To the Graduate Council:

I am submitting herewith a dissertation written by Mary Ann Spruill entitled "The Effect of 4-H Foods and Nutrition Projects and Demonstrations on Food and Nutrition Knowledge and Dietary Adequacy of 4-H'ers in North Carolina." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Home Economics.

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THE EFFECT OF 4-H FOODS AND NUTRITION PROJECTS AND DEMONSTRATIONS ON FOOD AND NUTRITION KNOWLEDGE AND DIETARY ADEQUACY OF 4-H'ERS IN NORTH CAROLINA

A Dissertation

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ABSTRACT

The purpose of this study was to document the effectiveness of 4-H foods and nutrition projects and demonstrations in increasing the food and nutrition knowledge and improving the eating habits of boys and girls in North Carolina. A food and nutrition knowledge test consisting of 30 true-false questions was administered and a 24-hour food recall was taken from 208 youth ages 15-18. Questionnaires were designed to identify non 4-H'ers and 4-H'ershaving completed various numbers of foods and nutrition projects and demonstrations. Demographic data collected included age, gender, location of residence (urban versus rural) and race.

Youth who had completed the most 4-H foods and nutrition projects and participated in the foods and nutrition demonstration program (Group I) scored higher at the .05 level on the food and nutrition knowledge test than did other youth. The mean knowledge score of youth in Group I was 24.73 ± 3.56, significantly higher than the mean score of youth who had completed at least three foods and nutrition projects but never had given a foods and nutrition demonstration (Group II)--20.82 ± 4.41. Group II youth also scored significantly higher on the test of food and nutrition knowledge than Group III youth who were members of 4-H but never had completed a foods and nutrition project or demonstration--18.00 ± 3.91. And, the mean food and nutrition knowledge score of Group III youth was also significantly higher than the mean score of 15.22 ± 5.52 of non 4-H youth (Group IV). The SAS-PROC FUNCAT statistical procedure

indicated the significant differences that existed among all groups in food and nutrition knowledge were not influenced by differences in demographic composition of groups.

Comparison of dietary adequacy among groups was assessed by two methods: by chi-square analyses; that is, examining the extent to which youth in each group met or exceeded two-thirds of the 1980 Recommended Dietary Allowances (RDA) for kilocalories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C as well as testing for statistical differences at the .05 level in actual energy and nutrient intakes that existed among groups.

Chi-square analyses showed that significant differences existed between Group IV and Groups I, II and III with respect to the extent that youth in each group met or exceeded two-thirds of the 1980 RDA for energy and all nutrients except calcium and vitamin C. In the cases of calcium and vitamin C, no statistical difference was found among groups as to the proportion of youth in each group consuming adequate and inadequate intakes. A higher proportion of non 4-H members (Group IV) was found to consume inadequate intakes of kilocalories, protein, iron, vitamin A, thiamin, riboflavin and niacin than did 4-H youth (Groups I, II and III). When comparing the nutrient intakes of 4-H youth who had completed various numbers of foods and nutrition projects and demonstrations, insignificant chi-square results were reported with the exception of niacin. A significantly larger proportion of 4-H youth in Group III consumed less than two-thirds of the RDA for niacin than did 4-H youth in Groups I and

II. The SAS-PROC FUNCAT statistical procedure indicated that the significant differences in energy and nutrient intakes that existed between Group IV and Groups I, II and III were independent of the demographic composition of groups.

In addition to examining nutritional adequacy versus inadequacy among groups, tests of statistical difference in actual nutrient intakes among groups also were employed. In all cases, Group IV (non 4-H youth) consumed fewer kilocalories and nutrients analyzed than did youth in Groups I, II and III (4-H youth), with the exception of calcium.

No correlation was found between the age of 4-H youth and their level of food and nutrition knowledge. Slight but insignificant correlations were found between age and nutrient intake and between level of food and nutrition knowledge and nutrient intake.

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CHAPTER I

INTRODUCTION

According to the Smith-Lever Act of 1914, Cooperative Extension work involves "diffusing among the people useful and practical information on subjects relating to agriculture and home economics" and encouraging the application of such information to meet individual and societal needs. Extension Service nutritionists in each of the 50 states, District of Columbia, Puerto Rico and the Virgin Islands cooperate with professionals in other governmental and private agencies in formulating, planning and coordinating foods and nutrition educational programs.

More than 3,000 Extension home economists and nutrition specialists in the United States are involved in developing and evaluating nutrition education programs involving professionals, paraprofessionals and volunteers in order to improve the diets of individuals and families (1). Priority audiences include those persons most likely to be consuming poor or nutritionally inadequate diets--children, adolescents, young homemakers and the elderly.

It has been said that every successful idea has many fathers. However, it was Seaman A. Knapp who consolidated various attempts at mass education when he started a 70-acre demonstration plot in Tyrrel, Texas on February 26, 1903. As Knapp later said, "What a man hears he may doubt, what he sees he may possibly doubt, but what he does himself he cannot doubt" (2). It was this demonstration technique--a "hands-on" experience, that became the cornerstone of Extension and the basis for the 4-H motto, "learn by doing."

Boy's corn clubs followed by girl's canning clubs foreshadowed the beginnings of 4-H. By 1904, 2000 boys were enrolled in 4-H clubs in Illinois. The first federally sponsored 4-H club was started in Mississippi in 1911 (3). These original corn and canning clubs have evolved into a wide variety of self-directed projects which serve as the basis for the 4-H educational program today.

The 4-H youth program of the North Carolina Agricultural Extension Service is an informal, year-round educational program conducted with the cooperation of parents, other adults and volunteers who organize and lead learning experiences for youth in a community setting (4). The principal objective of 4-H is to help young people develop their potential. Through interaction with other young people and adults, youth gain leadership skills, abilities and knowledge that will enable them to be more capable young people and influential members of their communities.

The funds for 4-H programs are obtained from federal, state and county governments. It is the only informal youth educational program administered through a university and for which public funds are appropriated directly. Industries, businesses, civic organizations, public and private agencies and individual citizens lend support, which greatly enriches the program. The present ratio of public to private support in North Carolina when measured in dollars is \$1 to \$4 (4).

In 1981, more than 95,873 youth, or approximately 10% of the total youth population between 9 and 19 years of age in North Carolina, were enrolled in the 4-H program through participation in community clubs, special interest groups, project clubs and other activities. Other 4-H participation included the statewide 4-H nutrition education television series, "Mulligan Stew," which reached 85,000 youth. More than 6000 youth participated in other 4-H camping experiences. In addition, 21,000 young people were introduced to the 4-H concept through cooperative efforts with the Expanded Foods and Nutrition Education Program (EFNEP) (5).

The North Carolina Agricultural Extension Service has long recognized the value of 4-H foods and nutrition projects. One agent in each of North Carolina's 100 counties is assigned responsibility for the foods and nutrition program and works closely with the county 4-H agent in planning and implementing a well-rounded program based on current needs and interests of youth. In addition, one person on the State Foods and Nutrition Specialist staff serves as a consultant to county personnel and devotes approximately 75% of her time to coordinating a statewide 4-H foods and nutrition program.

The number of available nutrition-related 4-H projects has increased significantly over the past decade in an attempt to meet the changing interests and needs of today's youth. Although nutrition has been considered a primary preventive health care measure for years, most major public health problems are still diet-related. Research has shown that sound eating habits and proper dietary modifications begun early in life may improve health status by delaying or preventing diet-related diseases. Thus, nutrition education programs may have the greatest impact on youth, who are in the formative years of development.

Purpose of the Study

In October 1978, Joab L. Thomas, Chancellor, North Carolina State University, appointed a committee to examine the future of the North Carolina Extension Program. The Chancellor gave the committee the following charge:

> As we continuously make adjustments to accommodate . . . to rapid change, it is essential that we establish benchmarks on a regular basis if we are going to maintain any sense of where we are and where we are going (6).

The overriding fact in North Carolina, as in the world, is unprecedented change—economic, social, technological and political. The immense speed and scope of societal change today requires constant innovation to avoid obsolescence and outright regression. The committee functioned on the assumption that progress in today's fast and changing social and economic system is not made by doing more of the same in the same way; rather progress is made by wondering if there are better ways to function, and having the courage to implement promising innovations.

Evaluative research is an important dimension of the program development process. Educational evaluation includes gathering, analyzing, and using data to provide information about the nature and worth of educational programs in order to improve decisions about the management of these programs (7).

Presently, little, if any, data exist that document the extent to which 4-H foods and nutrition projects and demonstrations serve to increase the nutrition knowledge of youth, which in turn, serves as a positive influence on their dietary practices. Such data are necessary, not only to justify the need for on-going 4-H foods and nutrition programs, but also to help set priorities and provide baseline data for future program planning.

The 4-H program must continue to serve the needs of its clientele. Rapidly growing demands for evidence of accountability and responsible public mission among federal, state, and local legislative bodies must be met. Evaluation designed to assess program results is long overdue and can provide invaluable information in re-directing efforts as new needs are identified. In an era of inflation and budget cut-backs, when all governmental programs are being closely scrutinized, it is mandatory that the effectiveness of the 4-H program be documented and communicated to public and private sponsors.

Because of the increased emphasis on program evaluation and the demand for accountability and efficient use of public funds, this study was designed to provide the public with data to substantiate the practical effectiveness of the 4-H foods and nutrition program in North Carolina. Specifically, the purposes of this study were to examine the nutrition knowledge and dietary adequacy of youths involved in one or more aspects of the 4-H foods and nutrition program, to determine the influence of "learn by doing" nutrition education activities on nutrition knowledge and dietary adequacy and to discover whether or not there was a correlation between level of nutrition knowledge and dietary adequacy.

Hypotheses

In order to compare the nutrition knowledge and dietary adequacy of youth involved in various types and amounts of nutrition-related activities, the following four groups were arbitrarily selected for study:

Group I — 4-H members having completed at least three foods and nutrition projects and having given at least one demonstration.

Group II — 4-H members having completed at least three foods and nutrition projects and having given no demonstrations.

Group III — 4-H members having completed no foods and nutrition projects and having given no demonstrations.

Group IV — Non 4-H members.

Based on the groups described above, the following null hypotheses were presented for this study:

Hypothesis One: There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects and having given at least one demonstration and 4-H members having completed three or more foods and nutrition projects only.

Hypothesis Two: There is no significant difference in food and nutrition knowledge between 4-H members having completed three

three or more foods and nutrition projects and having given at least one demonstration and 4-H'ers having completed no foods and nutrition projects nor given any demonstrations.

Hypothesis Three: There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects and having given at least one demonstration and non 4-H'ers.

Hypothesis Four: There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects only and 4-H'ers having completed no foods and nutrition projects nor given any demonstrations.

Hypothesis Five: There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects only and non 4-H'ers.

Hypothesis Six: There is no significant difference in food and nutrition knowledge of 4-H members never having completed a foods and nutrition project nor given a demonstration and non 4-H'ers.

Hypothesis Seven: There is no significant difference in nutrient content of diets of 4-H members having participated in various amounts and types of nutrition-related activities and non 4-H'ers.

Hypothesis Eight: There are no correlations among age, level of food and nutrition knowledge and nutrient intake.

Definition of Terms

Terms used in relation to this study:

Four-H Program: The youth component of the North Carolina Agricultural Extension Service; an informal, year-round education program conducted through the involvement of parents, other adults, and volunteers who organize and lead learning experiences for youth in a community setting.

Four-H Member: A youth aged 15-18 who participates in North Carolina's 4-H Program, a voluntary informal education program.

Non Four-H Member: A youth aged 15-18 who is enrolled in school but is not a 4-H member.

Four-H District Retreat: A one-day meeting open to all 4-H'ers in the district for the primary purposes of program planning and education in a specific subject matter area. District retreats are held approximately two times each year and are attended primarily by senior 4-H'ers.

Four-H Foods and Nutrition Project: A written manual designed to teach skills related to food preparation, sound eating habits, and the importance of good nutrition as it relates to health and fitness. Projects incorporate a wide variety of "learn-by-doing" activities and include Adventures in the Kitchen, Cooking is Fun, Incredible Milk, Quick Bread Made From Mixes, Quick Breads from Basic Ingredients, Tricks for Treats, All American Foods, Meals for Today the Easy Way, Teens Entertain, Foods with an International Flavor, Picnic Meals, Campout Meals, Hiking and Backpacking, Calorie Countdown, Food Conservation and Safety, Peanuts . . . Nutrition in a Nutshell, Winning Ways with Yeast Breads and Health I.

Four-H Demonstration: The act of showing and telling others how to prepare a recipe in order to:

- promote a product,
- teach nutrition and/or the nutritive value of the product,
- teach principles of food preparation,
- develop poise and self confidence.

CHAPTER II

REVIEW OF THE LITERATURE

Numerous nutrition education programs aimed at raising the nutrition knowledge of target populations in order to serve as a positive motivator for dietary behavior are cited in the literature. Some studies have reported positive changes in both knowledge levels and subsequent dietary practices. Other studies, however, have been successful in raising cognitive learning, but have had little, if any, effect on modifying dietary behavior.

Unfortunately, even though evaluative research is an integral part of the program development process, little, if any, data exist that document the impact of 4-H foods and nutrition programs, specifically, foods and nutrition projects and demonstrations, on increasing knowledge levels and changing eating habits of youth. For the purposes of this study, the review of literature is divided into six sections, namely, The Adolescent, Food Habits of Adolescents, Nutritional Status of Adolescents, Effect of Nutrition Education on Nutrition Knowledge and Dietary Intake, Learning Transaction and the 4-H Philosophy.

The Adolescent

Adolescence has been defined by Valadian (8) as the period in which a child develops into a mature man or woman. He/she becomes sexually mature, achieves the ability to reproduce and realizes the kind of physique he/she is to have as an adult. He/she does so by undergoing profound physical, physiological, mental, emotional and social changes. These changes are not only considerable, but the interrelationships among them are extremely complex.

Adolescence is a difficult period of life; difficult not only for the adolescent, but also for his/her parents. It is a period when pressure from one's peers is very strong. Adolescence is a time when one is trying to learn about oneself, question values one has been taught from birth, and establish one's own beliefs and lifestyles.

Adolescence is sometimes delayed or prolonged; and it can go on past the teen years. The adolescent craves independence, yet at the same time, is afraid of "letting go" of parents and the security they provide. The adolescent is unsure of him or herself, but wants to be "grown up." In short, adolescence is a new beginning--a time when one stops being a child and strives to be an adult. It cannot be viewed as beginning at a specific time, but rather with signs of puberty and continuing until most have achieved sexual maturation and maximum growth in height.

From a physiological perspective, adolescence usually is accompanied by increases in height and weight, changes in bone structure, growth of various internal organs, changes in blood pressure and external and internal pubertal alterations (9). The adolescent growth rate is second only to that found in the prenatal and infancy period. The peak velocity of growth in height averages about 10 cm a year in boys and slightly less in girls. In boys, the spurt usually takes place between 12.5 and 15.5 years of age, and in girls, approximately two years earlier (10).

Practically all skeletal and muscular dimensions take part in the spurt, though not to an equal degree. Most of the spurt in height is due to trunk growth rather than growth of the legs. The muscles appear to have their spurt about three months after the height peak; and the weight peak velocity occurs about six months after the height peak (10).

The adolescent spurt in skeletal and muscular dimensions is closely related to the rapid development of the reproductive system which takes place at this time. One major psychological task for the adolescent is adjusting to these changes. Since bodily growth and sexual maturation are the predominant changes, adjusting to sexual drive and changes in physical appearance becomes the fundamental task for the adolescent. Additionally, it often becomes the role of professionals working with adolescents to help interpret the significance and adequacy of these changes and help the adolescent learn to like the kind of adult he/she sees him/herself becoming.

Sieg (11) has defined adolescence from a behavioral perspective--the period that begins when an individual feels adult privileges are due him/her but are not being accorded him/her and that ends when the full power and social status of the adult are accorded to him/her by society. This definition ignores the biological factors of puberty and age.

During the adolescent period, an individual also is expected to acquire certain developmental tasks. Thornburg (12) defines these developmental tasks as "skills, knowledge and functions or attitudes which individuals should acquire within a specific period of their lives." The behavior of the individual ultimately reflects efforts to fulfill these tasks (8).

As food habits are an integral part of an individual's life-style, all aspects of adolescence--physiological, sociological and psychological--must be considered in a study of teenage nutrition- and food-related behavior. It has been postulated that as one sphere of life increases in complexity, other spheres increase in complexity also (13). Therefore, because the adolescent may try to compensate for the vague and uncertain position in which he/she finds him/herself, changes in established eating patterns are likely to occur (14).

As a result, many teenagers develop poor and bizarre eating habits, which may be detrimental to their health. Especially for those young people with unstable family relationships and poor emotional adjustment, adolescence seems to precipitate erratic food habits--skipping meals, snacking and eating away from home (15-18) and adoption of alternate dietary patterns such as weight-reduction fads, megavitamin therapy and vegetarian practices (19). Therefore, the adolescent period has been identified by numerous nutrition educators and health specialists as a cause for nutritional concern.

Food Habits of Adolescents

The adolescent is approaching the period in life when individual expression as well as rebellion appear to be desirable, if not essential, for peer acceptance. This individuality and independence is expressed not only in dress, choice of words and music, but also in the foods he/she eats and the time and places he/she eats them (20).

The teenager is not willing to abide by parental mandate that he/she must eat certain foods or eat at a particular time but is inclined to invent individual eating patterns and develop rather limited dietary habits (21).

Hodges (22) states that ". . . the only constant in evaluating adolescent eating habits is continual change." Breakfast appears to be the meal most frequently skipped by adolescents (23-26). According to the 1977-78 Nationwide Food Consumption Survey (27), 19% of the teenage girls (12-18 years) and 11% of the teenage boys in the same age range missed this meal. And, as many as 50% of healthy adolescents studied at the University of Alabama Medical Center reportedly ate no breakfast (28).

In a study of dietary habits of 178 adolescent females, over 90% snacked at least once per day (24). Whether between meal snacking deserves the reputation of interfering with the nutrient intake of adolescents depends on the quality and quantity of foods consumed as snacks in relation to the day's intake.

The family meal is becoming less and less important to the dietary patterns of teenagers, especially older teenagers (29). In studies by Hodges (22) and Greger (24), older teenagers selected more meals away from home than did younger teenagers. The household survey phase of the 1977-78 Nationwide Food Consumption Survey (27) indicated that teenagers (15-18 years) had about 22% of their meals away from home. The largest proportion of these were consumed at school, followed by fast food establishments. Whether patronizing fast food establishments jeopardizes the adolescent's nutrient intake depends on the nutritional value and amount of specific foods selected.

Even when an adolescent eats a meal in his/her home, it is likely to be more unconventional than at other stages in his/her life--unconventional in timing, as well as what is eaten at that particular meal (29). Wyman (21) reported that teenagers frequently restricted themselves to a few favorite foods or ate unusual combinations of foods, contributing to the rapid spread of fad diets and unusual notions about diet and health. When selecting foods, teenagers wanted the fast and the convenient (30). They were snackers and frequently consumed soft drinks, french fries and other foods of low nutrient density (31). Vending machines, drive-ins and fast food establishments were popular eating places.

A portion of the adolescent population has a problem with excess weight, resulting from the consumption of high caloric foods of low nutrient density above the caloric expenditure, and frequent between-meal snacks. Consumption of sugar-containing foods such as candy, soft drinks and pastries also have been associated with the development of dental caries in this age group (32).

Greenwood and Richardson (33) listed the most popular food items of teenagers in the United States as reported by numerous studies. These foods include milk, ice cream, steak, roast beef, hamburger, pork chops, ham, chicken, turkey, orange juice, oranges, apples, potato chips, corn, peas, bread, cake and pie. There was a reluctance to eat salads, green leafy vegetables and casserole dishes. In a Texas study, potato chips, candy, soda pop and pastry were strongly liked; peas, beans, peanut butter and some vegetables were not (33). Schorr et al. (34) gave a list of 24 items most liked by teenagers in upper New York State. In descending order they are: soda pop, milk, steak, hamburgers, pizza, chicken, french fries, ice cream, spaghetti, orange juice, corn, turkey, lobster, candy, roast beef, eggs, ham, shrimp, beer, pie, milk shakes, pork chops, apples, bread, frankfurters, oranges, lasagna, tuna fish, cake, peas, wine, cheese and cereal. Their shorter list of disliked foods included liver (most unpopular), fish, squash, clams, coffee, spinach, cabbage and beets.

There are gender differences in food likes and dislikes as illustrated by Huenemann et al. (35) at Berkeley, California. Boys had a greater preference for bread, milk and meat than did girls whereas girls preferred candy and fruit more than did boys.

Alcohol consumption--amount and patterns--has been largely ignored in the literature on adolescent food habits; however, statistics indicate alcohol plays an important role in the lifestyle of many adolescents. According to the U. S. Surgeon General's Report on Health Promotion and Disease Prevention (36), about 20-25% of adolescents aged 14-17 years are problem drinkers, intoxicated at least once per month.

Adolescents, due to their increased nutrient needs for growth and development, are especially susceptible to nutritional deficiencies associated with alcohol abuse (37). Alcohol potentially compromises an individual's nutritional status in several ways. Through ethanol's effect on the gastro-intestinal tract, absorption and digestion of many nutrients may be impaired, and chronic alcohol consumption may result in damage to organs such as the liver, which in turn, can alter the metabolism of several nutrients. Thus, alcohol may interfere with nutrition at several levels to produce marginal, if not clinically overt, deficiencies. Use of drugs in combination with alcohol may increase the harmful effects of alcohol.

Nutritional Status of Adolescents

The eating habits of teenagers have become of increasing concern to nutritionists throughout the country, as surveys have repeatedly shown their food intakes to be more variable and less adequate than those of either younger children or adults (23-26, 38-42). Because caloric and nutrient needs tend to parallel growth rate and the attainment of menarche in girls significantly increases the iron requirement, the adolescent's needs are higher in proportion to body size than are those of younger or older people. As a result of the rapid physical changes in their bodies, teenagers become particularly vulnerable to malnutrition, and, if energy needs are not met, the pubescent growth spurt may be delayed.

Very few nationwide studies have been conducted to assess the nutritional status of teenagers, although it generally is agreed that a significant problem exists. However, numerous studies have been conducted on a smaller scale to assess the eating patterns and nutritional status of teenagers. Nutrients most often consumed in inadequate amounts in teenage diets are iron, calcium, riboflavin and vitamin A (26, 34, 38-40).

In studies by Everson (43) and Schorr (34), it was observed that 21% of teenagers studied consumed less than two-thirds of the Recommended Dietary Allowance (RDA) for ascorbic acid. In addition, 44%, 69% and 51% consumed less than two-thirds of the RDA for calcium, iron and vitamin A respectively. Nutrient intake of males was consistently found to be superior to that of females probably because of the greater amount of food they consumed to meet appetite demands and energy needs; whereas girls whose energy needs are less, frequently diet and decrease their total food and nutrient intakes substantially (34).

Similar findings were reported by Spindler and Acker (44) in 1963 in a survey of 160 youth 15-17 years of age. Omitting breakfast and other meals was a common practice, often resulting from the family's meal schedule not coinciding with the teenager's time schedule. Only 25% of the girls and 50% of the boys consumed four cups of milk or its calcium equivalent. On the day surveyed, less than 50% of both sexes consumed four servings of fruits and vegetables and 50% had no good source of ascorbic acid in their diet. Girls tended to avoid foods they believed to be fattening, resulting in minimal consumption of milk and grain products.

An evaluation of three-day diet records of teenagers in Illinois (45) in 1963 revealed that a large percentage of both boys and girls failed to meet two-thirds of the RDA of many nutrients. Nutrients often consumed in inadequate amounts were calcium, vitamin A, iron and ascorbic acid, more so in girls than boys, except for ascorbic acid. More than 50% of the girls consumed less than two-thirds of the RDA for calcium, vitamin A and iron.

Edwards et al. (46) in 1964 conducted a study of 6,200 North Carolina teenagers to determine the extent to which their food intake for one day met recommendations by the Department of Agriculture, based on the Basic Seven Food Groups. Only 66% of the youth surveyed consumed two or more servings from the milk group and only 16% consumed one serving of green or yellow vegetables. Thirty-five percent had one serving of an ascorbic acid-rich food. Although the majority of youth ate breakfast, 15% skipped at least one meal during the 24-hour survey period. These findings agree with those of Hinton et al. (15) who also observed a high correlation between the percentage of meals missed and a poor diet.

Hodges and Krehl (47) in a 1965 survey of 2,045 Iowa teenagers, found that high school students had dietary habits that did not necessarily reflect the economic status of their families or recommendations of their parents. Eating patterns varied considerably; however, dietary questionnaires revealed that a substantial number of students omitted breakfast and consumed a nutritionally unbalanced diet with excessive consumption of candy and soft drinks. A large percentage of these teenagers had elevated levels of blood cholesterol, although statistically significant dietary correlations were lacking.

In a 1967 longitudinal study of teenagers in Berkeley, California, on the basis of four seven-day dietary records, Hampton et al. (48) reported that 15% of the girls failed to meet two-thirds of the Recommended Dietary Allowances for vitamins A and C, while

10% of the boys failed to meet this level for vitamin A and 30% for vitamin C. While protein intake was adequate for both genders, 50% of the girls consumed less than two-thirds of the Recommended Allowances for iron and calcium.

In 1968, Huenemann et al. (49) reported on seven-day dietary records of California adolescents. Taking two-thirds the RDA as the cutoff point, almost 33% of the boys had ascorbic acid intakes below this, 20% were low in calcium and vitamin A and 10% were low in iron. Girls appeared to fare worse. Over 50% had low iron and low calcium intakes and 25% had low vitamin A and ascorbic acid intakes.

The dietary habits and food consumption patterns of 100 teenage parents in Birmingham, Alabama were studied by Van de Mark and Underwood (50) in 1971. Race, annual income and age of homemaker were found to have little effect on dietary intake. In all cases, intake of milk, fruits and vegetables were low for husband and wife. While the children of the teenage parents consumed more than adequate quantities of milk, they consumed less than adequate quantities of meat, fruits and vegetables.

In Montreal, Mongeau (51) found that two-thirds of the adolescent girls studied consumed less than 75% of the RDA for calcium, 20% had low iron intakes and 15% had low vitamin A intakes.

In 1978, Lee (52) reported that about 75% of the teenage girls studied had iron and calcium intakes less than two-thirds the RDA, 70% had low vitamin A intakes and about 50% had low vitamin C intakes.

About 50% of the teenage boys studied had calcium, iron and vitamin C intakes less than two-thirds the RDA and more than 50% had low vitamin A intakes. The method used was a 24-hour dietary recall.

Greger et al. (53) studied zinc and copper nutriture in addition to the usual nutrients in adolescent girls in Indiana in 1978. Twenty-four hour recalls and dietary histories were used. Girls were found to consume less than two-thirds the RDA of iron, calcium, vitamin A and vitamin C. Thiamin and zinc intakes also averaged 37% below the RDA.

Findings of national surveys in the United States--the Ten-State Nutrition Survey (41), which focused on low-income groups, and the Health and Nutrition Examination Survey (1971-1974) (42), which included all income groups--showed some evidence of malnutrition among adolescents. Low dietary intakes and marginal or subclinical deficiencies of some vitamins and minerals were observed, particularly among select segments of the population--adolescents of low socioeconomic status and/or belonging to certain ethnic groups and females (41-42).

Results of the 1968-1970 Ten-State Nutrition Survey (41), designed to determine the prevalence and location of serious hunger, malnutrition and health problems of low-income populations in the United States, showed that adolescents between the ages of 10 and 16 had the highest evidence of unsatisfactory nutritional status of any age group. Male adolescents showed more evidence of malnutrition than did females.

Wide ranges of energy intakes were reported and significant numbers of adolescents had energy intakes below the standard set for their age and gender. The mean energy intake for male adolescents 15-16 years of age was 2855 kilocalories per day and for females, 2039 kilocalories per day (Table 1). In spite of the low caloric intake on the part of many adolescents, a high incidence of dental caries was found, attributed to the consumption of refined carbohydrates between meals and the high intake of foods containing sugar.

Protein and vitamin C nutriture appeared to be no major problem among adolescents. Acceptable serum albumin values indicated protein intakes that were well above levels considered to be adequate. Mean protein intake for all subgroups of the adolescent population exceeded the dietary standards. The mean vitamin C intakes for all subgroups of adolescents was higher than the dietary standard of 30 mg, often 200 or 300% higher. Males generally had a higher prevalence of lower vitamin C levels than did females and the prevalence of poor vitamin C status increased with age.

Mean calcium intakes generally exceeded the dietary standards and were higher for males than for females. While mean calcium intakes tended to increase with age among males, in females, they generally decreased with age.

A positive relationship was found between urinary thiamin excretion and thiamin intake, implying adequate thiamin nutriture among adolescents. Riboflavin status, however, was found to be age-dependent, with a higher prevalence of low urinary values found for persons 17 years of age and under.

Iron deficiency anemia, as evidenced by a high prevalence of low hemoglobin and low percent transferrin saturation values, was a

TABLE 1

Comparison of mean energy intake and mean nutrient intake per 1000 kilocalories of males and females 15-16 years of age, ten-state nutrition survey in the United States, 1968-1970 (41)

Energy/Nutrient	Males	Females
Kilocalories	2855	2039
Protein (g)	37	32
Calcium (mg)	412	384
Iron (mg)	5.5	5.5
Vitamin A (I.U.)	1828	2059
Thiamin (mg)	0.6	0.6
Riboflavin (mg)	0.9	0.9
Niacin (mg)	6.9	7.4
Vitamin C (mg)	29	33

U. S. Department of Health, Education and Welfare (1972). Ten-State Nutrition Survey in the United States, 1968-1970. Publication No. (HSM) 72-8134, Government Printing Office, Washington, D.C.

problem in the adolescent age group, particularly in the black population. Mean iron intakes of adolescents, except those of males 10-11 years of age, were less than recommended. Iron intakes averaged 5.5 mg/1000 kilocalories for adolescent males and 5.4 mg/1000 kilocalories for adolescent females (Table 1).

A comparison of mean intakes of the nutrients discussed above, expressed per 1000 kilocalories for males and females is found in Table 1.

The first nationwide, statistically valid sample of American youth was studied in the Health and Nutrition Examination Survey (42), begun in 1971 and completed in 1974. Prompted by the preliminary results of the Ten-State Nutrition Survey, the purpose of the study was to establish an ongoing national nutrition surveillance system by measuring the nutritional status of a representative sample of the population. Subjects underwent complete clinical examinations, anthropometric assessments and biochemical determinations. Findings from the survey (42) substantiated many of the earlier findings of the Ten-State Survey (41).

Iron deficiency, documented by both dietary and biochemical data was prevalent in both male and female adolescents 12-17 years of age in all income levels. Females between the ages of 18 and 44 also showed evidence of iron deficiency regardless of race and income level. Adolescents, on the average, were found to consume 12.6 mg iron per day or 25% below the standard. Black adolescents fared slightly worse than white adolescents (Table 2).

TABLE 2

Energy and selected nutrition intakes for persons aged 12-17 years by race from health and nutrition examination survey, 1971-1973 (42)

Energy/Nutrient	Race		Total[a]
	White	Black	
Kilocalories			
Mean	2387	2083	2346
Protein (g)			
Mean	91	75	89
Calcium (mg)			
Mean	1163	769	1110
Percent of Standard	185	120	176
Iron (mg)			
Mean	12.6	12.0	12.6
Percent of Standard	76	70	75
Vitamin A (I.U.)			
Mean	4334	3423	4219
Percent of Standard	132	103	128
Vitamin C (mg)			
Mean	78	73	77
Percent of Standard	161	152	160

[a]Total includes all races.

U. S. Department of Health, Education and Welfare (1975). Plan and Operation of the Health and Operation of the Health and Nutrition Examination Survey. U. S. 1971-1973, HEW Publication No. (HSM) 73-1310, Government Printing Office, Washington, D.C.

Adolescents, regardless of race and income levels, had calcium and vitamin A and C intakes that were above the standards. Mean intakes of all three nutrients were consistently higher for whites than for blacks (Table 2). Mean energy intake and mean intake of selected nutrients per 1000 kilocalories for adolescents 12-17 years of age by race are shown in Table 3.

The Department of Agriculture's 1977 Nationwide Food Consumption Survey of food intake and nutritive value of diets in the United States (27) substantiated many of the findings of both the Ten-State and Health and Nutrition Examination Survey and showed a decrease in quality of food consumed compared with the 1965 survey. Calcium intakes were lower on the average for teenagers in 1977 than in 1965, reflecting a decreased consumption of milk and milk products. However, teenage boys closely approximated the calcium RDA whereas teenage girls consumed only 46% (Table 4). Average iron intakes were approximately the same as in 1965--60-65% of the RDA. Vitamin A intakes decreased slightly in 1977 for teenagers, although they met the 1980 RDA. Mean energy intake and intake of selected nutrients for adolescents 15-18 years of age by gender are found in Table 4. Table 5 represents intake of selected nutrients per 1000 kilocalories.

Effect of Nutrition Education on Nutrition Knowledge and Dietary Intake

Nutrition education has been defined as the process by which beliefs, attitudes, environmental influences and understanding about food lead to practices that are scientifically sound, practical

TABLE 3

Mean energy intake and mean intake of selected nutrients per 1000 kilocalories for adolescents 12-17 years by race, health and nutrition examination survey, 1971-1973 (42)

Race	Mean Energy Intake (kcal)	Mean Nutrient Intake per 1000 Kilocalories Protein (g)	Calcium (mg)	Iron (mg)	Vit. A (I.U.)	Vit. C (mg)
White	2387	38	487	5.3	1816	33
Black	2083	36	369	5.7	1643	35
Total[a]	2346	38	473	5.4	1798	33

[a]Total includes all races.

U. S. Department of Health, Education and Welfare (1975). Plan and Operation of the Health and Operation of the Health and Nutrition Examination Survey. U. S. 1971-1973, HEW Publication No. (HSM) 73-1310, Government Printing Office, Washington, D.C.

TABLE 4

Mean Energy and mean intake of selected nutrients for adolescents 15-18 years of age by gender, USDA nationwide food consumption survey, 1977-78 (27)

Energy/Nutrient	Gender: Males	Gender: Females
Kilocalories	2560	1660
Protein (g)	104	66
Calcium (mg)	1105	769
Iron (mg)	16.3	10.7
Vitamin A (I.U.)	5015	4074
Thiamin (mg)	1.7	1.1
Riboflavin (mg)	2.4	1.6
Niacin (mg)	24.3	15.7
Vitamin C (mg)	93	68

USDA. (1980). Food and Nutrient Intakes of Individuals in One Day in the United States, Spring, 1977. USDA Nationwide Food Consumption Survey, 1977-78, Preliminary Rept. No. 2 Consumer Dept. of Agriculture, Hyattsville.

TABLE 5

Mean intake of selected nutrients per 1000 kilocalories for adolescents 15-18 years of age by gender, USDA nationwide food consumption survey, 1977-78 (27)

	Gender	
Nutrient	Males	Females
Protein (g)	40	40
Calcium (mg)	440	436
Iron (mg)	6.5	6.3
Vitamin A (I.U.)	2274	2361
Thiamin (mg)	0.7	0.7
Riboflavin (mg)	1.0	0.9
Niacin (mg)	9.4	9.7
Vitamin C (mg)	42	47

USDA. (1980). Food and Nutrient Intakes of Individuals in One Day in the United States, Spring, 1977. USDA Nationwide Food Consumption Survey, 1977-78, Preliminary Rept. No. 2 Consumer Dept. of Agriculture, Hyattsville.

and consistent with individual needs (54). More specifically, the results of nutrition education should enable a child to:

1. increase his/her ability to make wise food choices throughout life,

2. understand the relationship between food and health,

3. gain knowledge of nutrients and their roles in the body,

4. develop the ability to evaluate advertising and other claims made about food and nutrition,

5. understand the influence of emotional and cultural factors on food choices, and

6. become aware of the role food can play in aiding him/her to reach goals he/she sets for him/herself (55).

Unfortunately, no completely effective method for teaching nutrition has ever been devised. The public has been exposed to a considerable amount of information about foods and nutrition; however, overall eating practices have not improved. The Nationwide Food Consumption Survey of 1977 (27) showed that little, if any, improvement had been made in nutrient intake compared with the 1965 survey. Yet, during this same 10-year period, a great deal of nutrition information was published and made available to the American public.

Nevertheless, one behavioral approach for teaching nutrition is based on the premise that an increase in nutrition knowledge should bring about a positive change in food habits. Causes of inadequate nutrition are numerous, but one significant reason is lack of knowledge concerning nutrition (56). Participants in the National

Nutrition Education Conference in Washington, D. C., in November, 1971, agreed that poor dietary practices of adolescents stem not only from insufficient motivation, but from inadequate nutritional knowledge as well (57).

Dietary habits acquired over a number of years cannot be expected to change radically in a brief period of time. Food is a physiological substance supplying the essential nutrients for health. However, it is much more than this to the average person. It is the sum of his culture and traditions, an emotional outlet, gratification of pleasure and a relief from stress. It is a means of communication, security and personal experience. These deeply rooted feelings about food do not yield easily to reasoning nor to the acquisition of scientific facts (58).

In spite of nutrition education programs, for teenagers who enjoy abundant health, the need to change food habits may not be readily apparent (59). However, nutrition educators can hope that knowledge acquired may foster changes in behavior at a later time.

A number of nutrition education programs have been cited in the literature. Positive changes in both knowledge and dietary practices have been reported by some investigators. On the other hand, others have been successful in increasing knowledge levels but unsuccessful in modifying dietary behavior.

Hinton et al. (15) designed a study to investigate the relationship among certain physiological, sociological and psychological factors and the eating behavior of 140 girls 12-14 years of age and the selection of a nutritious diet. Knowledge of nutrition was very positively related to good food practices. These findings agree with the conclusions of Covan et al. (60) who observed better diets among adolescents possessing the most information about nutrition.

Jones (61) also reported positive changes in both knowledge levels and dietary practices of over 18,000 low-income homemakers and children enrolled in the Expanded Foods and Nutrition Education Program (EFNEP). Prior to an eight-week nutrition education program, initial interviews were used to ascertain dietary habits and nutrition knowledge levels. Significant changes in food consumption occurred in both children and homemakers as a result of the nutrition education program. The greatest changes included an increase in the consumption of milk, fruits and vegetables. A slight increase occurred in the consumption of breads and cereals and little, if any, changes occurred in the number of foods selected from the meat and meat alternate group.

Similar findings resulted from an evaluative study of the Federal Extension Service's "Mulligan Stew" (62), a series of six half-hour nutrition education television programs designed to increase the nutrition knowledge of third, fourth and fifth grade youth. The study involved 1,368 disadvantaged youth in Minnesota, North Carolina, Oklahoma and Vermont. After participating in the series, youth demonstrated more knowledge about nutrition and showed slight positive changes in food selection patterns. After viewing the series, more youth ate breakfast than before and youth in all three grades tended to select fewer empty calorie items when given free choice in a menu containing large numbers of food.

Duyff et al. (63) examined the food habits of 75 Puerto Rican teenage girls in a Chicago community to ascertain nutritional adequacy within a sociocultural and cognitive context. Patterns typical of United States consumption emerged as evidenced by intakes of high caloric snack foods. Although nutrition knowledge generally was poor among all teenagers, a relationship was found to exist between nutrition knowledge and positive dietary habits. Higher intakes of vitamin A and vitamin C and greater dietary diversity were all significantly and positively related to better knowledge scores.

Results from a North Carolina study (64) are in agreement. Fifth, seventh and tenth grade youth were involved in a study designed to determine the influence of nutrition education on acceptability and consumption of school-served food, dietary habits and knowledge of nutrition. All fifth grade classes and one seventh grade class significantly improved their knowledge of nutrition as measured by cognitive tests. Three-day dietary recall data showed that diets of seventh graders improved significantly after nutrition education. Plate waste from fifth graders decreased significantly. Acceptability ratings of school-served food increased among fifth grade experimental groups more than among other groups. The amount of change decreased progressively at higher grade levels.

Schwartz (65), in 1975, investigated the nature of the relationship between previous enrollment in home economics classes and nutrition knowledge, attitudes and dietary practices of Ohio high school graduates. Results of the study showed that previous enrollment in high school home economics courses with a unit in food, nutrition and health was not consistently associated with scores for tests of nutrition knowledge, attitudes and practices. No correlation was found between nutritional knowledge as measured with a test of 30 true-false statements and dietary practices.

Numerous studies, on the other hand, report that while nutrition education programs have been successful in increasing nutrition knowledge, no significant changes in diet have been observed. In 1977, Alexander (66) conducted a survey, the purpose of which was two-fold: (1) to determine the relationship between nutrition knowledge and eating habits of college students, and (2) to compare the adequacy of diet of non-home economics majors to home economics majors. A 24-hour food recall was obtained from each respondent and a nutrition knowledge quiz composed of 25 multiple-choice questions was administered. No significant relationship existed between level of nutrition knowledge and adequacy of diet for any of the groups tested. Home economics majors answered 72% of the questions correctly compared to 54% for non-home economics majors.

In 1968, a study was conducted by Geary (67) to identify some of the eating habits and factors influencing food choices of 200 junior (9-13 years) and 70 senior (14-19 years) 4-H club members in Williamson County, Tennessee. Results indicated that boys tended to have better eating habits than girls and senior members tended to have slightly better eating habits than junior members. Farm residents consumed somewhat more nutritious diets than did rural non-farm and urban members while no difference existed between the eating habits of youth whose mothers were employed outside the home and those whose mothers were full-time homemakers. Four-H members enrolled in a food or nutrition project did not have noticeably different eating habits from those not enrolled, but members who had been enrolled for a longer period of time has slightly better eating habits than did those enrolled for a shorter period of time.

These findings agree with those of Wang (68), former Health Education Specialist at the University of Maryland, who conducted a study to assess the nutrition knowledge of Extension's clientele in order to form a basis for program planning in nutrition education. The population studied included homemakers in organized clubs, low-income EFNEP homemakers and 4-H members in the 13-15 year old age group. A Food Knowledge Inventory consisting of eight categories of statements regarding facts and fallacies about food served as the basis for knowledge measurement. Results of the survey showed that knowledge scores for the low-income women and 4-H youth were similar, both groups answering approximately 54% of the questions correctly. Homemaker club women scored 10% higher. No difference was found in knowledge scores between 4-H'ers currently enrolled in 4-H foods and nutrition projects and those not enrolled. It therefore was recommended that more imaginative approaches for teaching nutrition be incorporated into the 4-H nutrition program, especially through the use of audiovisual materials and food preparation.

A recent nation-wide survey was conducted between May and November of 1978 to appraise current nutrition beliefs and practices among 1000 parents of children under 18 years of age and 750 youth aged 9-18 (69). Parents scored higher on nutrition knowledge tests than did students and parents of younger children tended to score higher than parents of older children. Among the regional groups, parents from the West and Northeast scored higher than those from the South and Central areas. Among students, males scored slightly higher than females and older students higher than younger children. Good eating habits were not necessarily found to be associated with the highest level of nutrition knowledge. Students with poor eating habits demonstrated as much knowledge on the nutrition quiz as those with good eating habits.

Learning Transaction

Knowledge may be defined as those behaviors and test situations which emphasize the remembering, either by recognition or recall, of ideas, material or phenomena (70). While it may or may not be true that the most important changes in the learner are those which may be described as cognitive (knowledge, problem-solving, higher mental processes, etc.), it is true that these are the types of changes most professionals in the field of education aim to bring about.

A common assumption among those who develop and administer nutrition education programs is that individuals who have gained a basic knowledge of the concepts and principles of nutrition are able to and actually do apply this knowledge in their choice of food. However, objective evidence is lacking of the long term effectiveness of nutrition education in improving eating habits and developing positive attitudes toward food and nutrition. Most available evidence indicates that consumer awareness of food and nutrition is increasing; but whether this new awareness will be translated into wise food choices is debatable.

There is ample and convincing evidence that knowledge of what constitutes good nutrition by itself has only limited, if any, effect on nutrition-related practices. Surveys have demonstrated over and over that increments in such knowledge in various population groups are not necessarily or even frequently accompanied by commensurate improvements in the kinds of foods purchased and consumed (71).

The necessity exists for people to be knowledgeable about certain aspects of sound nutrition in order to be able to make rational decisions, but such knowledge functions as a tool only if and when people are ready to make changes. From research in other health-related behaviors, it appears that there has to be an emotional "readiness" on the part of a person to shift from a present to a different kind of behavior in order for factual knowledge to be accepted. Facts are used to justify and rationalize the decision to change rather than to stimulate it. In the absence of such readiness, facts are either disregarded or altered to rationalize the present behavior (72-74).

Based on current research and experiences with the learning change process, an effective teaching/learning process should be predicated on two basic assumptions, namely (1) that the teaching/learning process is a human transaction that involves the learner, teacher, teaching/learning environment and behavioral change or subject matter to be acquired by the learner in a set of dynamic interrelationships and (2) that the target of education is change and growth in the individual and his/her behavior.

Encompassed within this second assumption is a deeper and broader goal than cognitive learning only. Learning that remains only cognitive, and does not become part of the learner's internal system and external behavior, does not necessarily affect his/her behavior.

Experimentation and practice by the learner are important conditions in the total teaching/learning process. Teaching strategies that lend themselves to participation seem to motivate and stimulate youth and result in greater behavioral change than traditional lecture-type methods of imparting knowledge. Olson's (75) findings concerning indicators of quality in the teaching/learning environment showed that the overall best predictor of quality is the educational activity itself. Teaching strategies that scored high in this study were small group participation, laboratory experiences and demonstrations. Lectures and movies received the lowest scores.

The 4-H Philosophy

The 4-H Foods and Nutrition Program offers a variety of educational experiences in which youth can participate--projects, demonstrations, food fairs, bake-offs, workshops and special interest meetings. Regardless of the teaching method used, the 4-H approach of "learn-by-doing" is almost always incorporated and has formed the basis of the 4-H educational process since 1904.

All project work is based on the concept of learning by doing. Studies show that people retain information by these methods: reading, 20%; hearing, 20%; seeing, 30%; hearing and seeing, 50%; saying, 70%; and saying and doing, 90% (76).

When 4-H'ers have the opportunity to learn by doing and subsequently tell others about it, their learning potential is the greatest, as shown in Figure 1 (76). In developing 4-H educational materials, a number of criteria have been proposed as guidelines to enhance the learning process:

- Relates to the developmental needs and interests of the particular age group.
- Provides practical learn-by-doing experiences.
- Provides for responsibility and/or ownership.
- Includes opportunity for decision making.
- Gives opportunity for learning skills, gaining knowledge and developing attitudes.
- Can be completed by the average of the intended age group.
- Is flexible enough to adjust to varied community conditions.
- Maximizes opportunity for members to work with parents.
- Brings tangible results.
- Stimulates a desire for continued learning and seeking excellence.

The educational concepts of sequencing, complementing and reinforcing are important considerations in the 4-H curriculum development process. Advancement through a project and individual growth depend upon experiences which incorporate these concepts (76).

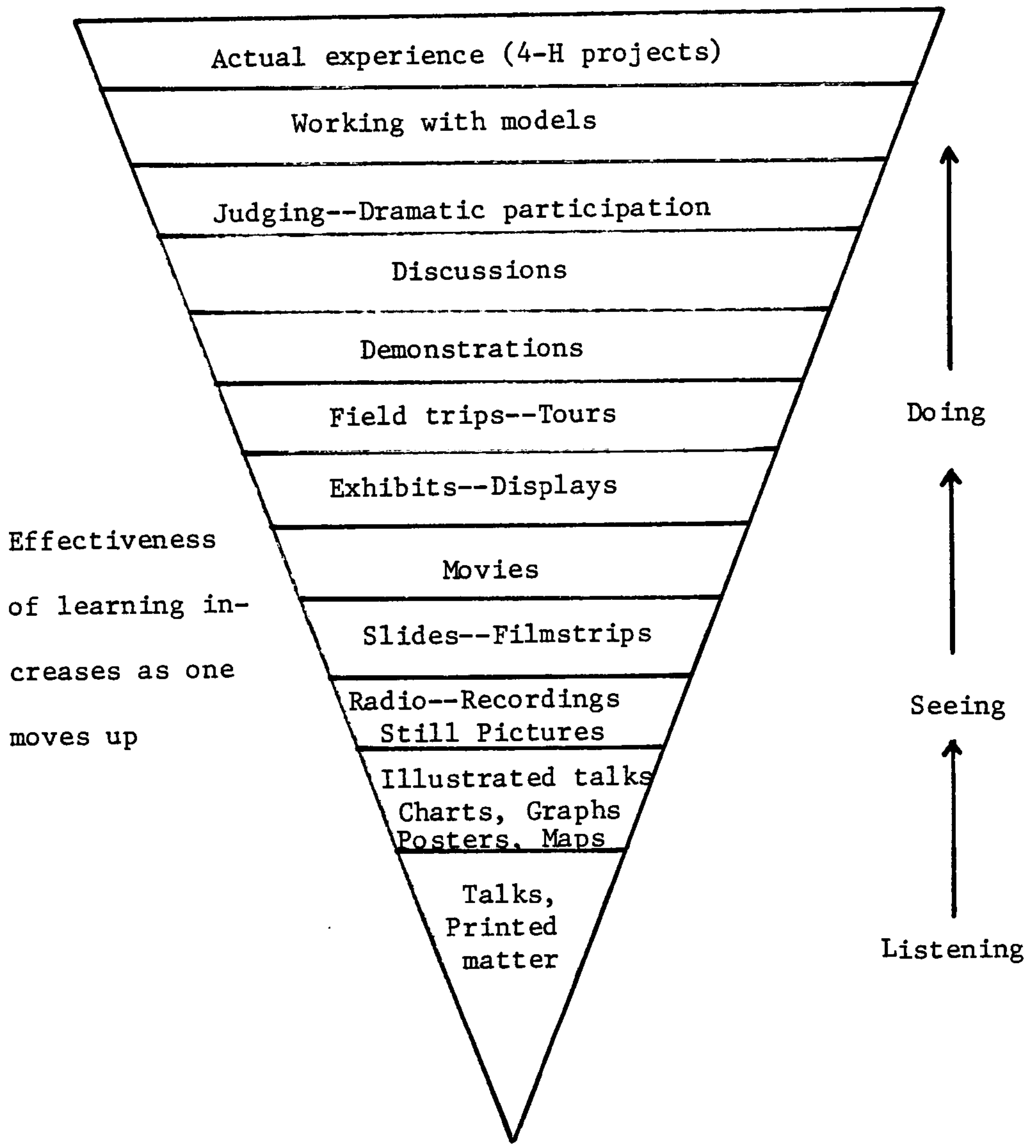

Figure 1. Cone of Experience--Teaching Methods and Techniques.

Summary

Medical science generally recognizes that the consumption of a wide variety of foods conforming to the Dietary Guidelines developed by the Unites States Department of Agriculture and the Department of Health and Human Resources (77) may help alleviate or postpone some diet-related diseases. Many nutrition education programs have been developed aimed at increasing the nutrition knowledge of clientele in order to motivate a change in eating habits; however, it is debatable as to whether or not an increase in nutrition knowledge serves as a positive influence on dietary practices.

It was concluded that favorable changes in dietary practices occurred when learning experiences provided personal involvement such as small group participation, laboratory experiences and demonstrations and were not merely the presentation of knowledge and facts. Research findings recommended educational methods that involved learners in a variety of direct and purposeful activities and experiences. The fact that youths in the formative years may be a viable audience also was supported in the literature.

CHAPTER III

PROCEDURES

Study Design

The three specific objectives outlined for this study were: (1) to determine the influence of 4-H foods and nutrition projects and demonstrations on food and nutrition knowledge of selected youths; (2) to determine the influence of 4-H foods and nutrition projects and demonstrations on dietary adequacy of selected youths; and (3) to determine whether or not there is a relationship between level of food and nutrition knowledge and dietary adequacy. A schematic representation of the conceptual framework for the study is found in Figure 2. This chapter presents information concerning pilot project, instrumentation, population and sample, data collection and data analyses.

Pilot Project

Prior to instigation of the present study, a preliminary project was undertaken with 4-H'ers from the North Central Extension District in North Carolina. The pilot study youths were not included in the target population.

At the fall meeting of the 4-H Leader's Association in the North Central Extension District, the purpose of the study was explained. Each leader was provided with instructions on how to administer the food and nutrition knowledge test and 24-hour food

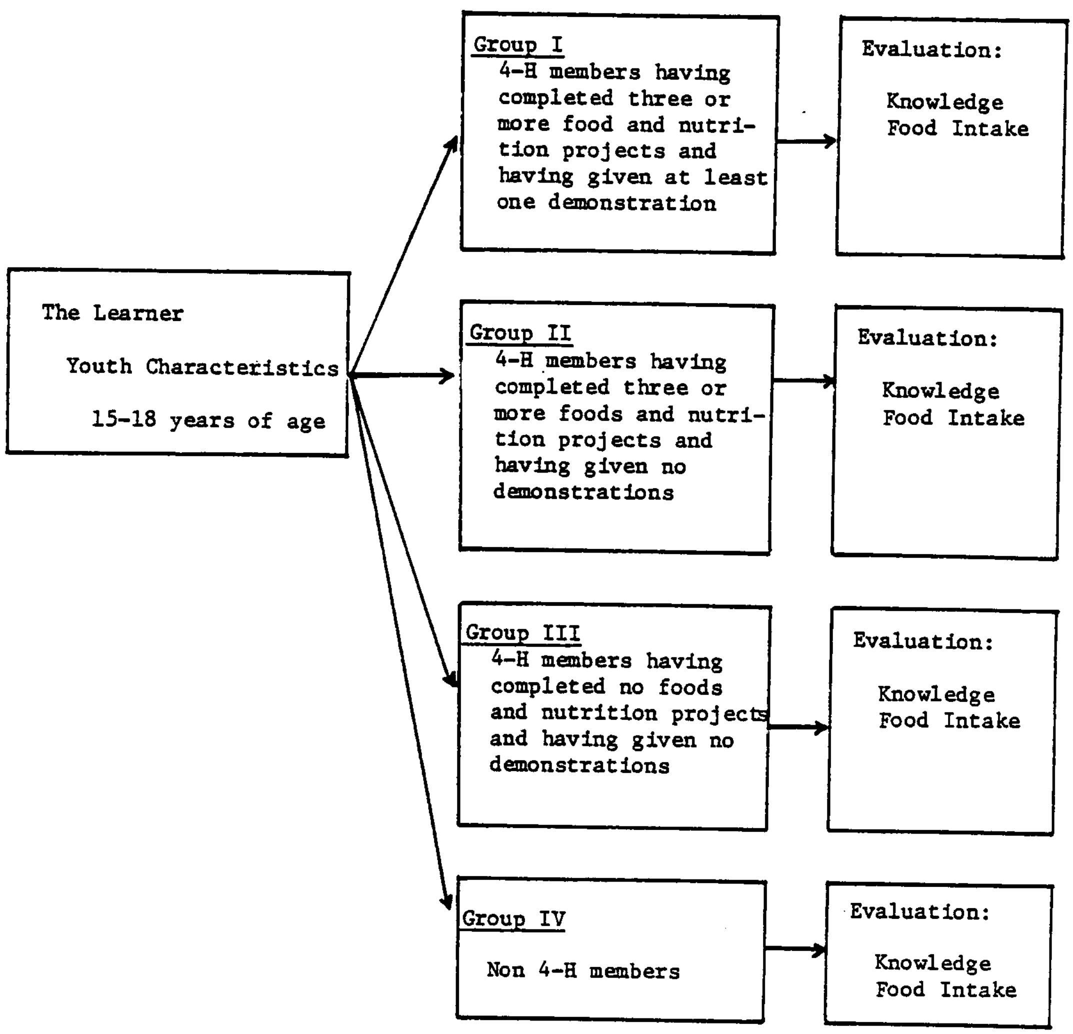

Figure 2. Conceptual Framework for the Present Study.

recall to the 4-H'ers in their club. Special attention was given to training the leaders about the importance of accurately assessing portion size so that they, in turn, could relay this information to youth. Plastic food models were used for this purpose and leaders were encouraged to utilize the plastic and/or paper food models available from their County Extension office. The 4-H leaders were instructed to use their regular procedure to notify club members of the next meeting.

On the basis of results of the pilot study and subsequent telephone conferences with several 4-H leaders, it was concluded that the 30 true-false questions were appropriate for assessing the food and nutrition knowledge of 4-H'ers. In addition, it was concluded that the 4-H leaders were not adequately trained to administer 24-hour food recalls. Because the background and skill of the interviewer are crucial in obtaining valid and reliable 24-hour recalls, it was concluded that 4-H leaders should not be used in gathering data. Direct contact with 4-H'ers was recommended.

It also was suggested that a question pertaining to the use of vitamin, mineral or other food supplements be added to the 24-hour food recall form.

Instrumentation

A food and nutrition knowledge questionnaire for high school students (Appendix A), developed by Wodarski et al. (78), consisting of 30 true-false questions, was used to measure food and nutrition knowledge. The basic concepts listed below served as a framework for the content of the knowledge questionnaire. Because the concepts reflected much of the subject matter addressed in various 4-H foods and nutrition projects, it was believed to be a good instrument to measure food and nutrition knowledge in this study.

1. We eat food to grow, work and live.

2. Food is made up of different nutrients needed for growth and health.

3. All persons, throughout life, have the need for the same nutrients but in varying amounts.

4. The way food is handled influences the amount of nutrients in food, its safety, appearance and taste (78).

Questions had been tested for content validity by a panel of food and nutrition professors at the University of Maryland. Ambiguous or easily misunderstood statements had been reworded or discarded. Questions also were read by several students of the appropriate age levels to rule out further problems with ambiguity or semantics.

Population and Sample

The target population for this study was defined as youths from 15-18 years of age who were members of a 4-H club affiliated with North Carolina Agricultural Extension Service on December 1, 1981, and who resided in either the Northwestern, Southwestern or Southeastern Extension Districts (Appendix B). The Western and Northeastern Districts were excluded from the study because of geographical inaccessability. The non 4-H sample was drawn from 9th, 10th and 11th grade health education classes in the Northwestern, Southwestern and

Southeastern Extension Districts respectively. A course in health education is a requirement for graduation in the North Carolina public school system.

Data Collection

From the three districts selected, names, addresses and telephone numbers of the 4-H District Officers were secured and a letter was mailed to the District Presidents, describing the study and soliciting support (Appendix B). Upon receipt of the letter, the District President was contacted and permission obtained to attend the 4-H District Retreat.

The purpose of the study was explained, after which each youth signed the Youth Consent Form (Appendix A), agreeing to participate in the project. A food and nutrition knowledge test consisting of 30 true-false questions was administered and a 24-hour food recall was obtained from each youth permitting the comparison of various groups with respect to food and nutrition knowledge scores and dietary adequacy, measured by the extent to which diets in each group approximate the 1980 Recommended Dietary Allowances for kilocalories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C.

Since knowledge is defined as a correct response with a concomitant high level of certainty, 4-H'ers were instructed not to guess and to leave a question unanswered if they did not understand the question or if they did not know the answer. Selected demographic data were obtained to facilitate interpretation of the results. A standard 24-hour food recall form also was used (Appendix A).

Permission was also obtained from two high school principals in each of the Northwestern, Southwestern and Southeastern Extension Districts to visit 9th, 10th and 11th grade health education classes in order to administer the food and nutrition knowledge test and food recalls.

Based on the demographic information provided by the questionnaire, youth were divided into the following groups:

Group I - 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

Group II - 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

Group III - 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

Group IV - Non 4-H'ers from 9th, 10th and 11th grade health education classes in the Northwestern, Southwestern and Southeastern Extension Districts respectively.

Data Analyses

Food and Nutrition Knowledge

Knowledge scores reflected a total number of correct responses out of a possible 30. Questions not answered were treated as incorrect responses. Knowledge scores for each group were tabulated and the means and standard deviations determined. Tests of significance using the F test for a one-way analysis of variance were used to analyze differences in variability around the sample standard deviations. The Duncan's New Multiple Range Test (79) for post hoc comparison of means was used to determine which group or groups was (were) significantly different from which other group or groups. The SAS-PROC FUNCAT statistical procedure (80) was employed to determine that any significant differences in food and nutrition knowledge that existed among groups were not influenced by differences in gender, ethnic origin and geographical location. A .05 level of significance was used throughout the study.

Dietary Adequacy

Twenty-four hour food recalls were analyzed by computer using reference values from USDA's Handbook No. 456 (81) for kilocalories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C. Mean intakes and standard deviations of each nutrient were determined and used to measure the extent to which diets in each group approximate the 1980 Recommended Dietary Allowances (82). Because the vitamin A value of food is listed in International Units in USDA's Handbook No. 456, International Units were used in relation to vitamin A as opposed to μg retinol equivalents (μg R.E.) which are used in the 1980 revision of the Recommended Dietary Allowances (82). Likewise, for the same reason, in the case of niacin, the niacin content of diets was expressed as mg preformed niacin as opposed to mg niacin equivalents. Therefore, it is quite possible that the niacin available from the diets as reported in this study is less than the actual mg of niacin equivalents.

For each of the nine variables listed above, persons were classified as having an "adequate" or "inadequate" intake. For the purposes of this study, "adequate" is defined as meeting two-thirds of the 1980 Recommended Dietary Allowances. A 4x2 chi-square test was used to determine whether or not significant differences existed among groups in adequacy of each nutrient. The SAS-PROC FUNCAT analysis (80) was employed to determine that any significant differences that existed among groups in nutrient adequacy were independent of any differences in demographic composition of groups. A one-way analysis of variance and Duncan's New Multiple Range Test also were used on actual nutrient intakes to determine significant differences in nutrient intakes among groups.

Mean nutrient intakes per 1000 kilocalories by gender by group also were calculated. In addition, Pearson Product-Moment correlation coefficients were calculated to determine if correlations existed among age, level of food and nutrition knowledge and nutrient intake.

CHAPTER IV

RESULTS AND DISCUSSION

A total of 319 demographic, foods and nutrition knowledge questionnaires and 24-hour food recalls were administered to youth in North Carolina. Of these, 111 were eliminated from the study due to such factors as incomplete or illegible dietary intake data, absence of portion size, age ineligibility (not falling between the ages of 15 and 18), missing demographic data or not falling within one of the four groups listed below.

Group I - 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

Group II - 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

Group III- 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

Group IV - Non 4-H members.

Thus, data were available from a total of 208 youths for analysis. The results and discussion of this study are presented in three parts: description of participants, foods and nutrition knowledge and dietary adequacy.

Description of Participants

The demographic data obtained from the questionnaires described participants according to age, gender, race and geographical location (urban versus rural) and extent of involvement in 4-H foods and nutrition projects and demonstrations. Each of these characteristics was examined.

Age

The design for this study limited participation to youths between the ages of 15 and 18 primarily to correspond with the age groupings used in the 1980 revision of the Recommended Dietary Allowances, and in doing so, facilitate interpretation of dietary adequacy. The mean age and SD of all youth participants was 16.3 $\pm$ 1.0 years. Seventeen years of age was the mode for all youth. The mean age and SD of youth by group is found in Table 6.

Gender

Of the 122 questionnaires of 4-H'ers analyzed in this study (Groups I, II and III), 75% were completed by females while the remaining 25% were completed by males. Statewide 4-H membership statistics in North Carolina for 1981 reported that 43% of the 4-H population in North Carolina was male while 57% was female. However, of those youth enrolled in foods and nutrition projects and demonstrations in North Carolina, 36% was male and 64% was female (5). These statistics correspond more closely to the sample population used in this study. A breakdown of each group, by gender,

TABLE 6

Number of participants, mean age and frequency distributions of age by group

Group	Participants		Age (years)		Frequency Distributions of Age (years)			
	Number	Percent	Mean	SD	15	16	17	18
I[1]	49	23.6	16.3	1.0	15	11	17	6
II[2]	39	18.8	16.5	1.1	8	12	10	9
III[3]	34	16.3	16.1	1.1	14	6	10	4
IV[4]	86	41.3	16.4	1.0	21	25	28	12
Total	208	100.0	16.3	1.0	58	54	65	31

[1]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[2]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[4]Non 4-H'ers.

is found in Table 7. Group III had a much higher percentage of males than did the other groups.

Race

A breakdown of each group by race is found in Table 7. Of the 122 questionnaires of 4-H'ers analyzed (Groups I, II and III), 21, or 17% were completed by blacks; 98, or 80% by whites, and 4, or 3% were completed by other persons (Indian, Spanish-American or Oriental). North Carolina 1981 statistics report that of the total 4-H population, 32,000, or 33% was black; 62,762, or 65% was white; and 1,060, or approximately 2% was "other" (5). Group IV had a much higher percentage of blacks than did the other groups.

Geographical Location

When considering the geographical location in which the 4-H respondents lived, approximately 81% of the youth resided in rural areas while 19% resided in urban areas. For the purpose of this study, rural was defined as residing outside city limits while urban was defined as residing inside city limits. Eighteen percent of 4-H youth in North Carolina live on farms. Fifty-six percent reside in towns with less than 10,000 persons and 26% reside in towns and cities with a population greater than 10,000 (5).

In the non 4-H group (Group IV), there was a greater percentage of urban youth than in any of the other groups (Table 7). This also was to be expected since youth in this group were not members of 4-H and were drawn from North Carolina public junior high and senior high schools serving both urban and rural youth.

TABLE 7

Gender, race and geographical location of participants by group

Group	Number of Participants	Gender		Race			Geographical Location	
		% Male	% Female	% Black	% White	% Other	% Rural[1]	% Urban[2]
I[3]	49	6.1	93.9	14.3	85.7	0	79.6	20.4
II[4]	39	18.0	82.1	20.5	76.9	2.6	79.5	20.5
III[5]	34	58.8	41.2	17.7	76.5	5.9	85.3	14.7
IV[6]	86	18.6	81.4	41.5	57.7	1.1	55.3	44.7
Total	208	22.1	77.9	27.1	71.0	1.9	70.5	29.5

[1]Residing outside city limits.

[2]Residing inside city limits.

[3]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[4]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[5]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[6]Non 4-H'ers.

Participation in Foods and Nutrition Experiences

Prior foods and nutrition experiences were ascertained by three different approaches: number of junior or senior high school home economics, chemistry, biology or health education classes taken, number of 4-H foods and nutrition projects completed and number of 4-H demonstrations given.

Data shown in Table 8 indicate youth in Group I had completed, on the average, more than eight foods and nutrition projects and had given more than four demonstrations. Youth in Group II had completed, on the average, more than four foods and nutrition projects and had never participated in the demonstration program. Youth in Groups III and IV had never completed a 4-H foods and nutrition project nor given a demonstration. All youth had received some nutrition education in the public school system through home economics, chemistry, biology and/or health education classes.

Food and Nutrition Knowledge

Hypotheses one through six relate to food and nutrition knowledge. In the following section, the data pertaining to these hypotheses are discussed. Knowledge scores reflected a total number of correct responses out of a possible 30. Results of the one-way analysis of variance are found in Table 9 and the Duncan's New Multiple Range Test are found in Table 10.

Although Table 10 indicates that significant differences existed among all groups in level of food and nutrition knowledge, it could not be concluded that the differences were due to a true

TABLE 8

Participation in foods and nutrition experiences by group

Group	Mean Classes Taken					Number 4-H Foods and Nutrition Projects Completed	Number 4-H Foods and Nutrition Demonstrations Given
	Home Economics	Chemistry	Biology	Health Education	Total		
I[1]	1.1	0.5	1.1	1.4	4.1	8.3	4.4
II[2]	0.6	0.7	1.3	1.5	4.1	4.6	0
III[3]	0.5	0.7	1.2	1.3	3.6	0	0
IV[4]	1.9	0.1	0.9	1.3	4.2	0	0

[1]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[2]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[4]Non 4-H'ers.

TABLE 9

Analysis of variance summary table for dependent variable food and nutrition knowledge score by group

Source of Variance	SS	df	MS	F
Group	3002.67	3	1000.89	*45.94
Error	444.10	204	21.78	
Total	7446.76	207		

*Significant at the p<.0001 level.

TABLE 10

Mean scores and standard deviations on food and nutrition knowledge test by group

Group	Number of Participants	Food and Nutrition Knowledge Score	
		Mean[1]	SD
I[2]	49	24.7[a]	3.6
II[3]	39	20.8[b]	4.4
III[4]	34	18.0[c]	3.9
IV[5]	86	15.2[d]	5.5
Total	208	19.0	4.7

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

group effect because of two large inconsistencies in group composition. Group III consisted of many more males than any other group--59% as compared with 6%, 18% and 19% for Groups I, II and IV respectively (Table 7). Group IV also consisted of a much larger percentage of blacks than other groups--42% as compared with 14%, 21% and 18% for Groups I, II and III respectively (Table 7). Conceivably, such considerable differences in gender and racial composition of groups could influence mean food and nutrition knowledge scores.

Therefore, in order to control for the variables gender, ethnic origin and geographical location (rural versus urban) and to answer such questions as "Is the low mean food and nutrition knowledge score of youth in Group IV due to the large percentage of blacks, not being a member of 4-H or neither?," the SAS-PROC FUNCAT (80) statistical procedure was employed. Table 11 shows that even after controlling for the above three variables, the significant differences in food and nutrition knowledge that existed among all groups at the .0001 level were due to a true group effect and were not influenced by differences in gender, ethnic origin or geographical location.

Hypothesis One

There is no significant difference in foods and nutrition knowledge between 4-H members having completed three or more food and nutrition projects and given at least one demonstration and 4-H members having completed at least three foods and nutrition projects only.

Table 10 presents the number of participants, mean food and nutrition knowledge scores and standard deviations for each group.

TABLE 11

SAS-PROC FUNCAT food and nutrition knowledge score as dependent variable

Independent Variable	Chi-Square
Gender	2.67
Ethnic Origin	6.80
Geographical Location	3.67
Group	*44.02

*Significant at the $p<.0001$ level.

Youth who had completed a minimum of three foods and nutrition projects and given a minimum of one demonstration (Group I) tended to score significantly higher at the .05 level than other youth. These youth had a mean food and nutrition knowledge score of 24.7 out of a possible 30 compared with 20.8 for those having completed at least three foods and nutrition projects but never having participated in the demonstration program (Group II).

The mean age of youth in both groups was approximately the same--16.3 years for youth in Group I and 16.5 years for youth in Group II (Table 6). Therefore, the significant difference in food and nutrition knowledge that existed between groups could not be attributed to age. Nor could it be attributed to the fact that Group II consisted of a higher percentage of males than Group I and had a higher percentage of blacks (Tables 7 and 11).

The extent of exposure to nutrition education in the public school system through home economics, chemistry, biology and health education classes could not be considered a contributing factor to the difference in level of food and nutrition knowledge that existed between Groups I and II as each group had completed an average of 4.1 classes in home economics, chemistry, biology or health education (Table 8). However, youth in Group I had completed twice as many 4-H foods and nutrition projects as had youth in Group II and had given a mean of 4.4 demonstrations while youth in Group II had given none.

Thus, based on the results of the analysis, the hypothesis was rejected, indicating that a significant difference in food and nutrition knowledge existed between 4-H members having completed at least three foods and nutrition projects and given at least one demonstration and 4-H members having completed at least three foods and nutrition projects but never having participated in the demonstration program. Interpreting these results may lead one to support the underlying theory of 4-H--the learn by doing approach; that is, when youth have the opportunity to "learn by doing" and subsequently tell others about it, their learning potential is the greatest. And, it also supports the evaluation of teaching methods and techniques as proposed by Sappington et al. (76) in which actual experiences such as 4-H projects and demonstrations are more effective in enhancing the learning and understanding of the learner than are such methods as talks, radio, slides, filmstrips, movies and displays--methods that do not involve the learner in the learning process.

It is also quite possible that when those youth who have been most involved in 4-H foods and nutrition projects and demonstrations are faced with the problem of providing nutritious food for themselves and their families, they will be more motivated to do so than those youth involved to a lesser extent, thus supporting the theory that 4-H foods and nutrition projects and demonstrations not only serve to increase the food and nutrition knowledge of youth but also, over a longer period of time, prompt positive eating habits based on acquired knowledge.

Hypothesis Two

There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more food and nutrition projects and having given at least one demonstration and 4-H'ers having completed no foods and nutrition projects nor given any demonstrations.

Four-H members having completed at least three foods and nutrition projects and having given at least one demonstration (Group I) scored significantly higher than 4-H'ers never having completed a foods and nutrition project nor given a demonstration (Group III)--24.7 and 18.0 respectively, out of a possible 30.

The mean age of Group I youth was 16.3 years, and likewise, the mean age of Group III youth was 16.1 years. Therefore, age could not be considered a contributing factor to the difference that existed in foods and nutrition knowledge between groups. Nor could gender, ethnic origin or geographical location be considered contributing factors (Table 11).

Thus, based on the results of the analysis, the second hypothesis was rejected, indicating that a significant difference in foods and nutrition knowledge existed between 4-H members having completed at least three foods and nutrition projects and having given at least one demonstration and 4-H members never having completed a foods and nutrition project nor being involved in the demonstration program.

Hypothesis Three

There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects and having given at least one demonstration and non 4-H'ers.

Four-H members having completed at least three foods and nutrition projects and having given at least one demonstration had a mean food and nutrition knowledge score of 24.7 out of a possible 30, significantly higher than the mean score of 15.2 for non 4-H members. The mean age of youth in all groups was approximately 16 years, with a range of 16.1 in Group III to 16.5 in Group II (Table 6, page 52).

Youth in both Groups I and IV had completed approximately equal numbers of home economics, chemistry, biology and health classes--a mean of 4.1 classes for Group I and 4.4 classes for Group IV. And, youth in Group IV had completed approximately two times as many home economics classes as youth in Group I (Table 8, page 56). However, youth in Group I had completed an average of over eight foods and nutrition projects and given an average of over four demonstrations, whereas non 4-H youth had not participated in either of these two activities. It, therefore, is quite possible that 4-H foods and nutrition projects and demonstrations played a major role in increasing the food and nutrition knowledge of youth in Group I since the non 4-H related nutrition education background of youth in Groups I and IV appeared to be similar.

Consequently, hypothesis three was rejected. A significant difference did exist between 4-H members having completed three or more foods and nutrition projects and having given at least one demonstration and non 4-H'ers.

The results were comparable with the results of a study by Wodarski et al. (83) who used the same test instrument to measure food and nutrition knowledge and evaluate the effectiveness of an innovative high school nutrition education program which incorporated the Teams-Games-Tournaments (TGT) teaching technique. This technique altered the traditional classroom structure and gave each student an equal opportunity to achieve and to receive positive reinforcement from peers by capitalizing on team cooperation, the popularity of games and the spirit of competitive tournaments. The TGT nutrition units were presented for 50 minutes per day for four weeks in two high school classes. Prior to the implementation of the nutrition education unit, the 30-question true-false test was administered. Pre-test scores on the nutrition knowledge tests were 19.4 ± 5.2 and 20.7 ± 4.3. It is interesting to note that 4-H members having completed at least three foods and nutrition projects and having given at least one demonstration had a mean food and nutrition knowledge score of 24.7 ± 3.6 (Table 10, page 58) as compared to post-test scores of the two high school classes, 24.2 ± 3.8 and 25.3 ± 2.5 respectively. Therefore, it might be interpreted that 4-H foods and nutrition projects and demonstrations are just as effective nutrition education tools as structured, in-school nutrition education programs.

Hypothesis Four

There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects only and 4-H'ers having completed no foods and nutrition projects nor given any demonstrations.

Four-H members having completed three or more 4-H foods and nutrition projects but never having participated in the demonstration program (Group II) had a mean food and nutrition knowledge score of

20.8, significantly higher than 18.0, the mean food and nutrition knowledge scores of 4-H'ers in Group III who had never completed a 4-H foods and nutrition project nor given a demonstration (Table 8, page 56). Although youth in Group III had taken slightly fewer home economics, chemistry, biology and health education classes than youth in Group II, youth in both groups had taken approximately the same number of home economics classes--0.6 and 0.5 respectively, where the majority of foods and nutrition subject matter has been traditionally taught in North Carolina. Youth in Group II had completed a mean of 4.6 foods and nutrition projects as compared with none for youth in Group III.

Although approximately 59% of youth in Group III were male as compared with only 18% of youth in Group II (Table 7, page 54), the SAS-PROC FUNCAT analysis (Table 11, page 60) showed that differences in gender composition between groups had no effect on the difference in food and nutrition knowledge that existed. The results also showed that differences in racial composition had no effect on food and nutrition knowledge (Table 11).

Therefore, based on the results of the analysis, hypothesis four was rejected. A significant difference in food and nutrition knowledge existed between 4-H members having completed three or more 4-H foods and nutrition projects only (Group II) and 4-H'ers having completed no foods and nutrition projects nor given any demonstrations (Group III).

Hypothesis Five

There is no significant difference in food and nutrition knowledge between 4-H members having completed three or more foods and nutrition projects only and non 4-H'ers.

Four-H members having completed three or more 4-H foods and nutrition projects but never having participated in the demonstration program (Group II) scored significantly higher at the .05 level than non 4-H'ers (Group IV)--20.8 and 15.2 respectively. Very small, insignificant differences existed in gender composition between groups. Eighteen percent of Group II was male and 82% was female as compared with 19% male and 81% female in Group IV (Table 7, page 54). Likewise, the mean age of both groups was similar--16.5 years for youth in Group II and 16.4 years for youth in Group IV (Table 6, page 52).

Four-H'ers in Group II had taken a mean of 4.1 classes in home economics, chemistry, biology and health education as compared with 4.2 classes for non 4-H'ers (Group IV). As a result, it could be interpreted that nutrition education in the public school system in North Carolina contributed little toward increasing nutrition knowledge among youth. Four-H members in Group II had completed a mean of 4.6 foods and nutrition projects as compared with none for non 4-H'ers (Table 8, page 56).

Although the racial composition of Groups II and IV differed considerably (Table 7), the SAS-PROC FUNCAT analysis (Table 11, page 60) showed that differences in racial composition between groups had no effect on level of food and nutrition knowledge.

Differences in the geographical composition of youth also existed between groups with almost 80% of youth in Group II residing in rural areas compared with approximately 20% of youth in Group IV. The 4-H program in North Carolina has traditionally been concentrated in rural areas, despite the current effort to reach the urban audience. However, as with ethnic origin, the SAS-PROC FUNCAT procedure showed that the differences that existed between groups in geographical location had no effect on level of food and nutrition knowledge (Table 11, page 60).

Therefore, based on the results of the analysis, hypothesis five was rejected. A significant difference in food and nutrition knowledge existed between 4-H members having completed three or more foods and nutrition projects only and non 4-H'ers.

Hypothesis Six

There is no significant difference in food and nutrition knowledge of 4-H members never having completed a foods and nutrition project nor given a demonstration and non 4-H'ers.

Four-H members who had never completed a 4-H foods and nutrition project nor participated in the demonstration program (Group III) had a mean food and nutrition knowlege score of 18.0--significantly higher than non 4-H members who had a mean score of 15.2 (Table 10, page 58). It therefore appeared that the 4-H program offered activities and/or experiences outside of foods and nutrition projects and demonstrations that were instrumental in enhancing the foods and nutrition knowledge of 4-H'ers. Some possibilities are health fairs, dairy poster contests, favorite food shows and opportunities to serve as junior leaders at 4-H EFNEP or youth camps, and, in doing so, teach educational classes to youth in attendance on various topics related to foods, nutrition and health. As in the comparison of all other groups, only small, insignificant differences in age were found. Therefore, it was impossible to relate age to food and nutrition knowledge, as the mean age of youth in Group III was 16.1 years and the mean age of youth in Group IV was 16.4 years (Table 6, page 52).

Youth in Group III had taken a mean total of 3.6 classes in home economics, chemistry, biology and health education compared with 4.2 classes for youth in Group IV. In support of the hypothesis that high school classes have little or no bearing on the food and nutrition knowledge of youth, youth in Group IV had taken almost four times as many home economics classes as youth in Group III--1.9 and 0.5 respectively, yet, at the same time, scored significantly lower on the test of food and nutrition knowledge.

Although Group III consisted of approximately 59% males and 41% females and Group IV consisted of 81% females and only 19% males, the results of the SAS-PROC FUNCAT analysis (Table 11, page 60) showed that the significant difference in food and nutrition knowledge between groups was independent of the gender composition of groups. And, regardless of the fact that Group IV consisted of a much larger percentage of black and urban youth than Group III (Table 7, page 54), ethnic origin and geographical location had no effect on level of food and nutrition knowledge.

Therefore, based on the results of the analysis, hypothesis six was rejected. A significant difference in food and nutrition knowledge did exist between 4-H members never having completed a foods and nutrition project nor given a demonstration and non 4-H'ers.

Dietary Adequacy

Hypotheses seven and eight pertained to dietary adequacy and the extent to which the nutrient content of diets approximated the 1980 Recommended Dietary Allowances. Although opinion differs regarding the level of intake of a nutrient that may indicate a dietary problem, researchers in the past have utilized 80%, 70% and 66.7% of the Recommended Dietary Allowance as levels below which diets may need improvement. These estimates have met with general acceptance in the nutrition community (84). For the purposes of this study, "adequate" was defined as meeting two-thirds (66.7%) or more of the 1980 Recommended Dietary Allowance (Table 12). "Inadequate" is defined as meeting less than two-thirds of the 1980 Recommended Dietary Allowance.

Hypothesis Seven

There is no significant difference in nutrient content of diets of 4-H members having participated in various amounts and types of nutrition-related activities and non 4-H'ers.

The mean daily energy and nutrient intakes of youth by group are found in Tables 13 through 16. In order to determine whether or not significant differences existed among groups in dietary adequacy, each subject was categorized as having an adequate or inadequate intake of kilocalories, protein, calcium, iron, vitamin A, thiamin,

TABLE 12

1980 Recommended dietary allowances of kilocalories and selected nutrients by gender for teenagers 15-18 years of age as compared with two-thirds of the 1980 recommended dietary allowances

	Males		Females	
Energy/Nutrient	RDA	2/3 RDA	RDA	2/3 RDA
Kilocalories (kcal)	2800	1865	2100	1400
Protein (g)	56	37	46	31
Calcium (mg)	1200	800	1200	800
Iron (mg)	18	12	18	12
Vitamin A (I.U.)	5000	3330	4000	2664
Thiamin (mg)	1.4	0.9	1.1	0.7
Riboflavin (mg)	1.7	1.1	1.3	0.9
Niacin (mg)	20	13.3	14	9.3
Vitamin C (mg)	60	40	60	40

Food and Nutrition Board (1980) Recommended Dietary Allowances, 9th Ed. National Academy of Sciences, Washington, D.C.

TABLE 13

Mean daily energy intake and mean daily intake of selected nutrients by gender of 15-18 year old North Carolina adolescents who had completed a minimum of three 4-H foods and nutrition projects and given at least one demonstration (group I)

Energy/Nurtient	Males (n=3) Mean	Males (n=3) SD	Females (n=46) Mean	Females (n=46) SD
Kilocalories	2007	378	1858	743
Protein (g)	105	40	85	43
Calcium (mg)	1085	175	556	357
Iron (mg)	9.8	3.4	11.8	6.1
Vitamin A (I.U.)	3170	1316	3854	3429
Thiamin (mg)	1.1	0.3	1.1	0.8
Riboflavin (mg)	2.2	0.7	1.4	0.8
Niacin (mg)	19.5	11.4	19.1	10.8
Vitamin C (mg)	54	35	90	74

TABLE 14

Mean daily energy intake and mean daily intake of selected nutrients by gender of 15-18 year old North Carolina adolescents who had completed a minimum of three 4-H foods and nutrition projects and given no demonstrations (group II)

	Males (n=7)		Females (n=32)	
Energy/Nutrient	Mean	SD	Mean	SD
Kilocalories	2034	996	1901	874
Protein (g)	84	32	75	33
Calcium (mg)	648	525	521	301
Iron (mg)	11.3	5.1	11.5	6.1
Vitamin A (I.U.)	2527	1702	5669	4693
Thiamin (mg)	1.3	1.2	1.0	0.4
Riboflavin (mg)	1.4	0.8	1.3	0.8
Niacin (mg)	17.5	7.3	19.1	9.0
Vitamin C (mg)	100	71	66	55

TABLE 15

Mean daily energy intake and mean daily intake of selected nutrients by gender of 15-18 year old North Carolina adolescents who were members of a 4-H club but never had completed a foods and nutrition project nor given a demonstration (group III)

Energy/Nutrient	Males (n=20) Mean	Males (n=20) SD	Females (n=14) Mean	Females (n=14) SD
Kilocalories	2424	831	1755	1032
Protein (g)	95	42	57	30
Calcium (mg)	979	758	708	632
Iron (mg)	12.7	4.9	8.1	4.9
Vitamin A (I.U.)	2824	1603	5048	3989
Thiamin (mg)	1.3	0.7	0.9	0.5
Riboflavin (mg)	1.9	1.2	1.3	0.9
Niacin (mg)	18.8	8.1	11.2	6.0
Vitamin C (mg)	89	61	81	52

TABLE 16

Mean daily energy intake and mean daily intake of selected nutrients by gender of 15-18 year old North Carolina adolescents who were not members of a 4-H club (group IV)

Energy/Nutrient	Males (n=16)		Females (n=70)	
	Mean	SD	Mean	SD
Kilocalories	1868	1237	1342	723
Protein (g)	69	57	48	34
Calcium (mg)	915	869	498	435
Iron (mg)	8.2	6.6	6.9	4.4
Vitamin A (I.U.)	2244	2014	2024	1834
Thiamin (mg)	0.9	0.5	0.7	0.5
Riboflavin (mg)	1.7	1.3	1.0	0.7
Niacin (mg)	14.6	13.0	11.4	8.8
Vitamin C (mg)	91	69	65	49

riboflavin, niacin and vitamin C. Kilocalories and each of the above nutrients then were subjected to comparison by chi-square analysis. To control for the variables gender, ethnic origin and geographical location, and, in doing so, be certain that any differences found in dietary adequacy among groups were due to a true group effect, the SAS-PROC FUNCAT statistical analysis was employed, as in testing for differences in food and nutrition knowledge.

Table 17 shows that a significant chi-square value was obtained ($\chi^2 = 16.049$, $p < .0011$) when groups were compared with respect to energy intake, indicating that differences among the four groups existed in terms of proportion of youth with inadequate and adequate intakes of kilocalories. A significantly higher proportion of youth in Group IV had inadequate intakes of kilocalories than in the other three groups--55% as compared with 25%, 26% and 38% in Groups I, II and III respectively. Results of the SAS-PROC FUNCAT analysis (Table 18) showed that this difference was due to a true group effect and was not due to the fact Group IV contained the largest percentage of blacks of all groups (Table 7, page 54). Group IV youth also scored lowest on the test of food and nutrition knowledge--15.2 $\pm$ 5.5 out of a possible 30, 3.8 points lower than the overall grand mean of 19.0 $\pm$ 4.7 (Table 10, page 58). Therefore, the null hypothesis was rejected. There was a significant difference in energy content of diets of 4-H members having participated in various amounts and types of nutrition-related activities and that of non 4-H'ers.

A significant chi-square value ($\chi^2 = 29.143$, $p < .0001$) was also obtained for protein (Table 19), indicating that one or more of

TABLE 17

Chi-square test[1] for energy adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	12	10	13	47	82
	Cell Chi^2	2.8	1.9	0.0	5.1	
	Col Pct	24.49	25.64	38.24	54.65	
Adequate	N	37	29	21	39	126
	Cell Chi^2	1.8	1.2	0.0	3.3	
	Col Pct	75.51	74.36	61.76	45.35	
Total		49	39	34	86	208

[1]$\chi^2 = 16.049$, $p<.0011$.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 18

SAS-PROC FUNCAT energy adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.27	0.5303
Gender	1.17	0.2802
Geographical Location	1.23	0.2667
Group	*12.71	0.0053

*Significant at the p<.0053 level.

TABLE 19

Chi-square test[1] for protein adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	3	3	6	35	47
	Cell Chi^2	5.9	3.8	0.4	12.5	
	Col Pct	6.12	7.69	17.65	40.70	
Adequate	N	46	36	28	51	161
	Cell Chi^2	1.7	1.1	0.1	3.6	
	Col Pct	93.88	92.31	82.35	59.30	
Total		49	39	34	86	208

[1] $\chi^2 = 29.143$, $p<.0001$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

the four groups was (were) significantly different from the others with respect to the proportion of youth consuming adequate and inadequate intakes. As with kilocalories, Group IV consisted of the largest proportion of youth consuming diets inadequate in protein. Approximately 41% of youth in Group IV consumed diets inadequate in protein compared with 6%, 8% and 18% for Groups I, II and III respectively (Table 19). The SAS-PROC FUNCAT analysis (Table 20) showed that the significant difference that existed among groups in protein adequacy was independent of any differences that existed among groups in ethnic origin, gender or geographical location. Therefore, in the case of protein, the null hypothesis was rejected. A significant difference existed among groups with reference to adequacy of protein intake, with Group IV consisting of a proportionately larger number of youth consuming less than two-thirds of the RDA than did Groups I, II and III.

In the case of calcium (Table 21), an insignificant chi-square value was obtained. However, when the SAS-PROC FUNCAT analysis was employed to correct for any differences that existed in ethnic origin, gender and geographical location among groups (Table 22), it was found that calcium adequacy was significantly different at the .03 level where gender is concerned. Therefore, the null hypothesis was not rejected.

Table 23 presents the results of chi-square analysis for iron adequacy versus inadequacy of diets among groups. As with kilocalories and protein, Group IV contained the largest percentage of youth consuming less than two-thirds of the iron RDA.

TABLE 20

SAS-PROC FUNCAT protein adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.09	0.5801
Gender	1.08	0.2994
Geographical Location	0.83	0.3625
Group	*12.46	0.0060

*Significant at the p<.0060 level.

TABLE 21

Chi-square test[1] for calcium adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	35	29	21	63	148
	Cell Chi^2	0.0	0.1	0.4	0.1	
	Col Pct	71.43	74.36	61.76	73.26	
Adequate	N	14	10	13	23	60
	Cell Chi^2	0.0	0.1	1.0	0.1	
	Col Pct	28.57	25.64	38.24	26.74	
Total		49	39	34	86	208

[1] $\chi^2 = 1.842$, $p<0.6057$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

TABLE 22

SAS-PROC FUNCAT calcium adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	0.41	0.8144
Gender	*4.97	0.0257
Geographical Location	0.37	0.5412
Group	0.38	0.9451

*Significant at the p<.0257 level.

TABLE 23

Chi-square test[1] for iron adequacy versus inadequacy of diets among groups

		Group				Total
		I[2]	II[3]	III[4]	IV[5]	
Inadequate	N	26	22	20	73	141
	Cell Chi^2	1.6	0.7	0.4	3.7	
	Col Pct	53.06	56.41	58.82	84.88	
Adequate	N	23	17	14	13	67
	Cell Chi^2	3.3	1.6	0.8	7.8	
	Col Pct	46.94	43.59	41.18	15.12	
Total		49	39	34	86	208

[1] $\chi^2 = 19.941$, $p<.0002$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

Approximately 85% of youth in Group IV consumed diets inadequate in iron, with only 15% consuming at least two-thirds of the RDA. Groups I, II and III contained significantly larger proportions of youth consuming adequate amounts of iron--47%, 44% and 41% in that order. The SAS-PROC FUNCAT analysis (Table 24) determined that the significant difference that existed among groups was independent of any differences that existed among groups in ethnic origin, gender or geographical location. Therefore, the null hypothesis was rejected. A significant difference did exist in iron adequacy of diets among groups, with a larger proportion of youth in Group IV consuming less than two-thirds of the RDA than Groups I, II or III.

Table 25 shows that a significant chi-square value of 20.576 ($p < .0001$) was obtained when groups were compared with respect to vitamin A, indicating that differences among the four groups existed in terms of proportion of youth consuming adequate and inadequate intakes of vitamin A. Group IV contributed over 50% of the chi-square value (Table 25), and it was therefore concluded that it was Group IV that was significantly different from Groups I, II and III at the .0001 level. Eighty-seven percent of youth in Group IV consumed less than two-thirds of the RDA for vitamin A while only 13% consumed adequate amounts. Much smaller percentages of youth in Groups I, II and III consumed less than two-thirds of the RDA--53%, 62% and 68% in that order. The SAS-PROC FUNCAT analysis (Table 26) showed that the significant difference that existed between groups in vitamin A adequacy was independent of any differences that existed in ethnic origin, gender and geographical location between groups. Therefore, the null hypothesis was rejected with

TABLE 24

SAS-PROC FUNCAT iron adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.17	0.5579
Gender	2.20	0.1384
Geographical Location	0.01	0.9323
Group	*15.41	0.0015

*Significant at the p<.0015 level.

TABLE 25

Chi-square test[1] for vitamin A adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	26	24	23	75	148
	Cell Chi^2	2.3	0.5	0.1	3.1	
	Col Pct	53.06	61.54	67.65	87.21	
Adequate	N	23	15	11	11	60
	Cell Chi^2	5.6	1.3	0.1	7.7	
	Col Pct	46.94	38.46	32.35	12.79	
Total		49	39	34	86	208

[1] $\chi^2 = 20.576$, $p<0.0001$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

TABLE 26

SAS-PROC FUNCAT vitamin A adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.31	0.5193
Gender	0.04	0.8456
Geographical Location	0.03	0.8675
Group	*13.96	0.0030

*Significant at the p<.0030 level.

respect to vitamin A. A significant difference did exist in vitamin A adequacy of diets among groups, with a larger proportion of youth in Group IV consuming less than two-thirds of the RDA than did Groups I, II or III.

Similar results were found upon chi-square analyses for the B-complex vitamins thiamin, riboflavin and niacin and are presented in Tables 27, 28 and 29 respectively. In all three cases, Group IV consisted of a significantly larger proportion of youth consuming less than two-thirds of the RDA for these vitamins than did Groups I, II and III. And, in the case of niacin, Group III was found to be statistically different from Groups I and II ($\chi^2 = 6.503$, $p < .05$); that is, Group III consisted of a greater proportion of youth who consumed less than two-thirds of the RDA for niacin than did Groups I and II. Thirty-five percent of Group III consumed inadequate intakes of niacin as compared with 16% and 13% of Groups I and II respectively (Table 29). Group III youth also scored lower on the test of food and nutrition knowledge than did youth in either Group I or Group II (Table 10, page 58). The SAS-PROC FUNCAT analyses showed that the differences that existed among groups in thiamin, riboflavin and niacin adequacy were not affected by differences in ethnic origin, gender and geographical location (Tables 30, 31 and 32 respectively). Therefore, in the cases of thiamin, riboflavin and niacin, the null hypothesis was rejected. A significant difference did exist in thiamin, riboflavin and niacin adequacy of diets among groups, with a larger proportion of youth in Group IV

TABLE 27

Chi-square test[1] for thiamin adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	16	15	13	49	93
	Cell Chi^2	1.6	0.3	0.3	2.9	
	Col Pct	32.65	38.46	38.24	56.98	
Adequate	N	33	24	21	37	115
	Cell Chi^2	1.3	0.3	0.3	2.3	
	Col Pct	67.35	61.54	61.76	43.02	
Total		49	39	34	86	208

[1] $\chi^2 = 9.309$, $p<0.0255$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

TABLE 28

Chi-square test[1] for riboflavin adequacy versus inadequacy of diets among groups

		Group				
		I[2]	II[3]	III[4]	IV[5]	Total
Inadequate	N	10	13	10	45	78
	Cell Chi^2	3.8	0.2	0.6	5.0	
	Col Pct	20.41	33.33	29.41	52.33	
Adequate	N	39	26	24	41	130
	Cell Chi^2	2.3	0.1	0.4	3.0	
	Col Pct	79.59	66.67	70.59	47.67	
Total		49	39	34	86	208

[1] $\chi^2 = 15.411$, $p<0.0015$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

TABLE 29

Chi-square test[1] for niacin adequacy versus inadequacy of diets among groups

		Group				Total
		I[2]	II[3]	III[4]	IV[5]	
Inadequate	N	8	5	12	47	72
	Cell Chi^2	4.7	5.4	0.0	10.0	
	Col Pct	16.33	12.82	35.29	54.65	
Adequate	N	41	34	22	39	136
	Cell Chi^2	2.5	2.8	0.0	5.3	
	Col Pct	83.67	87.18	64.71	45.35	
Total		49	39	34	86	208

[1] $\chi^2 = 30.687$, $p<0.0001$.

[2] 4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3] 4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4] 4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5] Non 4-H'ers.

TABLE 30

SAS-PROC FUNCAT thiamin adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	0.15	0.9262
Gender	1.45	0.2280
Geographical Location	1.67	0.1959
Group	*16.52	0.0090

*Significant at the p<.0090 level.

TABLE 31

SAS-PROC FUNCAT riboflavin adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	0.23	0.8930
Gender	1.87	0.1713
Geographical Location	1.40	0.2369
Group	*10.32	0.0161

*Significant at the p<.0161 level.

TABLE 32

SAS-PROC FUNCAT niacin adequacy as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.43	0.4897
Gender	0.59	0.4432
Geographical Location	0.77	0.3800
Group	*19.75	0.0002

*Significant at the p<.0002 level.

consuming less than two-thirds the RDA of these nutrients than did Groups I, II or III.

A significant chi-square value was not obtained for vitamin C (Table 33), indicating that no statistical difference existed among groups as to the proportions of youth in each consuming adequate and inadequate intakes (Tables 33 and 34). As with calcium, the null hypothesis was not rejected.

Although significant differences in niacin intake only were reported between 4-H youth having been involved in various amounts and types of 4-H foods and nutrition activities, it should not be interpreted that participation in 4-H foods and nutrition activities make little or no contribution to the development of positive eating habits and ultimately an improvement in nutritional status of youth. Four-H foods and nutrition projects and demonstrations were shown to be effective in increasing the foods and nutrition knowledge of. youth. And, although attitudinal changes were not measured in this study, it is quite possible that 4-H foods and nutrition projects and demonstrations play an equally important role in changing attitudes of youth; that is, impressing upon them the importance of good nutrition and its relationship to health.

In addition to chi-square analysis, a one-way analyses of variance and Duncan's New Multiple Range Test also were used to determine significant differences in actual energy and nutrient intakes among groups. A .05 level of significance was accepted, as was used with the test of food and nutrition knowledge.

TABLE 33

Chi-square test[1] for vitamin C adequacy versus inadequacy of diets among groups

		Group				Total
		I[2]	II[3]	III[4]	IV[5]	
Inadequate	N	17	16	12	39	84
	Cell Chi^2	0.4	0.0	0.2	0.5	
	Col Pct	34.69	41.03	35.29	45.35	
Adequate	N	32	23	22	47	124
	Cell Chi^2	0.3	0.0	0.1	0.4	
	Col Pct	65.31	58.97	64.71	54.65	
Total		49	39	34	86	208

[1]$\chi^2 = 1.912$, $p<0.5909$.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 34

SAS-PROC FUNCAT vitamin C as dependent variable

Independent Variable	Chi-Square	Probability
Ethnic Origin	1.58	0.4539
Gender	0.93	0.3337
Geographical Location	0.05	0.8249
Group	1.23	0.7456

Results of the analysis of variance and Duncan's New Multiple Range Test for intake of kilocalories are shown in Tables 35 and 36 respectively. Group IV youth consumed significantly fewer kilocalories (1444) than did youth in Groups I, II and III. No significant difference existed between youth in Groups I, II and III with respect to intake of kilocalories, substantiating the results of the chi-square energy analysis (Table 17, page 77).

Results of the analysis of variance and Duncan's New Multiple Range Test for protein intake are shown in Tables 37 and 38 respectively. Youth in Group IV consumed significantly fewer grams of protein than did youth in Groups I, II or III. No significant difference in protein intake existed among youth in Groups I, II and III (Table 38), confirming the results of the chi-square protein analysis (Table 19, page 79) from which it was concluded that Group IV consisted of a proportionately smaller number of youth consuming diets that met or exceeded two-thirds of the 1980 Recommended Dietary Allowance.

Because no statistical significance existed among the four groups as to the proportions of youth in each consuming "adequate" and "inadequate" intakes of calcium, a one-way analysis of variance and Duncan's New Multiple Range Test were used to determine if significant differences in actual calcium intake existed among groups. Results are presented in Tables 39 and 40 respectively. Group III youth consumed significantly more calcium than did youth in Groups I, IV or II--877 mg, compared with 589, 578 and 544 mg

TABLE 35

Analysis of variance summary table energy intake as dependent variable

Source of Variance	SS	df	MS	F
Group	15397427.99	3	5132476.00	*7.09
Error	144070222.73	199	723971.00	
Total	159467650.72	202		

*Significant at the p<.05 level.

TABLE 36

Mean energy intake by group

Group	Number of Participants	Mean Intake[1] (kcal)	SD
III[2]	34	2173[a]	953
II[3]	39	1926[a]	885
I[4]	49	1867[a]	724
IV[5]	86	1444[b]	863

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[5]Non 4-H'ers.

TABLE 37

Analysis of variance summary table protein intake as dependent variable

Source of Variance	SS	df	MS	F
Group	44589.42	3	14863.14	*9.43
Error	313746.05	199	1576.61	
Total	358335.47	202		

*Significant at the $p<.05$ level.

TABLE 38

Mean protein intake by group

Group	Number of Participants	Mean Intake[1] (g)	SD
I[2]	49	86[a]	43
III[3]	34	81[a]	42
II[4]	39	77[a]	33
IV[5]	86	52[b]	40

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 39

Analysis of variance summary table calcium intake as dependent variable

Source of Variance	SS	df	MS	F
Group	2538154.32	3	846051.44	*3.17
Error	53031905.93	199	266492.00	
Total	55570060.27	202		

*Significant at the $p<.05$ level.

TABLE 40

Mean calcium intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
III[2]	34	877[a]	715
I[3]	49	589[b]	370
IV[4]	86	578[b]	563
II[5]	39	544[b]	346

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[4]Non 4-H'ers.

[5]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

respectively. No significant difference existed among youth in Groups I, IV and II with respect to intake of calcium.

As for kilocalories and protein, Group IV youth were found to consume significantly less iron than did youth in Groups I, II and III--a mean of 7.2 mg compared with 11.7, 11.4 and 11.0 mg respectively. Results of the analysis of variance and Duncan's New Multiple Range Test are shown in Tables 41 and 42. No significant difference existed among youth in Groups I, II and III with respect to iron intake (Table 42).

A significant F value of 3.83 also was obtained with respect to vitamin A intake (Table 43). Mean vitamin A intakes by group are presented in Table 44. Vitamin A intake of youth in Group II was highest--5105 I.U. as compared with 2067 I.U. for youth in Group IV, who were found to consume the least amount of vitamin A of all groups. No statistical difference in vitamin A intake was found to exist among youth in Groups I, II and III. Nor was any difference in vitamin A intake found among youth in Groups I, III and IV. However, youth in Group II were found to consume a statistically larger intake of vitamin A than did youth in Group IV.

A significant F value of 6.47 was obtained with respect to thiamin intake (Table 45). Mean thiamin intakes of youth by group are presented in Table 46. Duncan's New Multiple Range Test showed that youth in Group IV consumed significantly less thiamin than did youth in Groups III, I or II (Table 46). No statistical difference in thiamin intake was found to exist among youth in Groups III, I or II.

TABLE 41

Analysis of variance summary table iron intake as dependent variable

Source of Variance	SS	df	MS	F
Group	890.46	3	296.82	*10.04
Error	5885.68	199	29.58	
Total	6776.14	202		

*Significant at the $p<.05$ level.

TABLE 42

Mean iron intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
I[2]	49	11.7[a]	6.0
II[3]	39	11.4[a]	5.9
III[4]	34	11.0[a]	5.3
IV[5]	86	7.2[b]	4.9

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition project and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 43

Analysis of variance summary table vitamin A intake as dependent variable

Source of Variance	SS	df	MS	F
Group	270224494.82	3	90074831.61	*3.83
Error	4685384747.91	199	23544646.97	
Total	4955609242.73	202		

*Significant at the p<.05 level.

TABLE 44

Mean vitamin A intake by group

Group	Number of Participants	Mean Intake[1] (I.U.)	SD
II[2]	39	5105[a]	4295
I[3]	49	3812[a,b]	3512
III[4]	34	3658[a,b]	2741
IV[5]	86	2067[b]	1832

[1]Means not sharing a common superscript letter are significantly different at the $p<.05$ level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 45

Analysis of variance summary table thiamin intake as dependent variable

Source of Variance	SS	df	MS	F
Group	7.00514416	3	2.33504805	*6.47
Error	71.79521249	199	0.36077996	
Total	78.80035665	202		

*Significant at the p<.05 level.

TABLE 46

Mean thiamin intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
III[2]	34	1.2[a]	0.6
I[3]	49	1.1[a]	0.7
II[4]	39	1.0[a]	0.6
IV[5]	86	0.3[b]	0.1

[1]Means not sharing a common superscript letter are significantly different from each other at the $p<.05$ level.

[2]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[4]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

Results of the analysis of variance and Duncan's New Multiple Range Test for intake of riboflavin are shown in Tables 47 and 48 respectively. Riboflavin intake of youth in Group III was the highest while the intake of youth in Group IV was the lowest. No statistical difference in riboflavin intake was found to exist among youth in Groups III, I and II. Nor was any statistical difference in riboflavin intake found among youth in Groups I, II and IV. However, youth in Group III were found to consume a statistically larger intake of riboflavin than did youth in Group IV.

Results of the analysis of variance and Duncan's New Multiple Range Test for intake of niacin are shown in Tables 49 and 50 respectively. No statistical difference in niacin intake was found to exist among youth in Groups I, II and III. Nor was any statistical difference in niacin intake found between youth in Groups III and IV. However, the niacin intake of youth in Groups I and II was found to be statistically different from youth in Group IV.

A significant F value was not obtained with respect to actual vitamin C intake among groups (Table 51). Mean vitamin C intakes by group are presented in Table 52. No statistical difference in actual vitamin C intakes were found to exist among groups (Table 52), confirming the results of the chi-square vitamin C analysis, stating that no statistical difference existed among groups as to the proportions of youth in each consuming adequate and inadequate intakes.

Reporting nutrient intakes per 1000 kilocalories referred to as nutrient density is another way to examine the quality of diets.

TABLE 47

Analysis of variance summary table riboflavin intake as dependent variable

Source of Variance	SS	df	MS	F
Group	8.19356141	3	2.73	*3.28
Error	165.54031051	199	0.83	
Total	173.73387192	202		

*Significant at the $p<.05$ level.

TABLE 48

Mean riboflavin intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
III[2]	34	1.7[a]	1.1
I[3]	49	1.4[a,b]	0.8
II[4]	39	1.3[a,b]	0.8
IV[5]	86	1.1[b]	0.9

[1]Means not sharing a common superscript letter are significantly different at the $p<.05$ level.

[2]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[3]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[4]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 49

Analysis of variance summary table niacin intake as dependent variable

Source of Variance	SS	df	MS	F
Group	2032.37611449	3	677.45870483	*7.08
Error	19048.32240767	199	95.72021310	
Total	21080.69852217	202		

*Significant at the p<.05 level.

TABLE 50

Mean niacin intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
I[2]	49	19.1[a]	10.7
II[3]	39	18.8[a]	8.7
III[4]	34	15.9[a,b]	8.2
IV[5]	86	12.1[b]	10.2

[1]Means not sharing a common superscript letter are significantly different at the $p<.05$ level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

TABLE 51

Analysis of variance summary table vitamin C intake as dependent variable

Source of Variance	SS	df	MS	F
Group	13840.45398940	3	4613.48466313	*0.88
Error	1042011.52630617	199	5236.23882566	
Total	1055851.98029557	202		

*Not significant at the p<.05 level.

TABLE 52

Mean vitamin C intake by group

Group	Number of Participants	Mean Intake[1] (mg)	SD
I[2]	49	88[a]	72
II[3]	39	86[a]	79
III[4]	34	72[a]	71
IV[5]	86	70[a]	68

[1]Means not sharing a common superscript letter are significantly different at the p<.05 level.

[2]4-H'ers having completed three or more foods and nutrition projects and having given at least one demonstration.

[3]4-H'ers having completed three or more foods and nutrition projects and having given no demonstrations.

[4]4-H'ers having completed no foods and nutrition projects and having given no demonstrations.

[5]Non 4-H'ers.

Variation in actual nutrient intakes among different gender or age groups is greatly reduced when nutrient intakes are expressed per 1000 kilocalories. Examining the nutrient density of food intakes relative to the RDA is a useful alternative method for considering nutritional quality of diets when average energy intakes are below the RDA (27). Mean daily intakes of selected nutrients per 1000 kilocalories for all subjects by gender are found in Table 53. The mean intakes of nutrients per 1000 kilocalories for subjects by gender in Groups I, II, III and IV are found in Tables 54, 55, 56 and 57 respectively.

Calculating nutrient densities of the diet for all subjects by gender (Table 53) in the current study confirmed many of the findings of the 1968-1970 Ten State Nutrition Survey (41) found in Table 1 (page 23) as well as the results of the Department of Agriculture's 1977 Nationwide Food Consumption Survey (27) of food intake and nutritive value of diets in the United States (Table 5, page 29). The average protein intakes per 1000 kilocalories of the diets were approximately the same for both males and females in the current study and agreed closely with the values obtained for males and females in the Ten State Nutrition Survey and the 1977 Nationwide Food Consumption Survey (Tables 1 and 5) respectively.

The mean calcium intakes per 1000 kilocalories of the diets were lower for both males and females in the current study as compared with males and females in either of the two previously mentioned surveys. Males consumed a mean intake of 398 mg calcium

TABLE 53

Mean daily intake of selected nutrients per 1000 kilocalories by gender of 15-18 year old North Carolina adolescents

	Males (n=46)		Females (n=162)	
Nutrient	Mean	SD	Mean	SD
Protein (g)	38	11	40	17
Calcium (mg)	398	240	336	227
Iron (mg)	5.0	1.3	5.7	2.2
Vitamin A (I.U.)	1297	873	2085	1895
Thiamin (mg)	0.6	0.2	0.6	0.3
Riboflavin (mg)	0.8	0.3	0.7	0.3
Niacin (mg)	7.8	3.4	9.3	4.7
Vitamin C (mg)	54	43	48	41

TABLE 54

Mean daily intake of selected nutrients per 1000 kilocalories by gender of 15-18 year old North Carolina asolescents who had completed a minimum of three 4-H foods and nutrition projects and given at least one demonstration (Group I)

	Males (n=3)		Females (n=46)	
Nutrient	Mean	SD	Mean	SD
Protein (g)	52	11	46	19
Calcium (mg)	541	49	297	140
Iron (mg)	4.7	1.0	6.4	2.5
Vitamin A (I.U.)	1580	541	2080	1847
Thiamin (mg)	0.6	0.1	0.6	0.4
Riboflavin (mg)	1.1	0.2	0.8	0.2
Niacin (mg)	9.7	4.2	10.3	5.4
Vitamin C (mg)	26	14	49	43

TABLE 55

Mean daily intake of selected nutrients per 1000 kilocalories by gender of 15-18 year old North Carolina adolescents who had completed a minimum of three 4-H foods and nutrition projects and given no demonstrations (group II)

	Males (n=7)		Females (n=32)	
Nutrient	Mean	SD	Mean	SD
Protein (g)	42	9	40	14
Calcium (mg)	319	184	274	153
Iron (mg)	5.6	1.8	6.1	1.8
Vitamin A (I.U.)	1243	1201	2982	2943
Thiamin (mg)	0.6	0.2	0.5	0.1
Riboflavin (mg)	0.6	0.3	0.7	0.4
Niacin (mg)	8.7	3.8	10.0	4.7
Vitamin C (mg)	49	41	35	29

TABLE 56

Mean daily intake of selected nutrients per 1000 kilocalories by gender of 15-18 year old North Carolina adolescents who were members of a 4-H club but never had completed a foods and nutrition project nor given a demonstration (group III)

	Males (n=20)		Females (n=14)	
Nutrient	Mean	SD	Mean	SD
Protein (g)	39	8	33	9
Calcium (mg)	404	176	403	310
Iron (mg)	5.2	0.9	4.6	1.8
Vitamin A (I.U.)	1165	794	2876	2436
Thiamin (mg)	0.5	0.2	0.5	0.2
Riboflavin (mg)	0.8	0.2	0.7	0.4
Niacin (mg)	7.8	3.1	6.4	3.9
Vitamin C (mg)	37	28	46	36

TABLE 57

Mean daily intake of selected nutrients per 1000 kilocalories by gender of 15-18 year old North Carolina adolescents who were not members of a 4-H club (group IV)

	Males (n=16)		Females (n=70)	
Nutrient	Mean	SD	Mean	SD
Protein (g)	37	12	36	16
Calcium (mg)	490	328	371	277
Iron (mg)	4.4	1.3	5.1	1.9
Vitamin A (I.U.)	1201	922	1508	1439
Thiamin (mg)	0.5	0.3	0.5	0.2
Riboflavin (mg)	0.9	0.5	0.7	0.3
Niacin (mg)	7.8	3.6	8.5	4.0
Vitamin C (mg)	48	41	48	38

per 1000 kilocalories while females consumed a mean intake of 336 mg calcium per 1000 kilocalories (Table 53), indicating diets of low calcium density. For comparison purposes, in the Ten State Nutrition Survey, males consumed 412 mg calcium and females consumed 385 mg calcium per 1000 kilocalories (Table 1, page 23). And, in the 1977 Nationwide Food Consumption Survey, males reported consuming 440 mg calcium per 1000 kilocalories and females consumed 436 mg calcium per 1000 kilocalories (Table 5, page 29).

Average iron intakes per 1000 kilocalories in the current study were low for both males and females and substantiated the findings of Mongeau (51) and Lee (52) in addition to the results of the 1968-1970 Ten State Nutrition Survey (41) and the Nationwide Food Consumption Survey (27). In the current study, the overall mean iron intakes for males and females varied from 5.0 mg per 1000 kilocalories for teenage boys to 5.7 mg per 1000 kilocalories for teenage girls (Table 53) as compared with 5.5 mg per 1000 kilocalories for both males and females in the Ten State Survey (Table 1) and slightly higher iron intakes reported in the Nationwide Food Consumption Survey--6.5 mg per 1000 kilocalories for males and 6.3 mg per 1000 kilocalories for females (Table 5).

The mean vitamin A intake of females per 1000 kilocalories was 2085 I.U. in this study (Table 53) and was relatively consistent with the mean vitamin A intake per 1000 kilocalories of females in the Ten State Nutrition Survey (Table 1) and in the Nationwide Food Consumption Survey (Table 5). In the current study, mean vitamin A intakes were lowest for teenage boys--1297 I.U. per 1000 kilocalories (Table 53), just as they were lowest for teenage boys in both the Ten State Nutrition Survey (Table 1, page 23) and the Nationwide Food Consumption Survey (Table 5, page 29). However, the intakes were lower than those reported in either of the larger studies and reflected the fact that mean vitamin A intakes of males in all groups were found to fall below two-thirds of the 1980 Recommended Dietary Allowance.

Mean thiamin intakes per 1000 kilocalories for both boys and girls in the present study were remarkably similar to those reported in the Ten State Nutrition Survey and the Nationwide Food Consumption Survey (Tables 53, 1 and 5). Mean riboflavin intakes per 1000 kilocalories were lower for both boys and girls than in the Ten State Nutrition Survey (Table 1) and the Nationwide Food Consumption Survey (Table 5), although the mean intakes for boys and girls in all four groups in the current study met or exceeded two-thirds of the 1980 Recommended Dietary Allowance. Mean niacin intakes per 1000 kilocalories compared favorably to data from the Ten State and Nationwide Food Consumption Surveys. The highest niacin intakes per 1000 kilocalories were reported by boys and girls in the Nationwide Food Consumption Survey--9.4 mg and 9.7 mg per 1000 kilocalories respectively, exceeding the RDA for niacin, expressed as per 1000 kilocalories.

Contrary to the findings reported by Schorr et al. (34), Everson (43), Spindler and Acker (44), Edwards et al. (46), Huenemann et al. (49), Lee (52) and Greger et al. (53), vitamin C intakes appeared to pose no problem to boys or girls in the present study. Mean vitamin C intakes per 1000 kilocalories were 54 mg and 48 mg for males and females respectively (Table 53). Both of these values are higher than those reported in either the Ten State Survey (Table 1, page 23) or the Nationwide Food Consumption Survey (Table 5, page 29).

Hypothesis Eight

There are no correlations among age, level of food and nutrition knowledge and nutrient intake.

Table 58 shows the Pearson Product-Moment correlation coefficients between age, level of food and nutrition knowledge (as measured by score on true-false test) and actual nutrient intake (as calculated from 24-hour food recall).

No correlation existed between age and level of food and nutrition knowledge (Table 58). And, only very slight, insignificant correlations were found between age and nutrient intake and between level of food and nutrition knowledge and nutrient intake. One possible explanation for this, in view of the fact 4-H'ers (Groups I, II and III) scored higher on the test of food and nutrition knowledge than non 4-H'ers (Group IV, Table 10, page 58) and also consumed higher intakes of kilocalories and all nutrients examined with the exception of calcium and vitamin C (Tables 36, 38, 40, 42, 44, 46, 48, 50 and 52, pages 101, 103, 105, 108, 110, 112, 115, 117 and 119 respectively) might be the relatively small sample

TABLE 58

Pearson Product-Moment correlation matrix for selected variables

	Age	Food and Nutrition Knowledge
Age	1.0	
Food and Nutrition Knowledge	0.0	1.0
Kilocalories	-.1	+.1
Protein	-.1	+.2
Calcium	-.2	0.0
Iron	0.0	+.2
Vitamin A	+.2	+.2
Thiamin	-.1	+.2
Riboflavin	-.1	+.1
Niacin	0.0	+.1
Vitamin C	0.0	+.2

size utilized. Also, the fact that intakes of a few subjects deviated substantially from the mean intakes of various nutrients ("outlyers"), may have contributed to the slight correlations between food and nutrition knowledge and nutrient intakes (Table 58).

Therefore, on the basis of these results, hypothesis eight was rejected. No correlation existed between age and level of food and nutrition knowledge and little or no correlation existed between age and nutrient intake nor between level of food and nutrition knowledge and nutrient intake.

CHAPTER V

SUMMARY AND CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Summary and Conclusions

The purpose of this study was to collect data that would help document the extent to which 4-H foods and nutrition projects and demonstrations serve to increase the food and nutrition knowledge of North Carolina youth, which, in turn, serves as a positive influence on their dietary practices. The data collection instruments consisted of a 30-question true-false test of food and nutrition knowledge and a standard 24-hour food recall form (Appendix A).

Boys and girls who were members of 4-H scored significantly higher at the .05 level on the test of food and nutrition knowledge than did non 4-H'ers. Statistically significant differences in food and nutrition knowledge at the .05 level were found to exist among all groups, with those 4-H'ers most involved in foods and nutrition-related activities scoring higher than youth lesser involved. Group I youth who had completed a minimum of three foods and nutrition projects and who had given at least one demonstration answered 82% of the questions correctly, scoring significantly higher on the test of food and nutrition knowledge than did 4-H members who had completed at least three foods and nutrition projects but who had never given a demonstration (Group II). In turn, 4-H'ers who had completed at least three foods and nutrition projects but never had given a demonstration scored significantly higher than did youth who were members of a 4-H club affiliated with the North Carolina Agricultural Extension Service but who had never completed a 4-H foods and nutrition project nor given a demonstration (Group III). And, Group III youth scored significantly higher on the test of food and nutrition knowledge than did non 4-H members who answered only 51% of the questions correctly. The SAS-PROC FUNCAT statistical procedure determined that the significant differences that existed among all groups in food and nutrition knowledge were not influenced by differences in demographic composition of groups.

Therefore, 4-H foods and nutrition projects and demonstrations may be instrumental in increasing the food and nutrition knowledge of 4-H youth and merely belonging to a 4-H club may play a role in enhancing the food and nutrition knowledge of youth through participation in nutrition-related activities such as health fairs, favorite food shows, special interest classes, weight reduction classes and opportunities to serve as junior leaders at 4-H and EFNEP camps, teaching basic nutrition to youth under the supervision of 4-H and youth agents.

Results of the 4x2 chi-square test analyzing the adequacy or inadequacy of diets in relation to energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C showed that a significant difference existed between adequacy of diets of persons in Group IV and Groups I, II and III with respect to energy and all nutrients except calcium and vitamin C. In the cases of calcium and vitamin C, no statistical differences existed among groups as to the proportion of youth in each consuming adequate and inadequate diets. A higher proportion of Group IV subjects (non 4-H members) was found to consume inadequate diets in relation to kilocalories, protein, iron, vitamin A, thiamin, riboflavin and niacin than other groups. When comparing the nutrient adequacy of diets of youth in Groups I, II and III, insignificant chi-square results were obtained with the exception of niacin. A larger proportion of youth in Group III consumed less than two-thirds of the RDA for niacin than did youths in Groups I and II.

When testing for differences at the .05 level in actual energy and nutrient intakes among groups, youth in Group IV were found to consume significantly fewer kilocalories and less protein, iron and thiamin than youth in other groups, with no significant differences existing among Groups I, II and III. Group III youth consumed significantly more calcium than youth in Groups I, IV and II, with no significant difference existing among youth in the latter groups. Youth in Group II were found to consume a statistically larger intake of vitamin A than youth in Group IV. No statistical difference in vitamin A intake was found among youth in Groups I, II and III nor among youth in Groups I, III and IV. No statistical difference in riboflavin intake was found among youth in Groups III, I and II nor among youth in Groups I, II and IV. However, youth in Group III were found to consume a statistically larger intake of riboflavin than did youth in Group IV. The niacin intake of youth in Groups I and II was found to be statistically higher than that of youth in Group IV. No statistical difference in niacin intake was found to exist among youth in Groups I, II and III nor between youth in Groups III and IV. No statistical difference in actual vitamin C intake was found to exist among groups.

No significant correlation was found between the age of 4-H youth and their level of food and nutrition knowledge. And, only very slight, insignificant correlations were found between age and nutrient intake and between level of food and nutrition knowledge and nutrient intake.

Implications

Nutrition education programs must be delivered in a manner which promotes attitudinal and behavioral change on the part of the learner. With respect to 4-H foods and nutrition programs, it is mandatory that we, as Extension Specialists, determine what 4-H'ers would like to know about nutrition, build on these interests and motivate them to learn what they need to know to make wise food choices.

Nutrition educators will not be successful in helping people to improve their diets until they utilize the methods of food advertisers and learn to appeal effectively to the emotions rather than the intellect, the primary reason why food faddists and health food advocates have had an impact on our society.

Adolescents are interested in health primarily for reasons related to their physical appearance, fitness for sports and social acceptance. Unless nutrition education can be linked to teenagers' concerns with self-development, chances are efforts will be futile. For this reason, an assessment of adolescents' current needs and interests should precede the instigation of any nutrition education program. The fact that one's nutritional status at any stage of life has an influence on one's health in subsequent years must be recognized. Nutrition education must meet the practical, everyday needs of adolescents and provide information about weight loss and gain, obesity, dental health, exercise, fitness, alcohol and drugs. More abstract information can be related to personal needs, body functions and appearance.

Nutrition education programs must provide not only reliable information but, most importantly, they must lead to improved food-related behavior. Although numerous studies have shown that increased knowledge of food and nutrition does not necessarily lead to immediate behavior change, future research should be directed toward the development of means whereby knowledge of foods and nutrition increases in conjunction with the application of knowledge to the improvement of dietary practices.

Achieving the long-range goal of improving nutritional status cannot be measured over a short period of time. A food and nutrition education program might very well be effective in changing knowledge, as did the present study, and attitudes, but a longer period of time might be needed before improvements in nutritional status could have been demonstrated.

Even though behavior change is clearly desirable, it is important to consider whether measuring changes in eating habits is a fair outcome of 4-H nutrition education programs. There are few research studies that support a clear and consistent relationship between increased nutrition-related knowledge and behavior change. Given the range of factors that influence an adolescent's food-related behavior, behavior change may not be a valid outcome for 4-H nutrition education programs which, in general, do not address many of the in-school factors that influence adolescents' eating patterns.

The necessity exists for people to be knowledgeable about certain aspects of sound nutrition in order to be able to make rational decisions, but such knowledge functions as a tool only if and when people are ready to make changes. By itself, knowledge is not the instigator of change. There must be an emotional "readiness" on the part of a person to shift from a present to a different kind of behavior in order for factual knowledge to be accepted. Facts are used to justify and rationalize the decision to change rather than stimulate it. In the absence of such readiness, facts are either disregarded or altered to rationalize present behavior (85).

Timing is a major factor related to motivating young people to make changes in their eating habits. The most likely time for young people to be exposed to nutrition education is when they are of junior or senior high school age. Unfortunately, at this time in their lives, they usually are not motivated to learn about nutrition, except when it might be of benefit to them; for example, if they are involved in athletics and believe a better diet might improve their performance. The time of highest motivation for learning about nutrition is not when people are young and living at home, but rather when they are faced with the actual problem of providing food for themselves and/or their family. When this time arrives, they must make an effort to seek out the desired nutrition information which can be acquired from a number of sources.

Assuming that the individual has been motivated, his or her ability to change behavior, namely food habits, will be affected by knowledge, or cognition. In this case, he/she must have the information to select appropriate kinds and amounts of food. Thus, although a knowledge of food and nutrition is indispensable in affecting the desired change, information itself is useless unless the individual has accepted the need for change and is motivated to do so.

Recommendations for Future Research

There are indications that this study could be expanded over a longer period of time, evaluating the dietary intakes of the same individuals used in this study several years from now, or at a time when most of the individuals surveyed would be faced with the problem of preparing food for themselves and/or their family.

Another variation of this study might be to measure the attitudes of 4-H'ers toward nutrition as well as food and nutrition knowledge, since attitudes also play an important role in determining the eating habits of youth.

In reviewing the literature for this research, very little published data are available related to the evaluation of Extension programs in foods and nutrition. While information is available on Extension program development, few comparative data on program evaluation are available, thus limiting the examination of our data.

Within the context of these limitations, the question is raised as to whether or not we are attracting youth who really need 4-H programs. The drawing and holding power of 4-H also raises some concerns; that is, parental encouragement often is the primary reason for joining. The concerns and goals of 4-H'ers often show a strong desire for pleasure and enjoyment, whereas 4-H was originally designed to be a year-round educational program, with the primary objective being that of helping young people develop to their potential.

These data suggest a need for more 4-H evaluation research. The awareness of the need for more research in North Carolina has certainly been heightened by the rather sparse availability of quality evaluation research data. Results of this study nevertheless raise important questions and concerns that we as Extension workers must take into consideration as we plan and develop programs in the area of youth development and 4-H work.

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APPENDIXES

APPENDIX A

INSTRUMENTS

FOOD AND NUTRITION KNOWLEDGE QUESTIONNAIRE

Carefully fill out the information requested about yourself before proceeding to the test questions.

Name______________________________ Age________ Race______________

Address___________________________ Date of Birth__________________

__________________________________ Sex: _______Male________Female

Are you a member of 4-H? ______Yes ______No

If so, name of club____

I live: _____inside city limits _____outside city limits

How many courses in high school home economics have you had? Please count those presently enrolled in. ________

How many high school chemistry courses have you had? Please count those presently enrolled in. ______

How many high school biology courses have you had? Please count those presently enrolled in. ______

How many high school health education courses have you had? Please count those presently enrolled in. ______

Check all of the Food and Nutrition Projects below that you have taken:

______Adventures in the Kitchen
______Incredible Milk
______Cooking is Fun
______Make Way for Dairy Products
______Foods with an International Flavor
______Meals for Today, the Easy Way
______Teens Entertain
______Tricks for Treats
______All American Foods
______Health I
______Canning I
______Canning II
_______Campout Meals
_______Picnic Meals
_______Hiking and Backpacking
_______Quick Breads Made from Mixes
_______Quick Breads Made from Basic Ingredients
_______Winning Ways with Yeast Breads
_______4-H Calorie Countdown
_______Food Conservation and Safety
_______Peanuts . . . Nutrition in a Nutshell
_______Frozen Foods

Check the demonstrations below that you have given and circle the number of times each has been given.

Demonstration	No. of Times
Junior Dairy Foods	1 2 3 4
Senior Dairy Foods	1 2 3 4
Junior Fruit and Vegetable Use	1 2 3 4
Senior Fruit and Vegetable Use	1 2 3 4
Junior Breads	1 2 3 4
Senior Breads	1 2 3 4
Junior Peanut Foods	1 2 3 4
Senior Peanut Foods	1 2 3 4
Junior Egg Cookery	1 2 3 4
Senior Egg Cookery	1 2 3 4

If you are a member of 4-H, list any other 4-H Foods and Nutrition activities in which you have participated.

____

____

If you are not a member of 4-H, list any Foods or Nutrition-related activities in which you have participated through Girl Scouts, Brownies, etc.

____

____

FOOD AND NUTRITION QUESTIONNAIRE

Directions: In the blank beside each true-false question write "T" if you believe it is true and "F" if you believe it is false. If you do not understand the question or do not know the answer, leave it blank. Please do not guess.

_____ 1. There are different RDA's for adolescents and adult males and females according to age.

_____ 2. The ingredient in greatest quantity by weight in a product must be listed first in the list of ingredients on the label.

_____ 3. Proper meal planning includes the use of the Basic 4 food groups.

_____ 4. Vitamin E is provided to the body through the use of margarine and vegetable oils.

_____ 5. Two types of carbohydrates are starches and sugars.

_____ 6. Sixteen to 18-year-olds need 2 cups of milk each day to meet the guidelines of the Basic 4.
_____ 7. By using food labels, you can become a more efficient shopper.
_____ 8. Factors to consider when planning a meal include shape, color, texture and size of the foods.
_____ 9. Ascorbic acid and vitamin C are two separate vitamins.
_____10. Advertisers are always concerned about the nutritional well-being of all humans and therefore advertise only nutritious foods.
_____11. The time and energy spent to prepare a meal is not related to the types of food you buy.
_____12. The B vitamin complex includes thiamin, calcium and niacin.
_____13. The way you look and feel may be a result of the way you eat.
_____14. Water provides no energy to the body but is essential for proper functioning of body processes.
_____15. Foods that have been grown without any commercially prepared fertilizers are referred to as organic foods.
_____16. The Meat Group of the Basic 4 Food Groups contains eggs, fish, poultry, beef and peanuts.
_____17. Even though commercially prepared foods are convenient, they are not always the best choice because they do not always contain as many nutrients as fresh foods.
_____18. Neither serving size nor servings per container are included on nutrition information labels.
_____19. Cereals that are not good choices of breakfast foods contain large quantities of sugar.
_____20. Natural foods are not supposed to contain artificial ingredients like coloring, preservatives and flavorings.
_____21. Constipation in a normal, healthy person usually can be relieved by increasing dietary fiber.
_____22. Exercise is a very important part of weight control, along with caloric restriction.
_____23. Different food customs may be a result of cultural background.
_____24. It's not necessary to have a food from each of the food groups each day to have a balanced diet.
_____25. The meals and snacks you eat regularly are referred to as your diet.
_____26. Both synthetic vitamins and natural vitamins perform the same function in the body.
_____27. USRDA stands for United States Reserved Dietary Allowances.
_____28. The body receives its energy from food in the form of calories from carbohydrates, protein and fats.
_____29. A deficiency condition resulting from lack of vitamin A is night blindness.
_____30. The fat, cholesterol and salt contents in foods are required to be on nutrition information labels.

24 HOUR FOOD RECALL

Think back to yesterday. What did you eat from the time you got up in the morning until you went to bed? Please indicate the time and place for your meals and snacks. Include such items as sugar, honey, milk or cream used in beverages and/or cooking, butter or margarine used on bread, vegetables, kind of fat or oil used in cooking, fried foods, and dressing used on salads, etc.

	Food	Amount Eaten
Time: Place		
Time: Place		
Time: Place:		
Time: Place		
Time: Place		

Does this represent a typical day? Yes____ No____
If not, how would you change it so that it would represent a typical day?

Do you take vitamin, mineral or other food supplements?____________
If so, what kind?________________________________

YOUTH CONSENT FORM

I, the undersigned, by my signature agree to participate in this project and understand that all results will be treated with strict confidence. By my signature, I indicate that the research has been explained to me in sufficient detail. I understand that I may withdraw at any time from the study without penalty.

If I have questions regarding this study, I may contact Mary Ann Spruill, Post Office Box 5097, Raleigh, North Carolina 27650 or call her at (919) 737-2770.

Signed______________________________

Witness______________________________

Date______________________________

APPENDIX B

STRATEGIES

Dear Selected 4-H'er:

As a result of the recent emphasis on Impact Assessment, an effort is being made to document the value of the 4-H Foods and Nutrition Program in North Carolina. In cooperation with the 4-H Staff, we are trying to ascertain the degree to which 4-H Foods and Nutrition Projects and Demonstrations increase the nutrition knowledge level of youth, which, in turn, serves as a positive influence on dietary practices. This study has been authorized by Dr. Black, Director, North Carolina Agricultural Extension Service, and will involve 4-H'ers in the Northwestern, Southwestern and Southeastern districts.

As a 4-H District President, I would like to request approximately 30 minutes on the program at the next 4-H Retreat in your district. At that time, I would like to administer a nutrition knowledge test, consisting of 30 true-false questions to all 4-H'ers in attendance and take a 24-hour dietary recall. This data will then be compiled, and used to re-direct future program efforts in the area of 4-H foods and nutrition. I will be contacting you within the near future to discuss this possibility with you.

Thank you for your cooperation.

Sincerely,

Mary Ann Spruill
Extension Nutrition Specialist

cc: District Agent Advisor

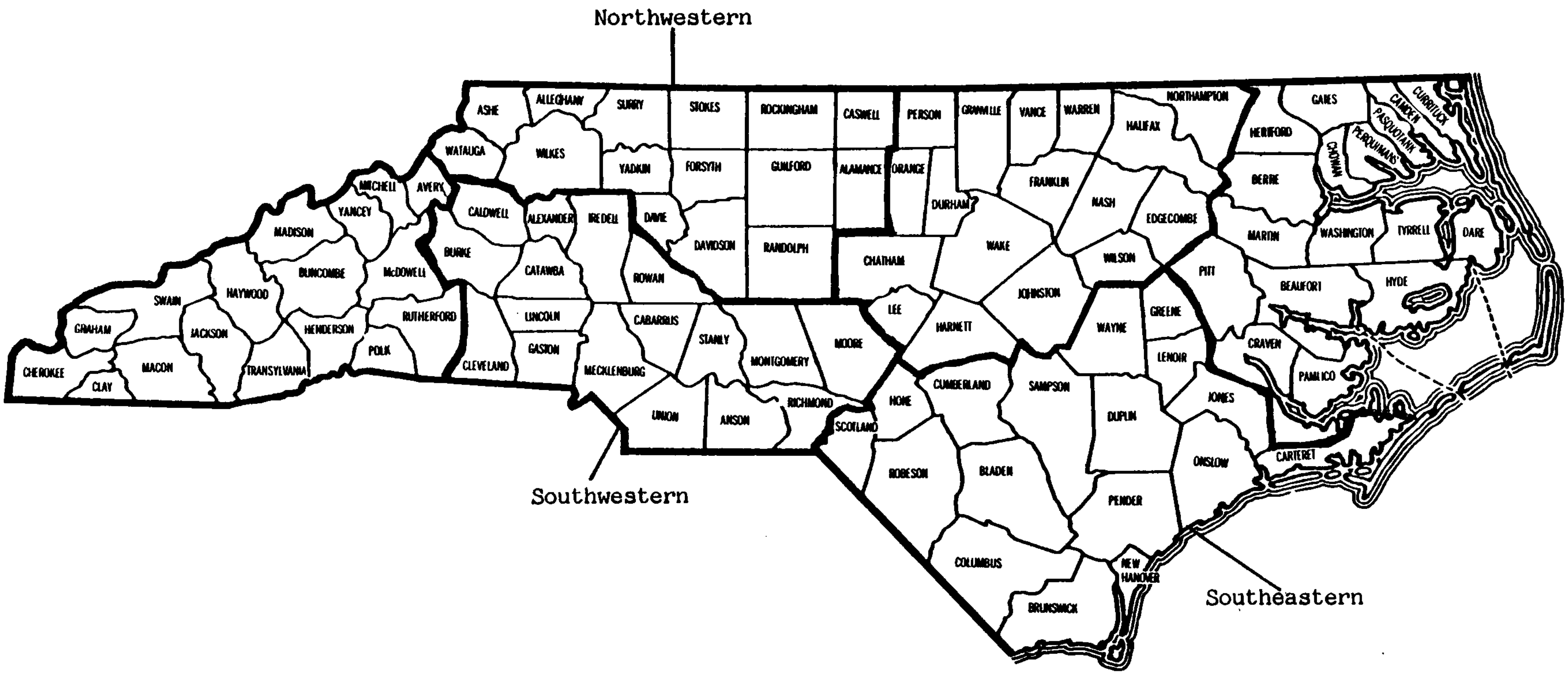

Figure 3. Northwestern, Southwestern and Southeastern Extension Districts in North Carolina.

VITA

Mary Ann Spruill, daughter of Franklin and Mamie Spruill, was born on April 6, 1950 in Washington, D. C. She graduated from Thomas Jefferson High School in Alexandria, Virginia in 1968. In 1972, she graduated with Distinction from Virginia Polytechnic Institute and State University, Blacksburg, Virginia, with a Bachelor of Science degree in Human Nutrition and Foods. She received a Master of Science degree in Human Nutrition from Virginia Polytechnic Institute and State University in 1974.

From 1974 to the present, she has been employed by the North Carolina Agricultural Extension Service as a Nutrition Specialist and Assistant Professor of Home Economics, providing leadership for state-wide educational programs related to foods and nutrition and assuming responsibility for the youth (4-H) component.

During the Fall Semester, 1977, she served as a representative from North Carolina State University to Western Carolina University as a Visiting Professor of Foods and Nutrition, where she taught both sophomore and senior level foods and nutrition courses. While at Western, she served as Assistant Advisor for the college chapter of the American Home Economics Association.

She is a Registered Dietitian and a member of the American Dietetic Association, Omicron Nu, Epsilon Sigma Phi, North Carolina Institute of Nutrition, North Carolina Council on Foods and Nutrition and the North Carolina State University Specialists Association.