation:_____________ Occupation:__________________
Years in current job:______ Years in current job:____________

Family Income/year
____less than $20,000 per year
____less than $40,000 per year
____less than $60,000 per year
____less than $80,000 per year
____less than $100,000 per year
____greater than $100,000 per year

Which of the following describes the ethnicity of your child?
___White ___American Indian ___African American ___Asian ___Hispanic ___Other:__________

Education Completed	Mother	Father
High School/GED	Yes/No (if no # of years attended____)	Yes/No (if no # of years attended____)
College	Yes/No (if no # of years attended____)	Yes/No (if no # of years attended____)
Graduate/Professional school	Yes/No (if no # of years attended____)	Yes/No (if no # of years attended____)

Number of children less than 18 years of age living in the household:________
Number of adults living in the household:________

Does your child currently stay at a childcare center, family day home or with an individual caregiver other than a parent? Yes/No
Please circle the one that applies to your child: childcare center/preschool/family day home/individual caregiver/ "mothers day out"/other_____________.

How many days/week does your child spend in childcare (care given by someone other than a parent or guardian)?_________
How many hours/day does your child spend in childcare (care given by someone other than a parent or guardian)?__________

How many meals and snacks does your child eat in childcare each day? Meals_______ Snacks_______

Does either parent eat with the child during childcare? Yes/No Which parent?____________ How often?____________

Does either parent bring snacks in the car for the child to eat to and from childcare? Yes/No How many times per week?__________
Foods generally carried:____
Who is the primary person who prepares food in your home?________________________________
What % of time does this person fix meals? _____% Which meals are prepared for your child during the week (i.e. breakfast, lunch, etc.)?___________________ Which meals are prepared for your child on weekends?_________________________

How many meals are consumed by your child away from home (excluding the meals eaten during childcare)?________/week
Where are these meals usually consumed? (ie sit-down restaurants, fast food, grandma's house, etc)?____________

Does your child prepare snacks for himself or herself at home? Yes/No How many times per week?______________

Do you take your child with you to the grocery store? Yes/No
Does your child eat snacks at the grocery store while you are shopping? Yes/No Please list snacks:___________________

Does your child take any vitamin supplements? Yes/No If so, which one?________________________

What is your child's sex? M/F Age?_______months
Does your child have a medical problem that affects their food intake? (ie, food allergies, diabetes, etc) Yes/No
Please list:

Appendix C

Ranking of the factors that influence parent's food choices and children's eating habits.

1. Please think about all the things that you consider when you decide what to feed your child for his/her **evening** meal. List your top 5 considerations **in order of importance**. For example, if you think ease of preparation is the most important factor in deciding what food to feed your child, write "ease of preparation" in blank 1. Examples of answers are listed below.

____1 (MOST IMPORTANT FACTOR)
____2 (2ND MOST IMPORTANT FACTOR)
____3 (3RD MOST IMPORTANT FACTOR)
____4 (4TH MOST IMPORTANT FACTOR)
____5 (5TH MOST IMPORTANT FACTOR)

Examples of possible answers (**you may use these or write your own**):
Your food preferences (what you like to eat); Your child's food preferences (what your child likes to eat); Time (things that can be picked up already prepared or prepared quickly); Ease of preparation (easy recipes or recipes requiring few ingredients); Nutritional content (vitamin/mineral content, fat content, etc.); Cost

---

2. Who or what has the most influence on your child's eating habits? Please rank them from 1 to 7. **(1= most influence; 7= least influence)**

_________Television
_________Childcare center
_________You
_________Your spouse
_________Your child's siblings
_________Other family members
_________Friends

---

3. In your opinion, who is the most responsible for making sure your child gets adequate nutrition each day? Please rank them from 1 to 6. (**1= most responsible; 6= least responsible)**

_________You
_________Your spouse
_________Childcare center
_________Your child's siblings
_________Other family members
_________Friends

Appendix D.1

Parents' perceived influence on and satisfaction with their child's food habits

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The time I eat meals influences the time my child eats.	1	2	3	4	5
If I eat between meals, it influences my child to do the same.	1	2	3	4	5
The speed at which I eat influences the speed at which my child eats.	1	2	3	4	5
I am satisfied with the times my child eats meals.	1	2	3	4	5
I think my child should eat between meals less often.	1	2	3	4	5
If I eat sweets and snack foods, is encourages my child to do the same.	1	2	3	4	5
If I eat a variety of foods, it encourages my child to do the same.	1	2	3	4	5
My food likes and dislikes influence my child's food likes and dislikes.	1	2	3	4	5
I am satisfied with the kinds of foods my child eats for meals.	1	2	3	4	5
I am satisfied with the kinds of foods my child eats between meals.	1	2	3	4	5
I am satisfied with the variety of food my child eats.	1	2	3	4	5
The amount of food I eat for meals influences the amount my child eats.	1	2	3	4	5

Appendix D.2

The amount of food I eat between meals influences the amount my child eats.	1	2	3	4	5
I think my child does not eat enough food for meals.	1	2	3	4	5
I think my child eats too much food between meals.	1	2	3	4	5
Overall, I think my child eats about the right amount of food.	1	2	3	4	5

Appendix E.1

Parents' frequency of control over their child's food habits

	Always	Most of the time	About half of the time	Seldom	Never
I decide when my child can eat meals.	1	2	3	4	5
I allow my child to eat between meals whatever he/she wants.	1	2	3	4	5
I encourage my child to eat more quickly	1	2	3	4	5
For meals, I fix foods I know my child likes	1	2	3	4	5
If my child does not like what I have fixed for a meal, I will give him/her something else to eat.	1	2	3	4	5
For meals, I encourage my child to taste each food that is available.	1	2	3	4	5
I allow my child to eat any foods he/she likes between meals.	1	2	3	4	5
I reward my child for good behavior by letting him/her eat foods he/she likes	1	2	3	4	5
I will allow my child to eat as much as he/she would like at meals.	1	2	3	4	5
At meals, I encourage my child to eat more than he/she seems to want	1	2	3	4	5
I allow my child to have a second helping of food only after he/she has eaten all of the first helpings.	1	2	3	4	5

Appendix E.2

I encourage my child to eat all the food on his/her plate.	1	2	3	4	5
I allow my child to eat as much food as he/she would like between meals.	1	2	3	4	5
If dessert is served, I allow my child to eat dessert only after he/she has finished all of the food on his/her plate.	1	2	3	4	5

Appendix F

Free analysis of your child's diet

UT Nutrition Study

Receive a dietary analysis and $10.00

To participate you must:

- Be a parent/guardian of a 3-5 year old child.
- Allow us to weigh and measure your child.
- Allow us to observe your child eating at childcare.
- Record what your child eats before and after childcare for 3 days.
- Answer surveys.

PICK UP YOUR PACKETS HERE ON MONDAY

Appendix G

Consent Form
Effects of childcare on parents' attitudes and behaviors in shaping children's food habits

You are invited to participate in a study of how parents' behaviors and attitudes affect the food habits of young children. My name is Alison Padget and I am a graduate student working with Margaret Briley, PhD,RD of the Department of Human Ecology at The University of Texas at Austin. We hope to learn how parents influence their children to develop healthy eating habits. You were selected as a possible participant in this study because you have a 3-5 year old child who attends a childcare center. You and your child will be one of 100 parents and 100 children chosen to participate in this study.

If you decide to participate, Margaret Briley and her associates will ask that you fill out questionnaires, allow your child's food consumption at the childcare center to be observed and recorded for three consecutive days, allow your child to be weighed and measured, and measure the food your child eats when not at the childcare center for three consecutive days. The questionnaires should take no more than 30 minutes of your time. Additional measurements of the foods your child eats will take no more than 15 minutes per day. This study involves no more risks than you and your child would normally encounter in daily life. You will be provided with measuring devices to measure the food that your child consumes away from the childcare center and $10.00 for completion of the study. You will also receive an analysis of your child's diet, suggestions for improvement (if needed), and a child nutrition information kit. I will be happy to answer your questions concerning the foods that your child eats.

Any information that is obtained in connection with this study that can be identified with you will remain confidential and will be disclosed only with your permission. All data will be kept in locked files and coded by identification numbers.

Your decision whether or not to participate will not affect you or your child's future relations with The University of Texas at Austin or the childcare center your child attends. If you decide to participate, you are free to discontinue participation at any time.

You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate. You may withdraw at any time after signing this form, should you choose to discontinue participation in this study.

If you have any questions, please ask me. If you have questions later, Margaret Briley or I will be happy to answer them. We can be reached at (512) 475-9762.

You may keep a copy of this form.

______________________________ ________________________
Signature of Participant Date

____
Child's Name

______________________________ ________________________
Signature of Investigator Date

Appendix H

Free analysis of your child's diet

UT Nutrition Study

Receive a dietary analysis and $10.00

To participate you must:

- Be a parent/guardian of a 3-5 year old "stay home" child.
- Allow us to weigh and measure your child.
- Record what your child eats for 3 consecutive days.
- Answer surveys.

Contact the child nutrition lab at 475-9762

alison_padget@hotmail.com

Appendix I

Consent Form
Effects of childcare on parents' attitudes and behaviors in shaping children's food habits

You are invited to participate in a study of how parents' behaviors and attitudes affect the food habits of young children. My name is Alison Padget and I am a graduate student working with Margaret Briley, PhD,RD of the Department of Human Ecology at The University of Texas at Austin. We hope to learn how parents influence their children to develop healthy eating habits. You were selected as a possible participant in this study because you have a 3-5 year old child who stays at home during the day. You and your child will be one of 100 parents and 100 children chosen to participate in this study.

If you decide to participate, Margaret Briley and her associates will ask that you fill out questionnaires, allow your child to be weighed and measured, and measure the food your child eats during the day for three consecutive days. The questionnaires and interview should take no more than 30 minutes of your time. Additional measurements of the foods your child eats will take no more than 15 minutes per day. This study involves no more risks than you and your child would normally encounter in daily life. You will be provided with measuring devices to measure the food that your child consumes and $10.00 for completion of the study. You will also receive an analysis of your child's diet, suggestions for improvement (if needed), and a child nutrition information kit. I will be happy to answer your questions concerning the foods that your child eats.

Any information that is obtained in connection with this study that can be identified with you will remain confidential and will be disclosed only with your permission. All data will be kept in locked files and coded by identification numbers.

Your decision whether or not to participate will not affect you or your child's future relations with The University of Texas at Austin. If you decide to participate, you are free to discontinue participation at any time.

You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate. You may withdraw at any time after signing this form, should you choose to discontinue participation in this study.

If you have any questions, please ask me. If you have questions later, Margaret Briley or I will be happy to answer them. We can be reached at (512) 475-9762.

You may keep a copy of this form.

______________________________ ________________________
Signature of Participant Date

____
Child's Name

______________________________ ________________________
Signature of Investigator Date

Appendix J.1

FOOD INTAKE RECORD FOR CHILDREN

Dear Parents:

We would like to ask your cooperation in helping us in a very important study about children's eating and activity habits. We would like you to measure what your child eats for 3 consecutive days. Be sure to include everything they eat including sampling of foods, quick snacks such as crackers and drinks at meal times. We need you to tell us the following:

1. Where the child ate the food (example: at the table, in front of the TV, at a friend's house, etc.)
2. Time of day.
3. Source of food (canned, homemade, purchased ready to eat, restaurant, etc).
4. Description of food including brand names.
5. If homemade, please give us a recipe.
6. Amount of food the child ate (1 tablespoon, ¼ cup, ½ cup, 3 oz, 1 bar, etc.)

We have provided forms for you to record your child's food intake. We appreciate your cooperation and want to thank you for helping us with this important work. We will either visit you personally or call you so we can clarify any questions you may have. As soon as the dietary analysis is complete, we will send you the results at the address you give below.

Child's Name______________________________

Parent____________________________________

Address__________________________________

City_______________State_____________Zip Code__________

Phone Number________________________

Appendix J.2

GUIDELINES FOR DESCRIPTION OF FOOD*

Please describe how food eaten at home was cooked or served. “Eating” means taking more than one bite or sip of something. Please write down brand names if you can. For food eaten at a restaurant, please write the name of the restaurant. The following is a list of guidelines to help you fill out the food record forms.

1. MILK
What kind of milk did your child drink: whole, skim, 2%, 1%?

2. MEAT OR FISH
How was the meat or fish cooked: fried, baked, broiled, or stewed?
Did the meat or fish have gravy or sauce?

3. CHICKEN OR TURKEY
How was the chicken or turkey cooked: fried, baked, broiled, or stewed?
Did your child eat the skin on the chicken or turkey?

4. CASSEROLES OR MIXED FOODS
What was used in the casseroles, stews, or sandwiches: meat, cheese, milk, rice, potato, pasta, or fats such as margarine, butter, mayonnaise, or vegetable oil?

5. VEGETABLES
What kinds of vegetables were eaten: fresh, canned, or frozen?
Were fats added such as bacon, margarine, or butter?

6. MARGARINE OR BUTTER
What kind of margarine or butter was used on breads or vegetables: stick, tub, whipped, salted or unsalted?

7. OILS OR SAUCES
What kinds of oils or sauces were used?
Was oil or fat added to cooking water for rice, noodles, potatoes, pasta, or vegetables?

8. SALT
Was salt added in cooking food?
Was salt added to cooking water for rice, noodles, pasta, or vegetables?
Was salt added at the table?

*CATCH Dietary Manual, 1991

Appendix J.3

CHILD'S FOOD RECORD: DAY ONE

Code #__________ Date_____________ Parent recording__________________

Time of Day	Food Item	Source	Where eaten	Amount eaten	Description

Appendix J.4

CHILD'S FOOD RECORD: DAY TWO

Code #__________ Date_____________ Parent recording__________________

Time of Day	Food Item	Source	Where eaten	Amount eaten	Description

Appendix J.5

CHILD'S FOOD RECORD: DAY THREE

Code #__________ Date_____________ Parent recording__________________

Time of Day	Food Item	Source	Where eaten	Amount eaten	Description

Appendix J.6

RECIPE(S)

We would like for you to tell us about the recipes for the food/s you prepare on the days you are recording the foods your child ate on the Child Food Record. For example, if you made a casserole we would like to know the ingredients, amounts of ingredients, and number of servings. We do not need to know how to mix or cook, but it would be extremely helpful if you would tell us things such as whether you used lean ground meat or regular ground meat; if you used canned vegetables or fresh vegetables; if you used skim milk or whole milk; if you used margarine or butter and other such kinds of information.

Please include all the recipes you used for each day. Feel free to use the backs of these pages if you need more space.

Thank you very much.

Name of recipe: ______________________Date________________

Number of servings for this recipe:_________________
Serving size (example: ¼ cup, 1T):_________________

Ingredients with descriptions	Amounts

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