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COMPARISON OF NUTRITIONAL INTAKE OF HOME SCHOOL CHILDREN AND PUBLIC SCHOOL CHILDREN: A COMPARISON STUDY

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ABSTRACT OF THESIS

COMPARISON OF NUTRITIONAL INTAKE OF HOME SCHOOL CHILDREN AND PUBLIC SCHOOL CHILDREN: A COMPARISON STUDY:

Purpose: To compare selected food /nutrient consumption between families that educate their children at home with those that educate their children in the public school system.

Methods: The study sample included 112 children aged 7-11 years in Fayette Co Kentucky. The children were divided into groups according type of education. There were 65 home-schooled children and 47 children who attend public school. Subjects recorded their dietary intake for one week. The data were analyzed using Nutrition Data Software for Research (2006). Comparisons were made for the intake of selected nutrients using two tailed independent sample t-tests.

Results: The public school students had a lower intake of Total Energy (calories, P=0.01), Total Fat (P= 0.02), Total Carbohydrate (P= 0.04), Total Protein (P= 0.004) and Total Dietary Fiber (P= 0.02) and selenium (P= 0.000) than did their home-schooled counterparts.

Conclusion: Interpretation of the statistical analysis indicates that differences for consumption exist between the groups. The results of this study indicate that the public school children consumed less fat, protein, carbohydrates and sucrose than did their home school cohort.

KEY WORDS: Education, Public School, Home School, Nutritional Intake, Nutrient Comparison

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Comparison of Nutritional Intake of Home School Children and Public School Children: A Comparison Study:

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Thesis

Stephen D. Perry RD, LD

The Graduate School

University of Kentucky

2008

Comparison of Nutritional Intake of Home School Children and Public School Children: A Comparison Study

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Thesis

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Agriculture
at the University of Kentucky

By

Stephen D. Perry RD, LD

Lexington, Kentucky

Director: Lisa Gaetke, Professor Nutrition and Food Science

Lexington, Kentucky

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Acknowledgments

The following thesis is submitted as partial fulfillment of the requirements for a Master's Degree at the University of Kentucky. However the completion of this requirement is more than what is contained within these pages. The depth of knowledge and understanding gained during the completion of the requirements for the degree are more than can be contained by this document.

I must first and foremost express my feelings of appreciation to my wife who has made it possible for me to complete this program without being cold, wet, or hungry. My words cannot fully encompass my appreciation for all that you have done; I would be lost and lonely if not for you.

In order to properly acknowledge those that I have had the pleasure to learn from, know and work with over these last few years it must be understood that the learning process is more than the effort that is put forth in the class room. To learn from professors and instructors is to be expected. What I did not expect were the changes that took place within me during its completion. I cannot begin to express my appreciation to the faculty and staff that labored tirelessly in answering my questions (often repeatedly) and ensuring that I was able to understand the point, or points. To them I most humbly say: For your time, patience, and perseverance, Thank You.

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Introduction:

The prevalence of childhood obesity has more than quadrupled in the United States over the last 40 years (1). The National Center for Health Statistics (2004) reports that the rates of obesity and overweight [Body Mass Index (BMI)-for-age >95th percentile] for children aged 6-11 years of age was calculated at 4.2 percent in 1965. By 2004, the rate increased to 18.8 percent (1). This increase in the prevalence/incidence and rate of obesity in children affects all levels of society and is evidenced across all income levels (1). There is cause for alarm, as being overweight as a child increases the chances of becoming an overweight adult and results in greater risk for chronic diseases such as type 2 diabetes, hypertension, and hyperlipidemia later in life (2, 3). The behaviors and attitudes concerning diet and health are learned as a child and are often carried into adulthood, and being overweight as a child increases the likelihood of being an overweight adult (4, 5). Overweight/ obesity in childhood increase the likelihood of these adverse health conditions, and the risks for these adverse effects have been shown to be independent of adult bodyweight (6).

Conditions related to obesity and overweight contribute significantly to increased healthcare costs, not only for the individual but to society as a whole (2). The estimated costs of being overweight or obese in this country were calculated to be $92.6 billion in 2002, with half of the costs being born by the Federal Government through the Medicaid and Medicare programs (7).

Due to the large economic burden of such obesity-related costs; prevention programs have been instituted at the state and local levels in an attempt to reduce the prevalence/rates and incidence of obesity among children (8). These programs focus on raising the level of nutrition awareness and education among primary aged school

children; specifically children aged 6-11 years (4). Children in this age category are targeted for prevention efforts because as a group, their attitudes about diet and health are considered to be more malleable than those of older children (9). In addition, it is believed that as a group their attitudes can be more readily influenced than older children in their teenage years (9).

Background Literature Review:

Increase in Prevalence and Rates of Obesity Worldwide:

In 2007, the majority of adults in the United States and many developed countries are categorized as overweight or obese (10). For developing countries, this is a different problem than what has been experienced in the past (11). Developed countries, and countries with developing economies that traditionally dealt with problems and diseases related to under nutrition, are now experiencing increases in the prevalence of overweight and obesity along with the associated health and economic consequences (10). With improvements in agriculture and the industrialization of food production, people have increased access to more processed foods.

These energy-dense nutrient deficient foods are inexpensive and easily available throughout society and they are readily consumed by children and adults (2). Anderson (2006) describes the changes in the food environment in conjunction with other changes in modern society as being detrimental in that they increase energy intake and upset energy balance. In effect, people are consuming more energy in calories than they are expending (12).

Factors leading to increased obesity in the US:

Over the last several decades the increasing number of single parent households and the need for dual career families has brought changes to the social environment (2). These changes have caused food consumption patterns of families to be altered as families are spending increasing amounts of time away from the home (2). These altered patterns have increased the demand for and consumption of prepackaged and convenience foods; with consumption of these foods more than doubling between 1977 and 1995 (2, 12). These new patterns of consumption have created changes in the food marketing environment, and in response providers are adapting strategies in an attempt to meet these needs (13).

Restaurants are attempting to differentiate themselves from competitors by offering increasingly larger portion sizes, or larger servings for a small increase in price. This tactic allows the perception of increased value for the customer, while minimally increasing cost for the producer (13). Increased portion sizes have led to a distorted view in the minds of consumers as to what a true portion actually is (13). This distortion has led to an increase in the number of calories consumed from foods with relatively low nutrient values (14). Secondly, consumption of foods away from the home is also associated with increased carbonated beverage consumption; and consumption of these beverages increases the caloric intake of the individual.

The development of these trends implicitly discourages physical activity while explicitly encouraging consumption of greater quantities of energy-dense, low nutrient value foods, and their emergence is highly correlated with the rise in incidence and prevalence of obesity in children (14, 15).

Obesity in Children:

Obesity in children is not as easily defined as with adults. For adults, the currently used definitions of overweight and obesity are related to functional outcomes of mortality and morbidity they are based on fixed values of BMI that do not vary by age or sex (9). In the United States, overweight in children is currently defined as a BMI at or above the 95th percentile of the 2000 CDC growth charts. The definition of children who are considered at risk for overweight is defined as a child having a BMI between the 85th and the 95th percentiles for children aged 2–19 years (9).

The treatment of established obesity has been largely ineffective, as preventative efforts to stem the rise in obesity have become preferable (13). Prevention programs help those children who are not obese to maintain a healthy weight, while assisting those who are overweight to become aware of the changes required to lose weight (16). For this reason pre-adolescent children have become the primary target for intervention programs (4). Obesity among children and adolescents is viewed as a major public health concern affecting both the physical and emotional health of youth while increasing their risk of reduced quality of life (6). This period of time in the development of a child includes increasing independence and self management, and teaching healthy behaviors is viewed as laying the foundation for a healthy lifestyle (6, 9).

Public schools offer an excellent platform for obesity prevention programs, as they can offer wide ranging strategies that apply to all pupils. A healthy school environment can help support weight loss provided that adequate follow-up and treatment are available (8, 16). The public school system offers continual regular contact with children and opportunities for nutrition education within the formal curriculum and

informally through a supportive environment such as healthy school meals and break time snacks (8). Schools offer a platform for the introduction and reinforcement of healthy behaviors and changes to the school environment which can be implemented with relatively few additional resources (8).

The Public School Environment:

Public education in this country is available to all citizens regardless of income level (17). The primary goal of public education is to promote the general welfare of the population by creating a skilled workforce and an informed electorate (17). Each State has regulatory authority over its public education, meaning the individual states are responsible for setting regulations for the financing, hiring of personnel and the curriculum to be followed (18). The educational standards and other practices of the schools are under the jurisdiction of the local school district, which are controlled by locally elected school boards (18). Funding for the school systems comes from federal, state and local governments, with primary funding coming from local property taxes (17). More than 97 percent of children five years and older spend six to eight hours a day in school for nine to ten months a year (16).

Public School Food Service:

The Federal School Lunch Program has a long history of development in this country. From its earliest beginnings in 1853; various forms of food service operations were undertaken by private societies and associations that were interested in the education and welfare of children (19). School meals were first introduced due to the anxiety over the health of children, particularly those in poorer areas where the children

were shorter and thinner than those in more privileged areas (20). The goals of the programs were to reduce daily hunger, and improve the nutritional intake of the pupils in the schools (19). However, it was not until 1932 that the first Federal monies were used to pay for lunches in public schools. The program was expanded through other social benefits programs including the Public Works Administration and the Federal Emergency Relief Administration (19). It was not until 1946 that permanent Federal funding was approved for school lunch programs. With the passage of this legislation, the Federal Government pledged continued support to programs that provide food and other assistance to the public schools in order to provide meals for school children. This assistance has grown over time to include free and reduced price lunches for those who qualify, and the addition of free and reduced price breakfasts in 1966 (19).

Federal monies are available to schools to help offset the costs of food for meals; however equipment and labor costs are not covered by monies from this program. School foodservice programs must often be self supporting (19). As a result, schools often sell competitive foods, which are available a' la-carte, or for purchase separately from the foods sold in the National School Breakfast and Lunch Program (NSBLP).

A' la carte foods are those foods not provided as part of the school lunch programs and are offered inside (and outside) the school's cafeteria, in vending machines and at school sponsored events. Also known as competitive foods, these foods often displace the consumption of foods provided by the school cafeterias (21). School meals which are often reported by students to be unappetizing must meet federal nutrition standards whereas competitive foods do not (22). Competitive foods tend to be high in calories and fat and include such foods as cookies, crackers, cakes, pastries, and salty snacks (2).

A' la carte foods are sold in part to offset the costs of equipment and labor as well as for other fund raising activities (2). Viewed as an external source of revenue, the sale of competitive foods has led many schools to enter into "pouring rights" contracts with food and soft drink companies. These contracts involve large payments to the school district and additional payments in return for exclusive sales of one company's products being sold in the vending machines in the schools (21). These foods are available to the students not only in and around the cafeteria, but from school stores and vending machines located throughout school grounds. It is interesting to note that during 1995-2004 when the pouring rights were becoming popular, the CDC reported increases in the incidence of obesity in children (2004). Between 1994 and 2000, student access to vending machines increased from 61 to 67 percent, and soft drink consumption from vending machines increased by 48 percent (2).

As the incidence of childhood obesity throughout this time period increased, policy makers and others interested parties began to recognize the problems of allowing children free access to these competitive foods (16). At a time when there has never been more nutritional information available, children are more likely to be overweight (20). This has led to increasing scrutiny of the dietary intake of public school children and to limiting the amounts and types of foods that are available to students. These parties have called for reforms to restore time spent on recess and physical education, and to limit the sale of competitive foods in schools (16).

A noticeable result of these changes is limitations of foods for snacking that are available to students, especially those foods sold in competition with the National School Lunch Program. As such policy makers and public health practitioners began calling for schools to change their environments and to begin to encourage healthier foods in schools

(16). In order to actively address this issue in Kentucky, the Kentucky State Legislature with the enactment of KAR 702 6:90, and KRS 158 set nutrition standards and portion size limits for food and beverage items that are available to the students during the school day (23). This regulation includes all beverages, and foods available to students including foods sold in competition with the National School Lunch and Breakfast Programs in vending machines, and includes foods and beverages sold for school fund raising activities during school hours (23).

KAR 702 and KRS 158:

There are two legislative regulations that were enacted to address the nutritional standards for foods. KAR 702 6:90 was put into effect by the Kentucky State legislature beginning with the 2005-2006 school year. Its purpose is to define minimal nutritional standards for foods and beverages available on public school campuses during the school day. This legislation requires the Kentucky Board of Education to specify the "Minimum nutritional standards for all foods and beverages (competitive foods) that are sold outside the National School Breakfast and Lunch Programs." This legislation was combined with the second regulation, KRS 158.854, an administrative regulation that establishes serving sizes and standards for the sugar and fat contents of foods and beverages.

Beverages:

Under KAR 702, the regulation for beverages served in grade schools states**:** "During the period of time beginning 30 minutes after the last lunch period until the end of the last instruction period, a beverage offered for sale through a vending machine, school store, canteen or fundraiser on school property shall:

- Be fluid unflavored or flavored milk that is no more than 1% milk fat.
- Plain or flavored, non-caloric, non carbonated water.
- 100% fruit or vegetable juice or any combination or both totaling 100%, or
- Any other beverage that contains no more than 10 grams of sugar per serving.

Beverages shall not exceed the volume size of seventeen ounces, except: for plain or flavored, non caloric, non carbonated water. Volume sizes for sale to middle and high school students shall not exceed 20 ounces." It is important to note that the volume limit does not apply to 100% fruit or vegetable juices.

Foods:

Foods under KAR 702 are regulated by the following rules: "During the period beginning 30 minutes after the last lunch period until the end of the last instructional period a food item offered for sale through a vending machine, school store, canteen, or fundraiser on school property shall meet the following standards:

Calories from fat:

- Shall not exceed 30%, excluding reduced fat (2% milk fat or less) cheese, nuts and nut butters. Calories from saturated fat shall not exceed 10%.

Calories from sugar:

- Shall not exceed 32% by weight. The grams of sugar shall not exceed 14 grams. These limits do not apply to fresh, frozen, canned or dried fruits and vegetables.

Sodium Restrictions:

- Chips, cereals, crackers, baked goods and other snack items shall not contain more than 300 mg of sodium per serving. Pastas, meats and soups shall not contain more than 450 mg of sodium. Pizza, sandwiches and main dishes shall not contain more than 600 mg of sodium.

Pack Sizes:

- The portion pack size for chips, crackers, popcorn, cereal, trail mix, nuts, seeds or jerky shall not exceed two ounces. The portion pack size for cookies shall not exceed one ounce.
- The portion pack size for cereal bars, granola bars, pastries, muffins, doughnuts, bagels, or other bakery type items shall not exceed two ounces. Non-frozen yogurt shall not exceed 8 oz. The portion pack size for frozen dessert items including low-fat or fat free ice cream, frozen fruit juice bars, or frozen real fruit items, shall not exceed 4 oz."

The regulations not only address what is available to the students in vending machines or what can be sold for fundraisers, it also addresses items available to the students for sale "a' la carte". KAR 702 Section 3 states: " Food or beverage items offered for sale as an ala carte item on the cafeteria line during the serving of breakfast of lunch shall meet the following standards:

- Any item that is creditable under the School Breakfast and National School Lunch Program Meal patterns.

- May offer only food and beverage items that meet the minimum nutritional standards of KRS 158.854 and Sections 1 and 2 of KAR 702, 6:90.

Used in conjunction with 702, 6:90, KRS 158.854 places limits on the availability of commercial foods that can be brought into the schools. It states that foods brought into the cafeteria from outside vendors such as foods from fast food chains must comply with the standards set forth in KAR 702 for fat and salt, and portion size, but also can not be made available for sale more than one day a week. It states:

"…Beginning with the 2006-7 school year, each school shall limit access to no more than one day each week to retail fast foods in the cafeteria, whether sold by contract, commercial vendor or otherwise."

KRS 158.850 sets forth standards not only for what can be sold in the school cafeterias, but has provisions for schools that are found to be in violation of the law. It also determines standards of education/certification levels for school food service directors; those in positions of authority or who are responsible for menu planning for each school district. KRS 158.850 in part states: "…Any person serving as a School Food Service Director or person otherwise responsible for menu planning in each school district… shall be credentialed as a "School Food Service and Nutrition Specialist… or be certified by a Level 2 certificate issued by the American School Foodservice Association." This credentialing/certification requirement ensures that those responsible for the planning and execution of the menus in the public schools understand the nutritional components as well as the regulatory requirements of school food service. The regulations call for each school district to compile a nutrition assessment report that is to be made available to the parents, and the district is to solicit input from the public about

concerns dealing with the nutritional qualities and values associated with foodservice offerings.

The implementation of these regulations has set forth changes in the school foodservice environment. The regulations not only set specific standards pertaining to what foods and beverages may be available to students within the public school system during the day, it also sets standards as to when competitive foods may be made available to the students. These actions have attempted to improve the nutritional quality and the nutritive value of the foods offered in the public schools.

The Modern Homeschool Era:

The movement to educate children at home has been increasing in popularity and in significance over the last several years. Basham (2001) defines homeschooling as "The education of school-aged children at home rather than in public or private school settings." The decision to educate children at home has grown in popularity and is seen as an alternative to education in the public schools (24). Collum (2005) remarks "At one time, parents who choose to home school were once dismissed as being on the fringe of society, however today this choice is becoming more acceptable."

Although the education of children in the United States originally occurred in the home, the growth of the population and its movement from rural to urban areas caused a change. The education of children shifted away from being done in the home to children attending public school. However, with the resurrection of the home school movement over the past 40 years, this practice of education has continued to grow and has emerged as a valid alternative to public education (24).

As home schooling has grown in popularity, so has the research tracking the phenomena. Princiotta et.al. (2004) stated that the number of home schooled children in 1990 was estimated to be 300,000, and has since grown to more than 1.1 million in 2003. The number of families who choose to educate their children at home is still growing (24).

The reasons that parents choose to educate their children at home are varied and wide ranging. Theorists and researchers have found increased parental involvement in the development and education of the child as the most often cited reason (24). Other reasons cited include (25):

- The parent wanting to be able to have a more positive influence on their child's upbringing.
- The parent being concerned with the environment of the public school system.
- The parent wanting to provide more religious or moral instruction.

Characteristics of Families that Home School:

Although the reasons that parents homeschool their children vary, families that make the choice of alternatively educating their children share similar characteristics. Collum (2005) identified several characteristics that are strongly associated with families that home school including:

- The vast majority of home school students are white.
- Parents that home school their children are better educated than average American adults.
- The annual household income of families that home school is above the national mean.

- The vast majority of parents are married (greater than 90%).
- The teaching parent is not in the workforce, and many of the non teaching parents are involved with the education of the child.

Families that choose to homeschool their children for reasons other than religion tend to be more highly educated than the general public. On average at least one if not both parents have a college degree, and quite often at least one parent has an advanced degree (24). In such cases, the advanced degree allows for an increase in household earnings. The income for families that choose to homeschool their children is generally higher than the national average (24). Kearney and Gibney (1998) found that people who have a college education have healthier eating habits (24). Neumark-Sztainer et.al (1998) stated that the level of education affects a wide range of healthy behaviors including healthy eating, and those with more education have greater access to health-related information and can be expected to eat healthier than those with less education (27). Previous research showed that a positive correlation existed between education, income, and health, but it is not clear if these characteristics translate into consumption of a healthier diet.

It is the characteristics of families that homeschool their children that is the interest of this study. Previous research showed that increased education leads to increased awareness of issues of health and nutrition. This study investigated whether there is a difference in the diets of children who are educated at home, and those that attend public school.

Purpose:

The purpose of this study is to compare selected food /nutrient consumption between children that are educated at home with children who are educated in the public school system. The two groups are compared for consumption of the following nutrient compounds: Carbohydrates, Protein, Total Fat, Dietary Fiber, Sucrose, and selected vitamins and minerals. The following hypothesis was used to guide the study.

Hypothesis:

There is no difference in the nutrient intake of public school children compared with children who are educated at home.

Methods:

Sample Population:

The study sample was drawn from the local population of Fayette County (KY) and surrounding communities in 2007. The sample included a total of 112 children aged 7-11 years old. The sample of children was divided into 2 groups. Group 1 consisted of 65 children (40 male, 25 female) that are educated at home, (HSC). Group 2 consisted of 47 children (30 male, 17 female) that are educated in the public school system (PSC). Subjects were recruited from February through May, through local home school association groups and cooperatives and from local public elementary schools.

Subjects did not have any physical limitations, did not have known HIV or any muscle wasting disease, and were not home schooled for medical reasons. Subjects were included in the study after informed consent was obtained from a parent or guardian, and verbal assent was obtained from each child. The study was approved by the Medical Institutional Review Board of the University of Kentucky.

Data Collection:

This data was collected as part of a larger study by Doug Long and Dr. Jody Clasey of the Department of Kinesiology and Health Promotion at the University of Kentucky. The study was partially funded by the UK Pediatric Exercise Physiology Laboratory Endowment, and a grant from The University of Kentucky Graduate School. The intent of the larger study was to compare and contrast differences of physical activity between families that home school their children and families whose children participate in the public school system. During the development of this program, it was determined that dietary intake should be included as part of the study, and therefore the data for this paper comes from the data that was collected as a part of the larger study. This paper compares dietary intake for the subjects. The result of the comparison for physical activity is reported in a separate study.

Subjects were instructed to record all nutritional intake for a period of seven consecutive days in a food journal provided for the study. The journal included both type and amount of all food, drink, and nutritional supplements ingested. Prior to the beginning of the study, counseling was provided to the child and the participating parent for the determination of portion size by comparing food models to different size sports balls and other commonly found household items. No counseling was given for recommended nutrient intake or for recommended consumption amounts. At the end of the seven day period, subjects were asked to return the food journals for analysis. The information provided was checked for accuracy and completeness with the participant present. Journal data was entered into a computerized data base for nutrient analysis.

The data base used for the analysis is the Nutrition Data System for Research (NDSR) 2006 Database, Nutrition Coordinating Center; Minneapolis, MN (28). NDSR is

designed for the collection and analyses of 24-hour dietary recalls and the analysis of food records, menus, and recipes. The macronutrients studied were: Fat, Protein (Pro), Carbohydrate (Cho), also included in this group were Sucrose (Suc), and total dietary fiber. The selected micronutrients to be evaluated were: Vitamin A, Riboflavin, Calcium (Ca), Iron (Fe), Zinc (Zn), Selenium (Se).

Statistical Analysis:

Descriptive statistics were used to summarize demographic information. Aggregate means for the selected nutrients for equivalency of intake were compared between the two groups using independent sample two tailed T-tests. Statistical significance was determined at the 0.05 level. The analysis was carried out using SPSS Statistical Software Version 15.0.1 dated 22 November, 2006.

Results:

Table 1 describes the participant breakdown of the group populations. The home school children (HSC) included 65 participants, making up 58% of the study population, while the Public school children (PSC) included47 participants or 42% of the study population.

Table 1: Descriptive Statistics for Age, Gender, and BMI: There are a total of 112 subjects; the demographic data for each group is as follows:

Group	N	Age (Y)	Gender	Mean BMI
Homeschool children (HSC)	65	9 $\pm$ 1.43	40 M, 25 F	17 $\pm$ 2.3
Public school children (PSC)	47	9 $\pm$ 1.3	30 M, 17 F	18 $\pm$ 4

Population Ethnicity:

The HSC group was made up of 59 Caucasian children, 5 children of Asian heritage, and 1 child being African American. The weight classification for this group at the time of entry into the study was 53 lean children, 8 children were classified as overweight with 4 children being classified as obese.

The PSC group contained 45 Caucasian children and 2 children of Asian descent. The weight status for this group at the time of entry into the study was 32 lean children, 9 children being classified as overweight with 6 children classified as being obese.

Table 2: Aggregated Seven Day Values, Difference of Means, P-value and RDA/DRI Comparisons by Group for Nutrients:

Group	Energy (Kcal)	Total Fat (g)	Total Carbohydrate (g)	Total Protein (g)	Sucrose (g)	Total Dietary Fiber (g)
Homeschool children (HSC)	11,824	423	1,616	429	316	94
Public school children (PSC)	10,336	369	1,428	367	286	78
Difference of Means	1488	54	188	62	30	16
P-value	0.01**	0.02**	0.04*	0.004**	0.3	0.02**
RDA/ DRI ≤ 8 y/o	**6,944-7,322**	**175- 280**	**910**	**133**	**N/A**	**175**
RDA/ DRI 9-13 y/o (M-F)	**14,497-15,953**	**140-245**	**910**	**238**	**N/A**	**217-182**

* Indicates P-value ≤ 0.05

** Indicates P-value ≤ 0.02

Table 2 Cont'd:

Group	Total Vitamin A (Iu)	Riboflavin (mg)	Calcium (mg)	Iron (mg)	Zinc (mg)	Selenium (Mcg)
(HSC)	37,472	18.8	6,003	112	72	618
(PSC)	34,699	18.0	5,584	109	73	473
Difference of Means	2773	0.8	419	3	1	145
P-value	0.6	0.6	0.3	0.8	0.9	0.00**
RDA/DRI ≤ 8 y/o	**48,496**	**4.2**	**5600**	**70**	**35**	**210**
RDA/DRI 9-13 y/o (M-F)	**49,896**	**6.3**	**9,100**	**56**	**56**	**280**

* Indicates P-value ≤ 0.05

** Indicates P-value ≤ 0.02

Nutrient Consumption Comparison HSC vs. PSC:

Table 2 displays the food consumption data for the two groups. The comparison shows that differences exist for nutrient intake. The home school children reported significantly greater intake for Energy (P= 0.014), Total Fat (P= 0.016), Total Carbohydrate (P= 0.042), Total Protein (P= 0.004), Total Fiber (P= 0.016) and Selenium (P= 0.000). The public school children's reported consumption was lower overall for energy as calories (averaging 212 Kcals/day less) than the home school children for the time of the study. The home school children not only reported consuming more total calories than did the public school children they consistently reported consuming the macronutrients in greater quantities. The public school children reported less total fat, (369g vs. 423g), and had lower consumption for carbohydrates (1616g vs. 1428g), protein (429g vs. 367g) sucrose (316g vs. 286g), and fiber (94g vs. 78g) consumption.

Each group consumed the macronutrients in relatively equal proportions in respect to their total diet. Total fat constituted 32% of intake for each group, total carbohydrate consumption was 55% of total intake, with total protein consumption being 14% of total intake for each group. Intake for total dietary fiber is where there is a difference in percentage of total diet. Total Fiber constituted 38% of the diet for HSC, while constituting 30% for PSC. Each of the selected nutrients can be found in the diet in a variety of forms. They occur naturally, are found in organic foods and are also used for supplementation or enrichment in processed foods.

The micronutrients selected for this study are: Vitamin A, Riboflavin, Calcium, Iron, Zinc, and Selenium. There were no differences in the nutritional intake between the two groups for these micronutrients except the home schooled children consumed more

of the trace mineral Selenium (P= 0.000). The home school children again had consistently greater consumption of the micronutrients than the public school children with the exception of zinc (HSC= 72mg vs. PSC= 73mg). The intake for both groups indicates sufficiency of intake for micronutrients with only two exceptions, vitamin A (DRI = 7,128 Iu/day- HSC = 5,353 Iu/day, PSC = 4957 Iu/day), and Calcium (DRI 1,300 mg/day- HSC = 857mg/day, and PSC = 797mg/day).

Comparison with Recommended Daily Allowance/ Daily Recommended Intake HSC/ PSC:

The nutritive qualities of the diets were compared with the Recommended Daily Allowances (RDA)/ Daily Recommended Intakes (DRI) for each component of interest as given by the 2000 National Academies Press (and/or National Academies of Sciences). For each group, all data were aggregated, and seven day means were determined for each of the nutrients. Comparison of the dietary intake for groups of children against the RDA/DRI indicates that both groups with exceptions for Energy, Total Dietary Fiber and Vitamin A consumed all of the components studied in amounts greater than what is considered necessary for a healthy diet. Both group's consumption for Energy was less than the minimum requirement for consumption. Dietary fiber is another constituent in which both groups failed to meet the RDA/DRI for consumption. It is also the only constituent studied in which greater consumption is associated with a healthier diet. Vitamin A on the other hand is a fat soluble vitamin and as such is stored in the fat reserve of the body, and is released as needed. Therefore although neither group met the DRI for Vitamin A, as such the children would not be considered deficient for this component.

Discussion:

This study was part of a larger study on the effect of type of school setting on physical activity and nutritional intake in public school children versus home schooled children. As part of this larger study, this was the first research that evaluated the differences in dietary intake between children educated in the public school system to those educated at home.

The data showed that the hypothesis was incorrect and there were differences for consumption between groups. Differences existed for all of the macronutrients studied. In each case with the exception of total dietary fiber the home school children's group consumed the macronutrients in greater amounts than did the public school children. This is not in contradiction to the findings of the background literature; which states that families who home school their children can be expected to consume a healthier diet than those of the general population (27). This is due to the home school children's reported consumption to be more closely aligned with the RDA/ DRI guidelines. Previous research indicates families that home school their children have better access to information concerning diet and health. As such the dietary intake of these families can be expected to be more healthful than that of the general population (27).

This finding is contradictory to what one could expect if the groups were compared solely by BMI. In this study, the homeschool children and the public school children had BMIs within the normal range. In a similar vein, using the RDA/ DRI recommendations for comparison of the groups would also lead to a false assumption of similarity of intake as well, as both groups consumed calories in amounts below what is recommended to maintain a healthy weight (HSC = 11,824 vs. PSC = 10,336). The

results of this study indicate that drawing conclusions for similarity of nutrient intake between the groups based solely upon either BMI or in conjunction with the RDA/ DRI recommendations would not allow for the findings of this study to be shown.

The home school children consistently consumed the macronutrients in greater quantities than did the Public school children. Their consumption was greater for total fat, (423g vs. 369g), carbohydrates (1616g vs. 1428g), protein (429g vs. 367g) sucrose (316g vs. 286g), and total dietary fiber (94g vs. 78g). The results of the comparison for micronutrients consumption indicates that no differences exist between the two groups except for the trace mineral selenium (P = 0.000; HSC = 618, PSC = 473). Both groups consumed selenium in amounts greater than is required for adequacy, and the ingested amount is not considered hazardous (tolerable upper intake = 1960 Mcg). The remaining micronutrients were consumed in amounts deemed adequate for a healthy diet and neither group had intakes to indicate insufficient consumption for adequacy. The similar results for intakes of micronutrients are not as unexpected as the differences found for the macronutrients. This is due to the heavy fortification of the selected micronutrients in processed foods and the frequent consumption of these foods by the subject population.

This study shows that the home school children consistently consumed greater quantities of food than did their public school counterparts. This finding is both exciting and unexpected. The prevalence of data in the background literature linking increased education and income to improved food/ nutrient consumption of children educated at home is well established, and widely accepted, but there are some factors that were not present in the background literature that helps to explain why the results of this study are different than what is found in previous studies.

Restriction of Foods for Public School Children:

In the past, food served in the school cafeterias was not as heavily regulated as it is now, and schools were not penalized if their menus did not meet the minimum nutritional requirements as set by the United States Department of Agriculture (USDA). Products sold à la carte or in vending machines, in competition with the National School Lunch and Breakfast Programs generally lacked substantive nutritional value.

Researchers studying the foods offered to students in secondary schools found that high-fat foods such as chips, crackers, and ice cream constituted about 21.5% of the available à la carte items; while a mere 4.5% of the à la carte items were fruits and vegetables (15). Before the introduction of legislation limiting the availability of foods served in school cafeterias, snack and soft drink vending machines had become ubiquitous fixture in schools. In Kentucky 44% of elementary schools had vending machines containing these types of foods and beverages (25).

The introduction of statutes regulating the content and availability of vending machines has led to increased promotion and consumption of healthier snacks and beverages for public school students. In addition the regulations restrict the type and availability of commercial foods that may be served during the week, further restricting access to foods that are high in fat, sugar and salt. The regulations also require that foods served à la carte must be creditable under the School Breakfast and National School Lunch Program Meal patterns. This increases the nutritive value of the competitive foods sold to students, and replaces less healthful foods that in the past contributed to excessive fat and saturated fat intake (25). This promotion of the eating of healthier foods including fruits, vegetables and the consumption of other healthy snacks has been shown to

increase satiety and reduce overall caloric intake (28).The regulations require that foods that are served in school cafeterias must meet the minimum nutritional requirements as set forth KRS 158.8, improving the nutrient content of the foods offered, again increasing feelings of satiety, and reducing the need for snacking (25). Whether this played a role in the decreased intake of foods by the pubic school children in this study is still unclear.

Availability of Food for Home Schooled Children:

It is unknown if any or what type of restrictions were placed upon the availability of food to children who are home schooled. Free access and availability of foods in the home would account for some of the increased caloric intake for this group. Similarly, the frequency of food consumed outside the home could also account for the increase consumption of calories, and calories from fat noted in this group, as families that eat in restaurants consume higher levels of calories and fat than those that do not (29).

We did not assess the number of times food was consumed away from the home in this study. It is extremely important to recognize that parental attitudes and beliefs are tremendously influential in determining the dietary patterns and habits of children. Parent's philosophies concerning diet, nutrition and health are fundamental to understanding the development and formation of dietary habits in children. Arrendondo (2006) asserts that the children of parents who monitor and reinforce healthy behaviors eat more of healthy foods and less of unhealthy foods. Similarly, parents who monitor their children's fat intake and their amount of physical activity are less likely to have children who are overweight than parents who do not monitor these aspects of their children's lives (31).

Other Factors:

There are several other points to be aware of as to the gathering of information for this study. First, the food records were self reported by the subjects in the study. The self recording of data is considered to be less reliable than methods of direct observation or interview by the researcher. The NDSR program is designed to be used with the multiple pass approach process of data recording (30). This approach allows the researcher to ask leading or probing questions of the subject, prompting a more accurate recording of dietary intake. NDSR software is acceptable for analyzing data, food records, and menu's however the multiple pass interview approach is considered more reliable than using self recorded data (30). Research participants often underreport consumption of food in an attempt to give the appearance of a more healthful diet, or in an attempt to gain approval from the researcher, this can lead to underreporting of food portions. Secondly, consistency in reporting consumption in food diaries as recorded food portions may not represent actual consumption, or standard portion sizes. Finally the sample population of children is not representative of the community population for weight, ethnicity or BMI. The study sample did not include an appropriate representation of overweight and obese children. Lastly, the majority of the research population was Caucasian, and the study participants were not representative of the minority population of the region. Household income is a key factor concerning the quality of diet as well, and it should be noted that the annual household income between groups was comparable.

Conclusion:

The purpose of this study was to discern if differences exist for dietary intake between public school children and home school children. The data showed home school children consumed more energy as calories, fat, carbohydrate, protein, fiber, and selenium than public school children. While this study finds that differences do exist, it is difficult to determine causation for the findings. Factors that were not included in this study but should be investigated in future research include, determining energy expenditure rates and using more accurate methods of documenting and reporting of food consumption patterns. These factors may help explain why such differences occur, and lead to the development of outcome based programs that will effectively encourage consumption of healthier diets across all sectors of society.

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