I, Colleen Witsken, hereby submit this work as part of the requirements for the degree of:

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The Effect of Parental Control Over Child-Feeding on Compliance to Dietary Recommendations to Lower Blood Cholesterol

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The Effect of Parental Control Over Child-Feeding on Compliance to Dietary Recommendations to Lower Blood Cholesterol

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Abstract

The purpose of this study was to investigate parental control of child-feeding as it relates to children's compliance to the national dietary recommendations to lower blood cholesterol. Fifty-eight children with hypercholesterolemia participated. Prior to formal nutrition counseling, children's dietary intake was assessed by 3-day food record. Parents completed a validated questionnaire regarding restrictive child feeding practices. Parents were categorized based on the level of restriction over child feeding (high versus low). Families were counseled by a dietitian on a Step one diet and children's diets were assessed 3 months and 1 year later. As compared to parents who were less controlling over their children's intake, parents who were more controlling had children who were more compliant with national dietary recommendations to lower blood cholesterol. These findings suggest that parent control over child feeding when accompanied with formal nutrition counseling may promote greater compliance to a cholesterol lowering diet in children.
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I. Introduction

Coronary heart disease (CHD) is the single leading cause of death in the United States. Hypercholesterolemia is one of the most important risk factors for atherosclerosis and increased levels in children are associated with fatty deposits in the aorta and coronary arteries (1). An increased awareness of the importance of early detection of children at risk and treatment is vital in the prevention of CHD.

A diet low in fat, saturated fat and cholesterol is recommended by the American Heart Association as a means of lowering high cholesterol in children. The first line of therapy to decrease the risk of hypercholesterolemia in children is through diet. The National Cholesterol Education Program’s (NCEP) Report on the Detection, Evaluation, and Treatment of Blood Cholesterol in Children and Adolescents and the American Heart Association (AHA) have established specific guidelines recommending a diet which provides no more than 30% of total calories from total fat, 10% of calories from saturated fat, and no more than 300 mg of cholesterol a day. In addition, these guidelines emphasize that the diet of children should include a variety of foods to insure an adequate intake of protein, vitamins, minerals, and total calories to support and sustain optimal growth and development (1-4). To achieve this end, the AHA recommends increasing daily servings of low fat foods including vegetables, fruits, breads, low fat dairy products and lean meats.

Despite the fact that these recommendations for reducing dietary cholesterol have been in existence for more than a decade, data from national surveys and the USDA Continuing Survey of Food Intake of Individuals I and II (5, 6) suggest that caloric intake has increased as well as the absolute intake of total fat. Additionally, the mean intake of
total and saturated fat intake among children is well above the established recommendations (7).

Achieving the dietary recommendations set forth by the AHA can be challenging for most children as recent evidence suggests that children prefer foods that are energy dense (8). In today’s society, this poses a problem because energy dense foods are high in fat and sugar, readily accessible and available, and over consumption can lead to high blood cholesterol as well as other chronic diseases.

Research suggests that parents who control by restricting, limiting or monitoring these foods in their child’s diet in an attempt to meet dietary recommendations may inadvertently increase their child’s preference for and intake of these foods. Birch et al looked at the effect of food restriction in girls ages 5-9 and whether this child feeding strategy fostered eating in the absence of hunger. Results showed that maternal restriction of calorie dense, high fat foods promoted overeating of these foods (9). Birch advised that parental influence on child-feeding should not be controlling or restrictive but rather allow the child to develop preferences for a healthy diet by offering a variety of healthy selections along with foods that are high in fat (8). Children who are deprived of certain foods (e.g. high fat foods) become preoccupied with these foods and when not in a restrictive setting, are prone to overeat (10, 11). Lifshitz and Moses (12, 13) reported that many parents restrict certain foods because of fear that their children will become obese and/or hypercholesterolemic. According to Birch and Fischer, parents should focus on the long-term goal of developing healthy self-control of feeding in their children (11). Children model parental eating behaviors and learn through conversations about food. Studies have (14, 15) shown that parents who are overly controlling over child-
feeding may compromise their child’s ability to self-regulate their intake of food which may lead to overconsumption, obesity or hypercholesterolemia in their child. Data from Costanzo and Woody (16) support the findings of Birch et al; these researchers found that controlling child-feeding strategies tended to undermine the child’s ability to self-regulate food intake and therefore were counteractive in producing the desired results that parents originally were striving to accomplish. Taken together, their data suggest that the product of the overly restrictive parent may be a child who experiences guilt and anxiety over foods that are categorized as “bad” and this same child may be easily induced by external forces that may contribute to overeating (16). Evidence suggests that parents should not restrict foods high in fat and sugar because restricted access may lead to a greater desire and intake of these foods.

The current project was undertaken to investigate parental control of child-feeding as it relates to children’s compliance to the NCEP’s dietary recommendations for lowering blood cholesterol. The central hypothesis of this study is as follows: as compared to parents who are less controlling over their child’s food intake, parents who are more controlling will have children who consume a greater number of servings of high fat foods 3 months and one year after receiving formal nutrition counseling on the NCEP dietary recommendations to lower high blood cholesterol.
II. Literature Review

A. Introduction

Coronary heart disease (CHD) is the single leading cause of death in the United States. About 42% of people discharged from hospitals for CHD are under the age of 65. Many of these adults have children who may have CHD risk factors that need attention (17). It has been established that high blood cholesterol levels play a role in the development of premature CHD in adults. The relationship between high blood cholesterol levels and childhood is not clear but it can be inferred from strong evidence that the atherosclerotic process has its onset early in life (3). Hypercholesterolemia is one of the most important risk factors for atherosclerosis and increased levels in children are associated with fatty deposits in the aorta and coronary arteries at a young age (1). An increased awareness of the importance of early detection of children at risk and treatment is key in the prevention of CHD.

B. Atherosclerosis and children

Atherogenesis is a process of chronic inflammation. Atheromatous lesions contain significant amounts of LDL-derived cholesterol as the main lipid constituent. These lesions are in the intima of the arterial wall. Early lesions, called fatty streaks, are formed from LDL-cholesterol deposits and are the initial step in the atherogenic process. This lesion appears as an irregular yellow discoloration near the luminal surface of the artery. Actually the streaks are not fat, but small collections of monocyte-derived macrophages filled with lipid droplets (foam cells) located beneath the inner, endothelial layer of arteries. The fatty streak mainly consists of foamy appearing macrophage cells, sometimes with some additional T lymphocytes, aggregated platelets, localized smooth
muscle cells, etc. Fatty steaks are considered harmless in that they do not disorganize the
normal structure of the intima, deform, or obstruct the artery. Under certain conditions,
some of the fatty streaks continue to accumulate macrophage foam cells, extracellular
lipid and smooth muscle cells, and then form raised plaques. Progression of advanced
lesions may develop with further accumulation of extracellular lipid, cholesterol, crystals,
collagen, and potentially calcium. The lesions grow, calcify, and can eventually block
arteries, or rupture and hemorrhage. Ischemic events may occur in the heart, brain,
and/or extremities (18-21). The history of atherosclerosis is based on the assumption that
a fatty streak in one age group at a specific anatomic site can progress into a more
advanced type of lesion at the same site later in life (22).

The Bogalusa Heart Study (23) measured arteries from 66 people aged 6-30 years.
The subjects were autopsied after death due to causes unrelated to CVD including
accidents, homicide, and suicide. The subjects had been measured for CVD risk factors
during their life. Results of the study showed that LDL-cholesterol concentrations were
positively associated with the percentage of arterial and aortic surface area involved by
fatty streaks. Seventy percent of children in the top quintile for blood cholesterol were in
the top 2 quintiles for blood cholesterol 12 years later (24). This study did not have a
sufficient number of subjects to determine relationships between LDL-cholesterol and the
amount and severity of raised lesions or associations within age, sex, or race.

A group of investigators organized the Pathobiological Determinants of
Atherosclerosis in Youth (PDAY) study in 1985. This study was performed on
approximately 3000 persons aged 15-34 years who died from accidental injury, homicide,
or suicide and were autopsied within 48 hours of death. Arteries, blood, and selected
tissues were collected. The study found that LDL-cholesterol concentrations, obesity, and smoking were positively associated with the extent of fatty streak and raised lesion coverage in both the aorta and right coronary artery. HDL-cholesterol concentrations were found to be inversely related (25).

Taken together, data from the pathobiological studies supports the notion that the process of atherosclerosis begins at an early age. Fatty streaks are shown to develop in the aorta as early as age 3 years. These studies provide evidence that risk factors for CHD including elevated LDL-cholesterol are present in childhood and should be controlled early to prevent the development and progression of atherosclerosis (22). The atherosclerotic process may not be totally preventable but early awareness and healthful lifestyle choices may slow the progression of the disease and subsequent heart attacks.

C. Causes of Hypercholesterolemia

Because of the evidence supporting the early roots of atherogenesis, pediatricians have set goals initiating prevention measures to reduce risk factors and set up long-term healthy habits (1). The first step in the management of hypercholesterolemia is finding the likely source of the disease. Hypercholesterolemia can be attributed to inherited diseases such as familial hypercholesterolemia. Causes of this dyslipidemia are genetic (e.g. LDL-receptor defect), but they can be exacerbated by environmental factors such as poor diet and physical inactivity. Hypercholesterolemia can occur secondary to other diseases such as renal, endocrine, or hepatic disorders, and diabetes mellitus. Drug therapy can also induce hypercholesterolemia (e.g. steroids, thiazide diuretics) (26). The contribution of poor lifestyle habits to hypercholesterolemia is becoming widely
recognized and is now considered the primary target for therapy to reduce elevated blood cholesterol in children and adults.

Dietary fat, especially saturated fat, is associated with high levels of blood cholesterol. Poor diet quality is an independent risk factor for atherosclerosis. The Framingham Heart study is a longitudinal study of risk factors such as poor diet and physical inactivity that are related to the development of CHD into adulthood. Data from this study showed that 40-57% of children in the highest quintiles for saturated fat intakes were still in these same quintiles for dietary saturated fat 2-3 years later (27). If this dietary pattern continues through adolescence and early adulthood, the risk of developing CHD may be potentially increased.

D. Treatment and Detection

The first line of therapy to decrease the risk of hypercholesterolemia in children is through diet. In 1985, the National Consensus Development Panel cosponsored by the National Institutes of Health (NIH) and the American Heart Association (AHA) first proposed dietary recommendations to manage elevated blood cholesterol in children (2, 28). The dietary recommendations called for reducing total fat to no more than 30% of total calories, reducing saturated fat to less than 10% of calories, and consuming no more than 300 mg of cholesterol a day. Additionally, children were recommended to consume an amount of calories to maintain adequate growth and development. These guidelines were recommended for all Americans over the age of 2 years. The National Cholesterol Education Program (NCEP) Expert Panel on the Detection, Evaluation and Treatment of High Blood Cholesterol in Children and Adolescents endorsed these guidelines in 1991 (4). The Academy of Pediatrics (AAP) was represented on this panel. The AAP later
went further to set a minimum of dietary fat intake to 20% of calories. Overall, at least 26 health-related organizations recommend limiting dietary fat intake for Americans more than 2 years of age.

Within the NCEP report, both a population approach and an individual approach were recommended as ways to lower blood cholesterol. The population approach was designed as the primary means of preventing coronary heart disease in the population at large. The goal of this approach was to lower the average level of blood cholesterol in all children through population changes in nutrient intake and eating patterns (3). At the time the guidelines were put forth, the age to initiate dietary fat reduction varied somewhat across different national organizations. The AHA recommended after 2 years of age while the NCEP considered age 2-3 years as "transitional" between the high fat diet needed in infancy and the recommended prudent diet (4, 28). The NCEP Panel considered this to be a safe time for toddlers to transition as they begin to eat with the family (4). The USDA Dietary Guidelines (29) suggested a longer transitional phase from 2 to 5 years of age so there was not an abrupt drop in fat intake. Overall, all organizations agreed that nutritional adequacy could be achieved by eating a wide variety of foods and caloric intake should be adequate to support growth and to reach or maintain a desirable weight (2, 3, 4, 28).

Another strategy other than a population approach to maintaining lower blood cholesterol in all children was described by the NCEP in the 1991 report. This organization recommended identifying children at higher risk for premature heart disease by measuring their blood cholesterol levels. Screening was recommended only for children with a family history of premature heart diseases, or for those presenting with
elevated blood cholesterol or with risk factors for premature CHD. These risk factors include premature coronary heart disease (at or below age 55) in parents, grandparents, aunts or uncles, and family history of hypercholesterolemia (parents with blood cholesterol $\geq 240$mg/dl). The physician may consider screening the child for whom family history is not available or if the child has high cholesterol or one or more of the following risk factors: hypertension, smoking, sedentary lifestyle, obesity, excessive alcohol intake, certain medications associated with hyperlipidemias (e.g. oral contraceptives or anticonvulsives), or disease states such as diabetes mellitus or nephrotic syndrome. The NCEP recommends selective case screening beginning at age 2 years (30). Cholesterol levels and suggested intervention are summarized in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Cholesterol (mg/dl)</th>
<th>LDL Cholesterol (mg/dl)</th>
<th>Dietary Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>&lt;170</td>
<td>&lt;110</td>
<td>N/A</td>
</tr>
<tr>
<td>Borderline</td>
<td>170-199</td>
<td>110-129</td>
<td>AHA Step I diet, other risk factor intervention</td>
</tr>
<tr>
<td>High</td>
<td>$&gt;200$</td>
<td>$&gt;130$</td>
<td>AHA Step I diet, Step II diet if necessary</td>
</tr>
</tbody>
</table>

After cholesterol screening, children may be instructed to follow the AHA Step I or Step II diets depending on the severity of their high cholesterol levels. The Step I diet recommends food choices that provide a total fat intake of $\leq 30\%$ of calories from fat, $\leq 10\%$ of calories from saturated fat and $<300$ mg of cholesterol per day. Instructions are provided to substitute foods high in saturated fat for those rich in monounsaturated and polyunsaturated fats. If a child cannot lower their LDL-cholesterol level to $\leq 110$ mg/dl, the Step II diet may be initiated. The Step II diet is more restrictive consisting of food
choices that allow no more than 7% of total calories from saturated fat and no more than 75mg/1000 kcal of dietary cholesterol. Children on the Step II diet should be monitored for nutritional adequacy as the food restrictions necessary to comply with this diet may limit dietary variety (30). The NCEP recommends reserving drug therapy to children >10 years of age and only if 6-12 months of dietary intervention have failed to lower LDL-cholesterol levels to less than 190 mg/dl or LDL-cholesterol levels remain ≥160 mg/dl after a dietary trial and there is a family history of premature cardiovascular disease (3).

E. Controversy Over Lowfat Diets for Children

Several critics of lowfat diets for children have raised legitimate concerns regarding the NCEP advice to encourage dietary fat restriction in children > age 2 years. Several studies have documented growth retardation in hypercholesterolemic children following a pediatrician’s advice to restrict dietary fat and cholesterol to lower blood cholesterol levels (12, 26, 31). Notably, these children did not seek the advice of a dietitian to assist with diet modification or receive follow up nutrition care. The low fat intake among children in these studies was achieved by reducing total caloric intake which likely contributed to the delayed growth. Once these patients were counseled appropriately by a dietitian to eat adequate amounts of calories to support growth, catch up growth was achieved. Nicklas et al (26) found that children following a low fat diet (<30% of calories from fat) increased their consumption of total carbohydrate and sucrose. High consumption of simple sugars including sucrose in the diet has been linked with elevated triglyceride levels and low HDL-cholesterol (26). In 1994, a study demonstrated that mothers of children with failure to thrive had higher levels of dietary
restraint (32). Again, low caloric intake, rather than fat restriction, was the likely cause here.

In a review paper by Olson (32), arguments were raised against restricting fat intake in childhood. This researcher suggested that although fatty streaks are present in childhood and may turn into fibrous plaques, most disappear with age. Olson also stated that maturation alone causes a decrease in blood cholesterol level, so many of the studies that showed cholesterol lowering with diet therapy in adolescence may have been confounded by this age effect. In a subsequent review by Olson and Satter (33), four primary arguments were raised against the current dietary recommendations to lower blood cholesterol in children. First, these researchers stated there is no evidence to confirm a low-fat diet will prevent CHD in adulthood. Second, Olson and Satter indicated that there is no evidence that developing a preference for a low-fat diet in childhood will last into adulthood. These researchers pointed out that a diet low in fat may cause growth failure and/or malnutrition and by restricting children's food choices, unhealthy attitudes may arise toward certain foods and eating in general. Satter suggested that health professionals need to teach children about how to make healthy dietary choices and not prescribe an exact amount of fat in the diet. Finally, low fat diets may lead to suboptimal nutrient intakes among children if not carefully planned. This fact was demonstrated by Vobecky et al (34) who reported results of a cohort study done on 500 children. Healthy children were stratified according to fat intake (<30, 30-40, and ≥ 40% of total kcal/day). The results indicated that children having a diet low in fat were consuming fat-soluble vitamins at levels far below the dietary reference intakes for these nutrients.
These early criticisms of the NCEP dietary recommendations have dissipated somewhat because of important clinical-based evidence supporting the safety and efficacy of the Step I diet. The Dietary Intervention Study in Children (DISC) studied 663 prepubertal children aged 8-10 years who had LDL-cholesterol levels in the 80th-95th percentile (26). Children in this study were randomized to either nutrition counseling on the Step I diet (28% of calories from fat) from a registered dietitian (intervention group) or were given a pamphlet of general nutrition information (control group). Baseline and 3 year follow-up measurements were made of growth status and LDL-cholesterol levels. The study found that children in the intervention group grew as well as those in the control group. Further, the children in the intervention group lowered their LDL-cholesterol levels more than in the control group (-15.4 mg/dl versus -11.9 mg/dl, respectively), which demonstrated the safety and efficacy of the Step I diet for children with elevated cholesterol.

Another study that showed positive effects of a low fat diet on overall diet quality in children was the Children and Adolescent Trial for Cardiovascular Health (CATCH) intervention trial. This study was a 1-year, school-based nutrition and lifestyle intervention trial done with 5106 third grade students to reduce risk of CHD by modifying diet, physical activity, and decreasing smoking initiation rates. Children participating in the intervention reduced their fat and saturated fat intake significantly more than children not participating in the intervention. Total fat and saturated fat intake was reduced from 33% and 13%, respectively at baseline, to 30% and 11%, respectively after the 1 year trial. Vitamin and mineral intakes at the end of the trial were similar between groups. Additionally, the CATCH 3 year tracking study found that children
maintained a low intake of total fat and saturated fat 3-years post-intervention (35-41). This important finding suggests that children can maintain positive dietary changes in response to a school based nutrition intervention for up to 3 years. Similar results were achieved in the “Healthy Start” (42) study, which was a 3 year school-based study of 1296 preschool children. The goal of the dietary intervention arm of the study was to reduce the saturated fat content of meals served to the preschoolers to <10% of total energy. A control group of preschoolers received no dietary modification to their school meals. After one year, the saturated fat intake of the intervention group was reduced from 11.0% to 10.4%, and after two years to 8.0% compared with an increase in saturated fat intake in the control group from 10.2% of energy at baseline to 13.0% at year 1 and 11.4% at year 2. The total energy intake of both groups was maintained at baseline levels.

Several home and clinic-based dietary interventions have proven to be effective for lowering blood cholesterol in children with high cholesterol. Tershakovec et al (43) evaluated 261 hypercholesterolemic children and 81 children with cholesterol levels within the normal range. Children in this study were randomly assigned to a home-based nutrition education program to lower blood cholesterol (PCAT program), a clinic-based nutrition counseling session teaching NCEP dietary principles, or a non-education control group. Results from this study showed that children participating in the PCAT program and the clinic-based nutrition intervention achieved a significant reduction in body fat with no detrimental affects on growth as compared to the control group. Additionally, both groups of children receiving nutrition education significantly modified their diets to consume less total fat and saturated fat compared to the control group. LDL-cholesterol
levels were not assessed post-intervention. In another study, Jacobsen et al (44) showed that hypercholesterolemic children who were counseled on the NCEP dietary recommendations by a registered dietitian in the clinical setting achieved a significant lowering of their LDL-cholesterol with no deleterious effect on growth. Another study implemented the NCEP Step 1 diet in 54 hyperlipidemic children (45) in the intervention group and 44 healthy children as the control group. The subjects in the intervention group received counseling from a registered dietitian while children in the control group consumed unrestricted diets and received no formal nutrition counseling. Findings showed no significant difference in consumption of energy, minerals or vitamins D and E between groups. While the control participants consumed greater amounts of fat, the intervention group consumed more vitamin A. The data from these studies suggest registered dietitians can prescribe the Step 1 diet with confidence in hyperlipidemic children.

F. Trends in Food Consumption

Despite the fact that recommendations for reducing dietary cholesterol have been in existence for more than a decade, data from national surveys and the USDA Continuing Survey of Food Intake of Individuals I and II (5, 6) suggest that caloric intake has increased as well as the absolute intake of total fat. A large portion of children continues to consume amounts of total and saturated fat that are above the recommended NCEP population guidelines. Munoz et al (38) analyzed the diets of approximately 3300 US children aged 2-19 years. Results showed that the intake of total fat, discretionary fat, and added sugar make up 40% of the total energy intake of the children and that few met dietary serving recommendations in any food group. Data from the NHANES III report
showed that intake of total fat and saturated fat has declined in children and adolescents since the 1970's. Fat has declined from 36-37% of total calories to 33-34% of total calories while saturated fat intake has gone from 14% to 12% of total calories. Mean total fat and saturated fat intakes (% energy) from a single day still exceed daily dietary recommendations and targets. Only 23 percent of children age 2-5 years, 16% of children age 6-11 years, and 15% of adolescents age 12-19 years met the recommendations for total fat intake in 1988-1991. The 1994-1996 CSFII reported approximately 30% of males and 34-36% of females aged 6-19 years consumed ≤ 30% of energy from fat. (7). Surveys also suggest more children are categorized at risk for developing hypercholesterolemia than in previous years (46, 47).

G. Influences on Food Intake of Children

Although numbers are showing a decline in overall fat intake, the majority of children are exceeding the recommendations for dietary fat intake, which may put these children at risk for diseases such as obesity, hyperlipidemia, and diabetes mellitus. Many factors come into play when questioning why children consume more than the recommended amount of total fat. Many sociocultural and demographic factors affect what children eat, where children eat, and with whom they eat. Cultural and ethnic diversity plays a role in food choice and sources of variety in a child's diet. Johnson et al (48) examined how locality of residence plays a role in food choice. The study found that diets of children living in rural areas were less compliant with the recommendations of the Dietary Guidelines for Americans (49) than children living in urban areas. Children in urban areas were found to have the lowest caloric intake.
Household characteristics such as income, type, and size, influence the kind and quality of food used. Lower income households tend to consume less fresh vegetables (50). Larger households consume less food per person with the exception of milk, flour, cereals, and sugars (50). Forty-six percent of family food expenditures are spent on food outside of the home, with 34% of this total expenditure spent on fast foods (51). Continuous snacking and consumption of super sized portions is facilitated by the availability and low cost of food at fast food establishments. Family dynamics affect food choices through food availability, selection, meal-timing, and portion control. Family-based meals can be negative or positive experiences depending on the stressfulness or togetherness of the meal. If a child is exposed to a majority of stressful meal experiences, they are more likely to have a negative attitude towards foods presented at those meals (15). Parents should provide nutrition education, a positive atmosphere, and model healthful food behaviors for their children to improve diet quality.

Childcare centers and schools also play a large role in developing food choices of children, through availability of foods and providing the child with an appropriate amount of education on healthy eating. Media, especially television, has a remarkable power over what children consume and in turn influences the family's meals. Children may view up to 3 hours a week on food advertisements alone (52) and over 50% of those advertisements are for foods high in fat, sugar, and oil (15).

H. Food Preferences of Children

Although many factors can affect a child's choice of specific foods in their overall diet, food preference plays a major role in establishing lifelong eating behaviors. Eating behavior in childhood can influence the development of CHD in adulthood. Birch et al
have published numerous studies on the development of food preferences early in life and how these preferences influence eating patterns (11). The preference for sweetness is strong, unlearned and well established at birth (53). Newborns were found to prefer sugar solutions to water and sweeter solutions to those that were less sweet (8). This preference is also shaped by the child’s dietary experiences. High-fat foods are more often sweet and associated with feasts, celebrations, holidays or social functions. These functions may cause the child to have a positive association with the high-fat food and therefore prefer it. Smith and Greenberg (11) showed that these high-fat high carbohydrate foods have physiological effects that can produce pleasurable feelings of satiety.

Children tend to fear novelty of foods and it has been shown to take 5-10 exposures to a food before a child will accept it as familiar. Also, the child must taste it this many times before a preference can evolve (6). Research done by Davis (6) has shown that food availability is vital in determining whether a child can self-select an adequate diet. Parents provide the children with their eating environment from the first decision, e.g. bottle or breastmilk, to child-feeding practices, to decisions regarding food purchased for family consumption.

Feeding practices parents use can influence a child’s preference. When a child is given food as rewards for approved behaviors, those foods are preferred (6). On the other end of the spectrum, children will not prefer foods that are eaten to obtain rewards, e.g. “If you eat your broccoli you can have dessert.” Parents should not categorize foods as “good” or “bad”. Recent research has shown that children who are restricted from “bad” food will actually make the restricted items more appealing and children will grow a
stronger preference for these (54). Learned preferences are also established through consequences. Children will have aversions to foods that make them sick and most likely prefer foods that have been paired with a previously sweet taste.

Evidence shows children tend to prefer energy-dense foods over energy dilute foods. When children consumed two novel drinks that differed in sweetness and energy density, children preferred the more energy dense of the two (6). In today's marketplace, energy dense foods are also usually high in fat and sugar, readily accessible and available, and over consumption of these foods can lead to high blood cholesterol as well as other diseases. Eating preferred food is a major source of pleasure and fear of giving up these foods can be a barrier to establishing a healthy diet.

Peers and adults can have a powerful influence on the development of food preferences. Several experiments have shown that a child will change their food choices based on the food choices of their peers (55). Children also model their eating habits and choices after their parents. (56, 57) With high-fat foods being readily and cheaply available, and being consumed by adult and older role models, children are likely to prefer these foods (58).

I. Parental Control over Child-Feeding

Parent control over child feeding may take several forms. Parents may restrict access to certain foods, such as high calorie, high fat snacks or restrict how much of certain foods are eaten. Parents may also monitor or keep track of what foods and how much of certain foods are eaten by their child. In addition, parents may verbally encourage or pressure their child to eat certain foods, particularly at mealtime. The
cumulative effect of these three types of child-feeding practices is not always an effective approach to limiting a child’s intake and may lead to over-eating (9).

Evidence suggests parents should not restrict foods high in fat and sugar because restricted access will lead to a greater appeal for these foods (11). Birch advises parental influence should not be controlling or restrictive but allow the child to develop preferences for a healthy diet by offering a variety of healthy selections along with those that are energy dense (10). Birch et al looked at the effect of restriction in girls ages 5-9 and whether this fostered eating in the absence of hunger. Results showed a maternal restriction of calorie dense, high fat foods promoted overeating of these foods (9). Children who are deprived of certain foods become preoccupied with these foods and when not in the restricted environment, are prone to overeat. Restricted eating and constant dieting are patterns for using food to cope. Lifshitz and Moses (12, 13) reported when parents restricted foods because of fear of their children becoming obese and/or hypercholesterolemic, negative consequences were evident early in the child’s growth. Birch and Fischer state that parents should focus on the long-term goal of developing healthy self-control of feeding in children and not on the immediate concerns of fat content in foods (11).

Children model parental eating behaviors and learn through socialization about food. Studies have (14, 15) shown that parents who overly control food behaviors of their preschoolers may compromise their child’s ability to self-regulate their intake of food which, in turn, is a factor in the development of obesity. Costanzo and Woody (16) examined parent-child feeding strategies and confirmed the findings of Birch in that controlling strategies tend to undermine the child’s ability to self-regulate and therefore
were counteractive in producing the desired results the parent was originally striving to accomplish. The product of the overly restrictive parent is a child who experiences guilt and anxiety over foods that are categorized as “bad” and this child is easily induced by externally forces and this child then overeats (16).

**J. Conclusion**

Because of the evidence that atherosclerosis begins early in childhood, detection and treatment of hypercholesterolemia in children is imperative in the prevention of CHD. Trends suggest children are consuming more saturated fat which can lead to hypercholesterolemia. The NCEP Step 1 diet has been successful in lowering a child’s blood cholesterol levels. Although shown to be effective, pediatricians should be cautious on any type of restriction of diet by the child or parent without proper nutrition counseling so that proper growth and development is not compromised. Parents need to be provided appropriate and accurate information regarding portion sizes and a healthy variety in foods. With all of the proper tools in place, prevention and treatment of hypercholesterolemia in children can be accomplished.
III. Methods

A. Subjects

Participants were children 5-12 years of age with diagnosed hypercholesterolemia recruited from the Children's Hospital Cholesterol Center at the Cincinnati Children's Hospital Medical Center (CCHMC). The Cholesterol Center is a referral program for the diagnosis and treatment of children with hypercholesterolemia. Children are referred to the Cholesterol Center by their primary care physician after an initial diagnosis of hyperlipidemia is made. Children excluded from this study were those with secondary causes of hypercholesterolemia, homozygous LDL-cholesterol receptor deficiency (LDL cholesterol >400 mg/dl), or those who were taking any cholesterol-lowering medication. This population was excluded in an effort to target those individuals who have the greatest potential for lipid profile changes based on the NCEP nutrition recommendations. This project was conducted as part of a larger study funded by the American Heart Association. The study was approved by the Institutional Review Board at the CCHMC.

B. Study Protocol

All newly enrolled families at the Cholesterol Treatment Center were contacted via a letter and telephone call and invited to participate in the study. Interested families were instructed to have a fasting lipid profile measured at CCHMC core laboratory or an affiliated site prior to their initial treatment visit. Additionally, families were sent a 3-day food record and a 2-dimensional portion size model with detailed instructions. Families were informed to bring their child's completed food record form with them to the Cholesterol Treatment Center and that the parent who was considered the major food
preparer for the child (prepared >75% of meals) should accompany the child to the visit. At the Cholesterol Center a registered dietitian reviewed the record with the families for details, clarification of brand names, etc. In addition, at their initial visit to the Cholesterol Center, children were given a routine medical history and physical examination to detect the manifestations of hypercholesterolemia and causes of secondary hypercholesterolemia. General screenings for risk factors of cardiovascular disease were conducted (i.e. weight, height, skin fold measurements, blood pressure). Children and their families were asked to give complete family history regarding heart disease. This included any information on heart disease in family members such as parents, grandparents, aunts, and uncles. All clinical data was reviewed by the center cardiologist to determine participant eligibility for the study. Those deemed ineligible based on exclusion criteria were given a gift certificate as an expression of appreciation for the completion of the food record. Parents of children deemed eligible gave informed consent.

Following eligibility determination and the initial assessment, a registered dietitian counseled (45 minute session) the family on the NCEP guidelines for treating pediatric hypercholesterolemia. These recommendations suggest a diet providing less than or equal to 30% of calories from fat, 10% of calories from saturated fat, less than or equal to 300 milligrams per day of dietary cholesterol, and adequate calories to support growth. A manual developed by the Cholesterol Center which follows these recommendations was provided to each family at the initial nutrition education session. The manual included an introduction to dietary terminology, lists of low fat and high fat foods categorized by food groups, fat goals, and suggestions for identifying low fat foods,
modifying recipes and other food preparation methods to reduce fat intake. The dietitian reviewed this information and developed a meal plan with the family and assisted the child in setting short term goals for changing eating behavior to meet dietary fat goals.

After their initial visit, families were asked to return to the Cholesterol Center at 3 months and 1-year time intervals. At these visits, a similar protocol to the one described above was conducted. Additionally, prior to each visit, each family was sent a 3-day food record form with detailed instructions on how to complete the form and a 2-dimensional portion size model. Families were called to determine whether they had any questions about completing the form. Forms were collected and reviewed for completeness by a registered dietitian at the 3-month and 1-year visits.

Demographic and Anthropometric Data

Parents were asked to report their child's age, gender and ethnicity. Weight was measured in triplicate in the clinic using a calibrated triple-beam balance scale. Height was measured by a stadiometer.

C. Dietary Assessment Measures

3-day food record

Three-day food records were used to record the child's diet, one at the initial visit to the Cholesterol Center and again at the 3-month and 1-year follow-up visits. Children and their parents were sent detailed instructions and forms for completing the food records. Subjects older than 8 years of age were asked to complete the 3-day food record with the help of the parent. Parents of subjects less than 8 years of age were asked to complete the food records with the help of the child. A 2-dimensional portion size model was given to the parents and children to use at home to help determine the quantity of food eaten. Parents and children were trained by telephone by a registered dietitian on
how to use the 2-dimensional model and complete the food record form. Once
completed, all food records were reviewed by the dietitian in a face-to-face session with
the families to ensure adequacy in documentation of food descriptions, preparation
methods and amounts consumed were recorded.

Food records were analyzed for nutritional content using Minnesota Nutrient Data
System (NDS, version 2.92). For this project, sum weights (grams) of foods contained in
the NDS summary files were used to determine number of servings from 7 different food
groups. Nutrient analysis for saturated fat was also used to classify children into groups
for statistical analysis. Many foods consumed appeared in the summary file as
ingredients and gram weights of ingredients were combined into a single whole-food
weight. This could be assigned to a food group according to the Food Group Pyramid
(59).

Food Group Intakes
Foods were grouped according to the food classifications described in the NCEP
All foods listed on the NDS food record summary files were assigned to one of 7 food
groups (4). These 7 food categories were meats, eggs, dairy products, fats/oils, breads,
vegetables, fruits, desserts, beverages, and gravies/sauces (Table 2). Any foods on the
food summary file that were listed as components rather than complete foods (e.g.,
apples, brown sugar, butter) were collapsed into their respective food items (e.g., apple
crisp). Gram amounts of foods on the food summary files were converted to the
recommended NCEP serving sizes (4), and the number of servings of foods within food
groups was calculated. Sample calculations are shown in Appendix I.
Table 2  Listing of representative foods within 7 main food groups as classified in The National Cholesterol Education Program’s Step One Diet (4)

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Food Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>Yeast breads, baked breads, flour and grains, cereals, pastas and rice, dried beans and peas, legumes and soy products, starchy vegetables, crackers, snacks, and chips, soups</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Fresh and canned vegetables, vegetable juices</td>
</tr>
<tr>
<td>Fruits</td>
<td>Fresh or canned fruits, dried fruits, fruit juices, fruit salads</td>
</tr>
<tr>
<td>Milk</td>
<td>Milk, cream, yogurts, cottage cheese, cream cheese, hard cheese, frozen dairy desserts, imitation dairy products</td>
</tr>
<tr>
<td>Meat &amp; Bean</td>
<td>Beef, lamb, pork, veal, game, cold cuts, organ meats, poultry, fish, meat substitutes, whole eggs, egg whites, egg substitutes</td>
</tr>
<tr>
<td>Fats &amp; Oils</td>
<td>Animal fats, shortenings, margarines, oils, salad dressings, nuts, seeds, peanut butter, olives, avocados, gravies, meat sauces</td>
</tr>
<tr>
<td>Dessert &amp; Sweetened Beverages</td>
<td>Cookies, cakes, pies, puddings, doughnuts and pastries, frozen nondairy desserts, sugars, syrups, jellies, frostings, fillings, toppings, dessert sauces, candies</td>
</tr>
</tbody>
</table>

D. Parental Control Assessment

The Child Feeding Questionnaire (CFQ), developed and validated by Birch et al (54), was used to assess parental control over feeding in the dimensions of restriction, encouragement, and monitoring. The CFQ is a parental self-report measure that includes 15 questions. Restriction (5 items) was defined as the extent to which parents restricted access to foods, encouragement (5 items) was defined as encouraging the child to consume more food, and monitoring (5 items) was defined as the extent to which parents monitor their child’s fat intake. A 5-point Likert scale for each question is used to measure individual differences in ideas about child feeding. Scores can range from 15 to 75, with a maximum score of 75 indicating a high degree of control in child feeding.

E. Data Analysis

All statistics were calculated using the SAS for windows (version 8.2 SAS Institute, Cary, NC). The scores on the CFQ were used to group parents into “high
control" (score ≥45) versus “low control” (score ≤ 45) for statistical analyses. Children with parents exerting high versus low control over their feeding behaviors were compared for baseline demographics, BMI, calories, total fat and saturated fat intake, and number of servings of foods eaten from different food groups within food groups using Chi-square and t-tests ($p$ value <0.05 denoting statistical significance). Within group comparisons for children's nutrient and food intakes between evaluations were made using the period t-tests. To assess change in children's diets between evaluations, least-square mean change between baseline and 3 months, and baseline and 1 year were compared between parent control groups using analysis of covariance with baseline values of each variable serving as a covariate.
IV. Results

Fifty-eight children in this study were children diagnosed with hypercholesterolemia who completed an initial 3-day food record prior to receiving formal nutrition counseling, another food record 3 months after receiving formal nutrition counseling, and a food record at 1 year after receiving formal nutrition counseling. Parents of the children enrolled completed the CFQ at these same time points. Children were dichotomized into high parental control (HPC) and low parental control (LPC) groups based on parents scores on the CFQ (detailed in methods).

As shown in Table 3, baseline demographic data and anthropometric data were similar between groups.

Table 3. Comparison of anthropometric and demographic measures at baseline for children whose parents are more (HPC) versus less (LPC) controlling over their food habits

<table>
<thead>
<tr>
<th>Child Data</th>
<th>Parents with High Control Over Food (HPC)</th>
<th>Parents with Low Control Over Food (LPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>Age, yrs, mean ± SE</td>
<td>9.8 ± 0.6</td>
<td>9.5 ± 0.6</td>
</tr>
<tr>
<td>BMI, kg/m², mean ± SE</td>
<td>22.0 ± 1.1</td>
<td>22.7 ± 1.3</td>
</tr>
<tr>
<td>Gender, Female/Males; N</td>
<td>13/17</td>
<td>11/17</td>
</tr>
<tr>
<td>Race, Black/White; N</td>
<td>3/27</td>
<td>3/25</td>
</tr>
</tbody>
</table>

a Parent control determined by score of the Child Feeding Questionnaire (CFQ)
HPC = a total score of >45; LPC = a total CFQ score of ≤45 (see methods)

A. Characterizing Child Food Choice, Nutrient Intake, and Parental Control

Table 4 presents data characterizing the average nutrient intake at baseline and also, the average change in nutrient intake between evaluation periods for children whose parents were more controlling (HPC) versus less controlling (LPC) over their eating
habits. Calorie intake (kcalories/day), total fat (% of kcalories), saturated fat (% of kcalories), and cholesterol (mg/day) were nutrients analyzed.

**Calories:** There was no significant difference between groups at baseline for average calories (kcalories/day) consumed. Both groups decreased their average consumption of calories from baseline to 3 months and 1-year. Children in the LPC group achieved a statistically significant decrease in average calories consumed at both evaluation periods. The HPC group achieved a statistically significant decrease in average kcalories/day consumed from baseline to 1-year.

**Total Fat:** Both groups had similar average total fat intake (% kcalories) at baseline, 3 months and 1 year. Children with high controlling parents achieved a statistically significant decrease in average total fat consumption from baseline to 3 months and to 1 year. Children with less controlling parents did not significantly decrease their average total fat consumption from baseline to 3 months or from baseline to 1-year.

**Saturated Fat Intake:** Both groups had similar average saturated fat intake (% kcalories) at baseline, 3 months and 1 year. Children with high controlling parents achieved a statistically significant decrease in average saturated fat consumption from baseline to 3 months and from baseline to 1 year. Children with less controlling parents slightly decreased their average saturated fat consumption from baseline to 3 months and from baseline to 1-year, but the change was not significant.

**Cholesterol:** At the baseline evaluation, children in the LPC group consumed a significantly greater amount of dietary cholesterol than the children in the HPC group. There was a statistically significant difference in the amount of cholesterol consumed by the children in the HPC group from baseline to 3 months and from baseline to 1 year.
Also, the decrease in cholesterol intake from baseline to 3 months was significantly greater for the HPC group versus the LPC group. Children in the LPC slightly decreased their cholesterol consumption from baseline to 3 months and from baseline to 1 year, but the change was not significant.

Table 4. Average (±SEM) nutrient intake at baseline and average change\(^1,2\) in intake between evaluation periods for children whose parents were more (HPC)\(^3\) versus less (LPC)\(^4\) controlling over their eating habits.

<table>
<thead>
<tr>
<th>Energy and Nutrient</th>
<th>Baseline (BL)</th>
<th>Change from BL to 3 months</th>
<th>Change from BL to 1-year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HPC(^3) (n=30)</td>
<td>LPC(^4) (n=28)</td>
<td>HPC(^3) (n=28)</td>
</tr>
<tr>
<td>Calories (kcal/day)</td>
<td>1633.95 (65.48)</td>
<td>1839.90 (106.67)</td>
<td>-121.63 (70.23)</td>
</tr>
<tr>
<td>Total Fat (% kcalories)</td>
<td>30.40 (1.09)</td>
<td>30.43 (0.93)</td>
<td>-2.99 (^b) (1.07)</td>
</tr>
<tr>
<td>Saturated Fat (% kcalories)</td>
<td>10.83 (0.42)</td>
<td>11.30 (0.39)</td>
<td>-1.32 (^b) (0.45)</td>
</tr>
<tr>
<td>Cholesterol (mg/day)</td>
<td>139.27 (11.47)</td>
<td>190.86 (20.80)</td>
<td>-35.15 (^b) (9.67)</td>
</tr>
</tbody>
</table>

\(^1\) Average change between evaluation periods was compared between groups using analysis of covariance with baseline values for each variable (e.g. grains) as the covariate; Because there are unequal numbers of subjects in each group (an unbalanced design), least-square means are reported; Negative values indicate a decrease in number of servings from different food groups.

\(^2\) Within group differences were compared using paired t-tests. Differences are denoted with superscript letters; \(^a\) = \(p<.05\), \(^b\) = \(p<.01\)

\(^3\) HPC = High Parent Control group refers to parents that exerted a high degree of control over child feeding as measured by a high score on the Child Feeding Questionnaire (see methods)

\(^4\) LPC = Low Parent Control group refers to parents that exerted a low degree of control over child feeding as measured by a high score on the Child Feeding Questionnaire (see methods)

* HPC versus LPC, \(p \leq 0.01\)
** HPC versus LPC, \(p \leq 0.05\)

Table 5 presents the average number of servings from different food groups at baseline and average change in intake from baseline to the 3 month evaluation period and from baseline to 1 year evaluation period for children whose parents were more (HPC) versus less (LPC) controlling over their eating habits.
Grains: The number of servings of grains at baseline or mean change therein was not different between LPC versus HPC groups. Neither group achieved a significant reduction in grains from baseline to 3 months or from baseline to 1 year.

Vegetables: The number of servings of vegetables at baseline or mean change therein was not different between LPC versus HPC groups. The HPC group achieved a significant increase in number of servings of vegetables from baseline to 3 months and from baseline to 1 year.

Fruits: The number of servings of fruits at baseline or mean change therein was not different between LPC versus HPC groups. Neither group achieved a significant increase in fruits from baseline to 3 months or from baseline to 1 year.

Milk: The number of servings of milk at baseline was not different between LPC versus HPC groups. The HPC group achieved a significant reduction in milk servings from baseline to 3 months compared to the LPC group. The HPC group achieved a significant reduction in milk servings from baseline to 3 months and from baseline to 1 year. The LPC group achieved a significant reduction in milk servings from baseline to 1 year.

Meats & Beans: The number of servings of meats and beans at baseline or mean change therein was not different between LPC versus HPC groups. The LPC group achieved a significant increase in meats and beans from baseline to 1 year.

Fats & Oils: The number of servings of fats and oils at baseline or mean change therein was not different between LPC versus HPC groups. The HPC group achieved a significant reduction in fats and oils from baseline to 3 months and from baseline to 1 year.
Desserts & Sweetened Beverages: The number of servings of desserts and sweetened beverages at baseline or mean change therein was not different between LPC versus HPC groups. The HPC group achieved a significant reduction in desserts and sweetened beverages from baseline to 1 year. The LPC group achieved a significant reduction in desserts and sweetened beverages from baseline to 3 months and from baseline to 1 year.

**Table 5.** Average (±SE) number of servings from different food groups at baseline and average change in intake between evaluation periods for children whose parents were more (HPC)³ versus less (LPC)⁴ controlling over their eating habits.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Baseline(BL)</th>
<th>Change from BL to 3 months</th>
<th>Change from BL to 1-year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HPC³ (n=30)</td>
<td>HPC³ (n=28)</td>
<td>HPC³ (n=26)</td>
</tr>
<tr>
<td>Grains</td>
<td>5.71 (0.37)</td>
<td>-0.37 (0.27)</td>
<td>-0.39 (0.27)</td>
</tr>
<tr>
<td></td>
<td>6.14 (0.26)</td>
<td>-0.61 (0.24)</td>
<td>-0.34 (0.25)</td>
</tr>
<tr>
<td>Veggies</td>
<td>0.86 (0.13)</td>
<td>0.44a (0.16)</td>
<td>0.01 (0.17)</td>
</tr>
<tr>
<td></td>
<td>0.89 (0.15)</td>
<td>0.73b (0.16)</td>
<td>0.29 (0.17)</td>
</tr>
<tr>
<td>Fruits</td>
<td>1.45 (0.21)</td>
<td>-0.25 (0.19)</td>
<td>-0.21 (0.20)</td>
</tr>
<tr>
<td></td>
<td>1.12 (0.17)</td>
<td>-0.21 (0.20)</td>
<td>-0.16 (0.21)</td>
</tr>
<tr>
<td>Milk</td>
<td>2.49 (0.24)</td>
<td>-0.83b,*** (0.19)</td>
<td>-0.05 (0.19)</td>
</tr>
<tr>
<td></td>
<td>2.98 (0.21)</td>
<td>-0.60b (0.20)</td>
<td>-0.56a (0.21)</td>
</tr>
<tr>
<td>Meats &amp; Beans</td>
<td>3.84 (0.37)</td>
<td>-0.01 (0.32)</td>
<td>-0.30 (0.27)</td>
</tr>
<tr>
<td></td>
<td>3.63 (0.43)</td>
<td>0.24 (0.34)</td>
<td>0.56a (0.27)</td>
</tr>
<tr>
<td>Fats &amp; Oils</td>
<td>1.39 (0.27)</td>
<td>-0.40a (0.17)</td>
<td>-0.40a (0.27)</td>
</tr>
<tr>
<td></td>
<td>1.27 (0.24)</td>
<td>-0.40a (0.19)</td>
<td>-0.13 (0.28)</td>
</tr>
<tr>
<td>Desserts &amp;</td>
<td>3.90 (0.31)</td>
<td>-0.35 (0.38)</td>
<td>-1.35b (0.40)</td>
</tr>
<tr>
<td>Sweetened</td>
<td></td>
<td></td>
<td>-0.97a (0.38)</td>
</tr>
<tr>
<td>Beverages</td>
<td>4.41 (0.29)</td>
<td>-1.35b (0.40)</td>
<td>-1.79a (0.40)</td>
</tr>
</tbody>
</table>

¹ Average change between evaluation periods was compared between groups using analysis of covariance with baseline values for each variable (e.g. grains) as the covariate; Because there are unequal numbers of subjects in each group (an unbalanced design), least-square means are reported; Negative values indicate a decrease in number of servings from different food groups.

² Within group differences were compared using paired t-tests. Differences are denoted with superscript letters: a< p<0.05, b< p<0.01

³ HPC = High Parent Control group refers to parents that exerted a high degree of control over child feeding as measured by a high score on the Child Feeding Questionnaire (see methods)

⁴ LPC = Low Parent Control group refers to parents that exerted a low degree of control over child feeding as measured by a high score on the Child Feeding Questionnaire (see methods)

* p<0.05
** p<0.01
V. Discussion

The purpose of this project was to investigate parental control of child-feeding as it relates to children’s compliance to the NCEP dietary recommendations for lowering blood cholesterol in children. In general, after receiving formal nutrition counseling from a registered dietitian, children who had parents who were more controlling had changes in total fat, saturated fat, and cholesterol intake that were consistent with the NCEP dietary recommendations to lower high blood cholesterol. Contrary to previous research, this finding shows that parental control can positively impact changes in children’s diets to become consistent with the NCEP dietary recommendations to lower high blood cholesterol.

Children in both groups experienced changes in the number of servings from different food groups. Children who had parents who were more controlling ate more vegetables from baseline to 3 months and from baseline to 1 year, and decreased intake of dairy foods from baseline to 3 months and from baseline to 1 year, fats and oils from baseline to 3 months and from baseline to 1 year, as well as, desserts and sweetened beverages from baseline to 1 year. Children who had parents who were less controlling decreased intake of dairy foods from baseline to 1 year, meats and beans from baseline to 1 year, and desserts and sweetened beverages from baseline to 3 months and from baseline to 1 year. Children who had parents that were more controlling had a significantly greater decrease in the number of servings of milk from baseline to 3 months compared to children with less controlling parents.

The children also had nutrient changes that were consistent with the NCEP dietary recommendations. Children who had parents that were less controlling significantly
changed their energy intake from baseline to 3 months and from baseline to 1 year. Children who had parents that were more controlling also had a significant reduction in energy intake from baseline to 1 year. Children who had parents that were more controlling significantly decreased total fat, saturated fat, and cholesterol intake from baseline to 3 months and from baseline to 1 year. The difference between the groups’ cholesterol intake was significant at baseline and from baseline 3 months.

Previous research has been done which suggested that increasing vegetable intake and consuming low-fat servings from the milk group may help lower blood cholesterol levels (28,61). Vegetables are high in nutrients and fiber and relatively less energy-dense than other foods. Substituting lower-energy dense foods for higher-density foods will help to lower blood cholesterol levels (28). A study (61) conducted found that children who used skim milk in place of higher fat milks came closer to meeting the NCEP recommendations for total and saturated fat intake than those who consumed high fat dairy products. Results reported by the American Dietetic Association between 1977 and 1994 showed the proportion of children drinking reduced-fat or fat-free milks has doubled, while total fat intake has decreased (35). These studies suggest that increasing consumption of low-fat or fat-free milk by children may contribute to reducing total caloric intake and saturated fat consumption and therefore, lower the risk of children developing hypercholesterolemia. When relating this research to our results, children with more controlling parents significantly increased vegetable servings and decreased high-fat milk consumption which may help to decrease blood cholesterol levels.

Our data also showed that parental control had a positive impact on children changing their diets to comply with the NCEP dietary recommendations to lower blood
cholesterol levels. Previous research has shown conflicting data. Research performed by Birch et al suggests parents should not restrict energy dense foods (e.g., foods high in fat and sugar) because restricted access will lead to a greater preference and intake of these foods and maternal restriction promoted overeating (9, 11). Birch's research also showed that children who are deprived of food become preoccupied with it and when not in the restricted environment, are prone to overeat. Restricted eating and constant dieting are patterns for using food to cope (10). Birch et al examined the cumulative effect of monitoring, encouragement, and restriction of child-feeding, showing it is not always an effective approach to limiting a child's intake and may lead to over-eating (9). Lifshitz and Moses (12, 13) reported when parents restricted foods because of fear of their children becoming obese and/or hypercholesterolemic, negative consequences were evident early in the child's growth. Birch and Fischer state that parents should focus on the long-term goal of developing healthy self-control of feeding in children and not on the immediate concerns of the calorie, fat or sugar content in foods (11). Other studies have shown that parents that overly control food behaviors of their preschoolers may compromise their child's ability to self-regulate their intake of food (14, 15). Given the fact that most restricted foods are those that are energy dense, high fat foods, parents who restrict these foods may be unintentionally increasing their children's intake of these foods potentially leading to obesity and/or hypercholesterolemia.

Our data are not consistent with previous findings and suggests the need for further research on this topic. The population used in this study was diagnosed with a health condition differing from the population used in Birch's studies who were healthy children with the sole intent to lose weight. Also, it must be noted, a decrease in
saturated fat intake must be accompanied with an increase in less-energy dense foods, such as vegetables, to maintain an adequate energy intake that supports proper growth and development.

Overall, after receiving formal nutrition counseling from a registered dietitian, children with parents that were more restrictive made changes in their diets that were more consistent with the NCEP dietary recommendations to lower high blood cholesterol.
VI. Conclusions

The findings of this study suggest that parent control over child feeding that includes food restriction, monitoring, and encouragement may be useful in promoting consumption of heart healthy foods in a child’s diet. Our data are not in accord with previous research on child-feeding strategies and suggest the need for more research on this topic.

Because of the evidence that atherosclerosis begins early in childhood, detection and treatment of hypercholesterolemia in children is imperative in the prevention of CHD. Trends suggest children are consuming more saturated fat which can lead to hypercholesterolemia. The NCEP Step 1 diet has been successful in lowering a child’s blood cholesterol levels. Although shown to be effective, pediatricians should be cautious on any type of restriction of diet by the child or parent without proper nutrition counseling so that proper growth and development is not compromised. Parents need to be provided appropriate and accurate information regarding portion sizes and a healthy variety in foods. With the proper tools in place, prevention and treatment of hypercholesterolemia in children can be accomplished.
VII. References


17. www.americanheart.org


VIII. Appendix I

Calculation of Serving Size

Child serving size/NCEP serving size = proportion of NCEP standard serving size consumed.