A SCORE CARD METHOD FOR PREDICTION OF NUTRITIONAL VALUE OF CONSUMED FOOD

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PREFACE

This study was undertaken to validate a Food Selection Score Card which is used as a nutrition education tool on the Four Food Group concept. The assistance of the students in the Basic Human Nutrition classes is greatly appreciated.

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CHAPTER I

INTRODUCTION

In the United States standards were developed by the Food and Drug Administration in the form of the minimum daily requirements (MDR) to provide a legally accepted standard for labeling the amounts of nutrients in foods. This standard was never revised and is now obsolete. Stare and McWilliams (1977) reported that another standard is the Recommended Dietary Allowances (RDA) which were first established and published by the Food and Nutrition Board of the National Research Council in 1943. The basic philosophy underlying the recommendations of this standard was to identify the amounts of nutrients needed by healthy, normal people in the United States, to promote good growth for children, and optimum health for all. A margin of safety was incorporated in these recommendations to allow for variations in utilization and need of nutrients by individuals. These RDAs were reevaluated and revised by the Food and Nutrition Board of the National Research Council (1974) at approximately five-year intervals. The revisions of the RDAs were made to update recommendations based on current research findings and changes in living patterns.

Nutrient intakes below or above the RDAs do not necessarily indicate an inadequate diet, nevertheless,

> . . . with no way of predicting whose needs are high and whose needs are low, it does mean that the farther habitual intake falls below the . . . RDA and the longer the period

> of low intake the greater is the risk of deficiency (Harper, 1974, p. 151).

Therefore, for practical purposes, when a diet consistently falls below the RDA, it was assumed that the individual was not meeting all of his or her body's nutritional needs.

The "Basic Eleven" food guide was described first by Hunt (1918) of the Department of Agriculture. The groups of foods whether fresh, canned, frozen, or dried, were: (1) milk and milk products other than butter, (2) meat, poultry, and fish, including bacon and salt pork, (3) eggs, (4) dry beans, peas, and nuts, (5) flour, cereal, and baked goods, (6) citrus fruit and tomatoes, (7) dark green and deep yellow vegetables, (8) potatoes, (9) other vegetables and fruits, (10) fats and oils, and (11) sugars and sweets.

This plan was simplified in the late 1940's by the U. S. Department of Agriculture when the "Basic Seven" food guide was devised to explain the variety needed in the diet to achieve good nutrition. The seven food groups included: (1) milk, (2) meat, (3) citrus fruits, (4) green and yellow vegetables, (5) other fruits and vegetables, (6) breads and cereals, and (7) butter or margarine. Stare and McWilliams (1977, p. 7) stated that "despite this improvement, it soon became apparent that a system with seven categories still presented more of a challenge than most people wished to accept."

In 1955 both the Department of Nutrition at Harvard and the U. S. Department of Agriculture introduced a "Basic Four" food guide (Hayes and Stare, 1955). This plan was adopted by most groups interested in nutrition education in the United States. The four food groups included: (1) milk, (2) meats, (3) all fruits and vegetables including citrus fruits and dark green leafy vegetables or deep yellow-orange fruits and vegetables, and (4) enriched breads and cereals.

The four groups were easier for people to remember than other plans listing six or more groups; but the four groups were not all-inclusive in the outline of dietary needs. Consuming a variety of foods from within each of the "Basic Four" food groups would essentially assure a good or balanced diet for most individuals, if they made wise food selections. For a number of years food and nutrition educators have used the Basic Four Food Groups as a teaching tool for nutrition education.

Availability of food is the main determinant in food choice, but other factors also have an influence, such as cultural background, religious laws, education, and family practice. Therefore, "the availability of nutritionally desirable food does not mean . . . [these foods] will be eaten" (McKenzie, 1963, p. 205).

A summation of the total nutrient intake can be obtained by keeping an accurate record of the amounts of food eaten and calculating the nutrient content of each food item by using the nutritive values as listed in: <u>Nutritive Value of Foods, Home and Garden Bulletin No. 72</u> (USDA, 1971), <u>Food Values of Portions Commonly Used</u> (Church and Church, 1975), and <u>Composition of Foods--Raw, Processed and Prepared</u>, Agriculture Handbook No. 8 (Watt and Merrill, 1963). When the daily figures for several days are averaged, the average values can be compared with the RDAs to assess the nutritional adequacy of the diet pattern.

One method in nutrition education is the "Basic Four" food guide which can be used in combination with the actual nutritive content of foods and with the RDA as teaching tools. Another method uses only the nutritive content of foods eaten compared with the RDA. At Oklahoma State University, the "Basic Four" Food Group Guide, the nutritive content and the RDAs are used as teaching tools in the Basic Human Nutrition class, FNIA 1113.

Statement of Problem

A Food Selection Score Card was used by the Food, Nutrition and Institution Administration (FNIA) faculty at Oklahoma State University in the Basic Human Nutrition course. The Food Selection Score Card was revised in 1970 based on the "Basic Four" food guide to provide a rapid method for judging the supposed nutritive content of food consumed when following this "Basic Four" food guide.

This is used by the Basic Human Nutrition students at Oklahoma State University. A point system was devised by which the individual scores his/her food intake by using 20 points for two servings in the milk group, 30 points for two servings in the meat group, 10 points for four servings of all fruits and vegetables, 10 points for a vitamin A source of fruits and vegetables, 10 points for a vitamin C source of fruits and vegetables, and 20 points for four servings within the enriched bread and cereal group. On this Food Selection Score Card (see Appendix A) the maximum number of points for one day's food intake is 100 points. An individual who consumes more servings of food in any of the food groups does not receive extra points in that food group. If more than 100 points were possible, this would be undesirable because kilocalories from foods eaten in excess of the recommended amounts may be stored as adipose tissue, excess water soluble nutrients may be excreted, and excess fat soluble nutrients may accumulate in the liver.

A score of less than 100 points indicates an inadequate intake from foods recommended within the "Basic Four" Food Group Guide as used in the Basic Human Nutrition class.

The Food and Nutrition Board, National Research Council of the National Academy of Sciences Recommended Dietary Allowances (1974) designated the quantities of specified vitamins, minerals, and protein needed daily to maintain good nutritional status in various age groups. Their recommendations are referred to as the Recommended Dietary Allowances (RDA) (see Appendix B). Use of the Food Selection Score Card assumed that if an individual has a score of 100 points, the nutritive value of the foods consumed will meet the RDA for that person.

The most common method of determining the nutrient content of a diet is the use of food composition tables and is referred to as the Nutritive Value method. This Nutritive Value method is used as a standard for determining the adequacy of the diet. The Nutritive Value method is derived from Home and Garden Bulletin No. 72 (USDA, 1971).

Dietary score cards have been used chiefly by nutrition educators as a basis for evaluating the diet by food groups. A limitation of the score card is its failure to give the complete nutritive contribution of each food. It is a commendable educational tool in that it encourages a varied diet and provides a guide for the selection of an adequate diet.

The problem was that the validity of the Food Selection Score Card (FSSC) method had not been tested and it was not known how well this score card predicted the intake in terms of Recommended Dietary Allowances (RDAs). The purpose of this study was to determine the accuracy of the Food Selection Score Card (FSSC) method in the prediction of the adequacy of nutritive intake.

Objectives of the Study

The objectives of this research were to:

1. Test the concurrent validity of a system of assessing dietary intake in terms of the extent to which the scores on the Food Selection Score Card (FSSC) adequately predict the scores of the Nutritive Value Method (NVM) in terms of:
    a. total score
    b. selected nutrients
2. Assess the dietary adequacy of a selected group of college students in terms of the current, 1974, Recommended Dietary Allowances including:
    a. percentages of RDAs met
    b. interrelationship among nutrients and food groups consumed
    c. comparison of sex and age groups, and year groups.

Hypotheses

The following null hypotheses were tested:

H_1: The various scores on components of the Food Selection Score Card (FSSC) method do not predict the scores on selected components and total scores of the Nutritive Value Method (NVM). (This hypothesis refers to objectives 1a, 1b and 2b.)

H_2: There will be no difference in the Food Selection Score Card (FSSC) scores between:

a. sex groups

b. age groups

c. year groups

(This hypothesis refers to objective 2c.)

H_3: There will be no difference in the Nutritive Value Method (NVM) scores between:

a. sex groups

b. age groups

c. year groups

(This hypothesis refers to objective 2c.)

Objective 2a did not require the testing of a hypothesis.

Assumptions

The plan for this study was based on the following assumptions:

1. the large majority of the students ate their meals in University cafeterias;
2. all the subjects had access to vending machines for additional foods;
3. the Basic Four Food Guide was one of the best methods for food selection in order to have an adequate diet;
4. the information given by the students was accurate; and
5. the serving size and amount of food indicated by the student was what actually was consumed.

Limitations

This study had the following limitations:

1. the subjects were individuals who were required to take the Basic Human Nutrition course or chose to take the course as

an elective;

2. the study included the current food eating pattern during the time of each sample;

3. only two days of dietary analyses were evaluated during the course of a semester;

4. the subjects may have been under stressful situations while compiling the two days of food intake due to examinations scheduled in other classes;

5. the subjects were in the age range of 17 through 22 years of the 1974 Recommended Dietary Allowances for age grouping;

6. all subjects were enrolled in the same university;

7. the accuracy of this study was dependent on the record keeping ability of each student; and

8. the accuracy of this study was dependent on the ability of each student to judge the size of various servings of food eaten.

Definition of Terms

To standardize the terms utilized in this study, the following definitions were used:

1. Nutritive Value Method (NVM). Those nutrient values (energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid) for foods listed in *Nutritive Value of Foods, Home and Garden Bulletin No. 72* (USDA, 1971) as percentages of the Recommended Dietary Allowances.

2. Recommended Dietary Allowances (RDA). The RDA used in this research are those established by the National Research Council in 1974.

> The quantities of specified vitamins, minerals and protein needed daily that have been judged adequate for maintenance of good nutrition in the U. S. population developed by the National Academy of Science, National Research Council (Guthrie, 1975, p. 493).

Throughout the remainder of this report the Recommended Dietary Allowances are referred to as RDA.

3. Basic Four Food Group Guide. A guide developed in 1955 by the United States Department of Agriculture as "a simple device for planning adequate nutrition on a daily basis to outline the variety of foods that will provide a 'balanced diet' that includes the essential nutrients" (Stare and McWilliams, 1977, p. 7). The food groups are (a) milk group, (b) meat group, (c) fruit and vegetable group, and (d) enriched bread and cereal group, or grain group.

4. Food Selection Score Card (FSSC). A point system score card developed for use in FNIA 1113, Basic Human Nutrition course, based on the individual's consumption of food for one day as compared to the Four Food Group concept.

5. Kilocalorie. "The unit of heat used in nutrition; the amount of heat required to raise 1000 gm water 1° C (from 15.5 to 16.6° C); also known as the large calorie" (Robinson, 1972, p. 720).

6. Subscores. Those individual totals for each nutrient in the Nutrient Value Method (NVM) and those individual scores for each category on the Food Selection Score Card (FSSC) as found on the computer dietary analysis for each student dietary project (see Appendix C). Example: ascorbic acid, 90 mg., or milk group, 10 points.

7. U. S. Recommended Daily Allowances (U. S. RDA). A set of nutrient standards which were established for the specific purpose of implementing nutritional labeling and which are derived from the

"highest value for each nutrient RDA for males and non-pregnant, not lactating females, four or more years of age" (Lachance, 1973, p. 19). Throughout the remainder of this study the U. S. Recommended Daily Allowances are referred to as U. S. RDA.

8. Energy. Chemical energy obtained by the breakdown or metabolism of foods (Labuza, 1974).

9. Specific Dynamic Effect (SDE). Energy "required to convert and transport food from the form in which it is eaten to the many individual nutrients needed by the cells throughout the body (Stare and McWilliams, 1977, p. 102).

Organization of the Report

This report is organized into five chapters. Chapter I presents a description and statement of the problem, statement of the objectives, hypotheses, assumptions, limitations of the study, definition of terms, and organization of the study. Chapter II is a review of literature related to the study. The researcher reviewed various methods used in nutrition education to evaluate individual diets.

Chapter III gives information about the student sample, the instrumentation, the collection of data, the analysis of data, student information, data collection, and data analysis. Chapter IV presents the findings and discussion. Chapter V presents the summary and recommendations of the study.

CHAPTER II

REVIEW OF LITERATURE

This research is concerned with the nutrient intake of a selected group of college students as evaluated by a Food Selection Score Card (FSSC) method and a Nutritive Value Method (NVM). The literature is reviewed in two sections. The first section traces the historical development of the Basic Four Food Groups, the U. S. RDAs, and the Food Selection Score Cards as nutrition education tools. The second section looks at the latest nutrition education methods which include the Index of Food Quality, the Index of Nutritional Quality, the Dietary Nutrient Guide, and the Food Exchange System. Each of these methods is utilized as a nutrition education tool by the nutrition educator.

Development of the "Basic Four"

Stare and McWilliams (1977) reported that in the United States, standards were developed by the Food and Drug Administration in the form of the minimum daily requirements (MDR) which provided a legally accepted standard for labeling the amounts of nutrients in foods. This standard was never revised and is now considered obsolete. The recommended dietary allowance (RDA) was another standard which was first established and published by the Food and Nutrition Board of the National Research Council in 1943. Stare and McWilliams (1977) reported that the basic philosophy underlying the recommendations of this standard was to identify the amounts of nutrients needed by healthy, normal Americans to promote good growth for children and optimum health for all. A margin of safety is incorporated in these recommendations to allow for minor variations in utilization and the individual's need of nutrients. These RDAs are reevaluated and revised at approximate five-year intervals by the Food and Nutrition Board of the National Research Council. RDAs are revised to update recommendations in light of current research findings and changes in living patterns. The last revision was in 1974 (National Research Council, 1974). The RDAs are generally recognized as the authoritative standard of dietary adequacy in the United States by all nutritionists, dietitians, and nutrition educators.

Beaton (1971) stated that nutrient intakes below or above the RDAs do not necessarily indicate an inadequate diet. Harper (1974, p. 152) indicated that there is "no way of predicting whose needs are high" or whose are low based on the RDA. The longer an individual's dietary intake falls below the RDA, the greater will be the risk of deficiency symptoms due to the lack of nutrients. Therefore, for practical purposes, when a diet consistently falls below the RDA, it is assumed that the individual is not meeting all of his or her body's nutritional needs.

The first food guide was described by Hunt (1918) of the Department of Agriculture in the Journal of Home Economics. The groups of food were classified as: (I-A) fresh and canned vegetables and fruits, (I-B) dried fruits and vegetables, (II-A) less watery protein-rich foods, (II-B) the more watery protein-rich foods, (III-A) dry cereals, (III-B) bread and other bakery goods, (IV-A) sugar, (IV-B) syrups, jellies, candies, etc., (V-A) butter and other fats, and (V-B) cream, ice cream, etc.

This plan was simplified in 1942 by the U. S. Department of Agriculture which introduced "A Guide to Good Eating," a guide devised to explain the variety needed in the diet to achieve good nutrition. The seven food groups included: (1) milk, (2) meats, (3) citrus fruits, (4) green and yellow vegetables, (5) other fruits and vegetables, (6) breads and cereals, and (7) butter or margarine. Stare and McWilliams (1977, p. 7) stated that "despite this improvement, it soon became apparent that a system with seven categories still presented more of a challenge than most people wished to accept."

In 1955, Hayes (1955) and Stare and McWilliams (1977), of the Department of Nutrition at Harvard, and the U. S. Department of Agriculture introduced a "Basic Four" food guide. This plan was adopted by most groups interested in nutrition education in the United States. The four food groups included: (1) milk, (2) meats, (3) all fruits and vegetables including citrus fruits and dark green leafy vegetables or deep yellow-orange fruits and vegetables, and (4) enriched breads and cereals.

The four groups were easier for people to remember than other plans listing six or seven groups; but, they were not all inclusive in their outline of dietary needs as they were not adequate in kilocalories. Consuming a variety of foods from within each of the "Basic Four" food groups could essentially assure a good or balanced diet for most individuals, if they make wise food selections (Stare and McWilliams, 1977). For a number of years nutrition educators at Oklahoma State University and throughout the United States have used the Basic Four Food Groups as a teaching tool for nutrition education.

The Basic Four Food Groups, often abbreviated as the "Basic Four," were presented in elementary and secondary schools, in colleges, and in various other educational programs as a guide to food and nutrient selection. Page and Phipard (1957) developed a guide from a point system for foods of specified serving-size portions as rated according to their content of one to four key nutrients. Foods in the meat group were assigned one point per one and a half grams of protein. Foods in the milk group were assigned one point per 30 milligrams of calcium. Foods in the fruit and vegetable group were assigned one point for each 125 International Units of vitamin A activity and/or one point for each two and a half milligrams of vitamin C. Foods in the bread and cereal group were not rated on a point system by Page and Phipard (1957).

According to Page and Phipard (1957), to be adequately nourished an adult must select a correct number of servings of foods so that he or she has 20 points for each of the four key nutrients (protein, calcium, vitamin A and vitamin C) from the specific food groups per day. This amount was to correspond to one half or more of the amount established by the National Research Council based on the 1953 RDAs for an adult. The remaining requirement for the four key nutrients was to be made up by foods from the other groups. Iron, thiamin, riboflavin, and niacin were to be obtained from all four food groups and were assumed to be adequate with the appropriate number of servings from the four groups (two from the milk group; two from the meat group; four from the fruit and vegetable group; and four from the bread and cereal group).

Pennington (1973) indicated that ensuring the four key nutrients by actual reference to a point system seemed troublesome and confusing. This system is not known to many nutrition educators today. It is known that it is difficult to group and to rate many of the processed commercial foods such as pizza, chow mein, and corned beef hash, but these can be broken down into component food groups--meat in the meat group, crust or noodles in the bread and cereal group. Obtaining the actual protein, calcium, vitamin A, and vitamin C contents from nutritional labeling can be easier than converting these values to an arbitrary point system according to four groups of foods as outlined by Page and Phipard (1957).

It appeared that ensuring the key nutrients (protein, calcium, vitamin A, and vitamin C) on which the Basic Four is based does not necessarily ensure iron, thiamin, riboflavin, or niacin in the diet. Sorenson (1975, p. 54) stated that "whether or not the deficit for these 4 nutrients or any of the remaining essential nutrients (which total 45 and are ignored with this plan) are met depends on foods chosen to round out energy needs." "Empty calorie" foods which were selected reduce the chance of getting adequate nutrients. The major problem with the Basic Four Food Groups seemed to be the non-uniformity of major and coincidental nutrients in average portions of foods within each food group.

Availability of food is a main determinant of food choice. Other factors influencing food choice include cultural background, religious laws, education, and family traditions. The ability to select nutritionally desirable foods which are also available does not mean that these foods will be eaten. This sentiment, stated by McKenzie (1963) has not improved but appears to be getting worse (Hicks, 1977).

The total nutrient intake can be obtained by keeping an accurate record of the amounts of food eaten and calculating the nutrient content of each food item. This can be done by using the nutrient values as listed in Home and Garden Bulletin No. 72 (USDA, 1971), Food Values of Portions Commonly Used (Church and Church, 1975), and Composition of Foods--Raw, Processed and Prepared, USDA Handbook No. 8 (Watt and Merrill, 1963). When the daily figures for several days are averaged, the average values can be compared with the RDAs to review the nutritional adequacy of the diet pattern.

Nutrition Labeling

In 1974, the Food and Drug Administration introduced nutrition labeling, a uniform method of labeling processed foods to indicate the nutrient contribution of protein, fat, carbohydrate, energy, vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, and iron. This type of nutrition labeling is mandated by the Food and Drug Administration for all foods to which nutrients have been added or for which any claim of nutritive value has been made. In all other foods it is voluntary.

Lachance (1973) discussed the development of the U.S. RDAs as a method

> . . . to implement the provisions of nutritional labeling for food and new regulations relevant to dietary supplements of vitamins and minerals, the FDA has established a 'set of standard nutrient requirements', called the U.S. Recommended Daily Allowances (U.S. RDA). The designation 'U.S. RDA' is deliberate to distinguish this set of values from any single set of values arrived at by the National Academy of Sciences--National Research Council. In setting the standard for nutritional labeling, the U.S. RDA values were derived from the highest value for each nutrient in the NAS/NRC RDA for males and non-pregnant, not lactating females, 4 or more years of age (p. 19).

The U.S. RDA was a single set of standards derived from the RDA and replaced the 1941 minimum daily requirement (MDR) developed by the Food and Drug Administration. The MDRs were values denoting the minimum nutrient intake necessary to prevent deficiencies and related illnesses.

The U.S. RDAs are the highest values for each nutrient given in the RDAs for males and non-pregnant, not lactating females, four or more years of age. Exceptions are calcium, phosphorus, biotin, pantothenic acid, copper, and zinc. Therefore, the U.S. RDA values are higher than the needs of some segments of the population. Separate U.S. RDAs were developed for infants under 12 months, children under four years, and for pregnant and lactating women (Peterkin, 1977).

The label must include serving size, servings per container, calories, grams protein, fat and carbohydrate, and additional nutritional information which is presented in a uniform format to comply with FDA regulations. This nutrition information is presented in the form of a percentage of the "U.S. RDA." The U.S. RDAs were chosen as a standard because it is assumed that these values will be the highest values anticipated for the nutrients involved over a reasonable period of time.

Index of Food Quality

The Index of Food Quality (IFQ) was developed based on the formula presented by Sorenson and Hansen (1975, p. 54).

$$\text{Index of Food Quality (IFQ)} = \frac{\text{Nutrients in a food quantity that contains X number of calories}}{\text{Recommended Daily Allowances for those nutrients based on X number of calories.}}$$

The U.S. RDAs in their present form were used as a necessary measure. Using this as a standard, a meal planner can specify more precisely the characteristics of a balanced diet. It is known that the U.S. RDAs are nutritional standards established for the purpose of guiding food selection of the population as a whole and not for specific individuals (Lachance, 1973).

"Nutrient density" is a term generally used to refer to the nutrient composition of a food relative to its energy or kilocalorie content. The Index of Food Quality (IFQ) is a quantitative method of defining or describing nutrient density. The IFQ uses and shows both nutrients and energy facts. In developing the IFQ, an arbitrary 2300 kilocalories were used in illustrative calculations as the reasonable intake goal of an average adult. Sorenson and Hansen (1975, p. 54) indicated that an active young male will require more than 2300 kilocalories to maintain weight while a "relatively sedentary middle-aged female will require fewer calories."

The IFQ relates the amounts of specific nutrients in a food to the amounts of those nutrients needed by the individual. This places the human nutrient needs and food composition on the same energy standard. An index of "1" or more for a particular nutrient indicates that 2300 kilocalories of the food being evaluated will supply the U.S. RDA of that nutrient. These values are shown in bar graphs for each food by Sorenson and Hansen (1975). The base parameter is the number of kilocalories contained in an estimated average adult portion.

The IFQ method indicates that it is impractical and undesirable to use a single food source to supply dietary needs. Sorenson and Hansen (1975) feel that a more meaningful food profile can be based on the usual contribution of a particular food to a total diet. To balance a diet, nutrients that are in low amounts in one food should be provided by other foods. "The Index of Food Quality makes it easier to devise such food complementation," stated Sorenson and Hansen (1975, p. 54). These authors also indicated that familiarity with the IFQ will permit individuals to "readily" see that a balanced diet can be achieved by choosing a variety of foods where the combined nutrient contents satisfy the U.S. RDAs. To meet nutritional goals, specific food combinations are immaterial with this method.

One suggestion is that food nutrient profiles be included in cookbooks or other recipe sources to help aid the individual in meal planning (Sorenson and Hansen, 1975). The potential value of the IFQ as a nutrition education tool for the public can be realized only when food profiles are readily available to the public. According to Sorenson and Hansen (1975) these lists can make food complementation rapid and simple when they are available.

It is known that people change their food habits when two prerequisites are satisfied; namely, (1) the individual believes that such a change will help him/her toward some personally desired goal, (2) the mechanics of the change process are uncomplicated and easily activated. A basic problem of modern nutrition education is to motivate individuals to want to improve their diets. IFQ may not be equated with motivation, but the IFQ authors (Sorenson and Hansen, 1975) feel that this method will make it easier for people to visualize their dietary needs and deficiencies. Changes in eating habits occur when an easily understood method to aid change is available which requires a minimum departure from the present dietary practices. This method does not appear to be as simple as Sorenson and Hansen wish it to be.

Index of Nutritional Quality

Any quantitative system that is supposed to describe food must be based on two factors: (1) the nutrient composition of food, and (2) the human allowance for those nutrients. As data about both of these areas are expanded, the ability to describe foods in more quantitatively useful terms should increase. The term "Index of Food Quality" was developed to define the relation between nutrient content of food and human allowances for those nutrients. Two years later the term Index of Nutritional Quality (INQ) was preferred by basically the same authors (Wittwer et al., 1977) who developed the IFQ. They feel that the implications for more effective educational programs will develop with the INQ.

Because foods must be consumed within narrow quantitative limits to maintain body weight, energy seems an appropriate common denominator for relating human nutrient requirements to the capacity of a food to provide those nutrients. It is theorized that when energy requirements are met, all other nutrients will be present in recommended amounts for a balanced diet. Nutrient density is defined as a ratio of a food's nutrient contribution to its kilocalorie contribution. Nutrient density enables evaluation of the potential nutrient contribution of that certain food to an individual's diet. This was defined for foods by Wittwer et al. (1977, p. 27) as:

$$\text{Index of Nutritional Quality} = \frac{\text{Percent of nutrient allowance}}{\text{Percent of energy requirement}}$$

The equation shows the degree to which human nutrient allowances are met in proportion to the energy requirement derived from foods. An INQ of 1.0 for a nutrient is a significant goal when considering the total daily diet.

INQs were calculated for all foods in USDA Handbook No. 8 (Watt and Merrill, 1963) and each food category was examined with reference to the distribution of the nutrients for which data were available (Wittwer et al., 1977). The U.S. RDAs were used as the standard for nutrient consumption throughout, with an arbitrary 2300 kilocalorie energy base being used as in the IFQ method with similar disadvantages.

Most food categories do have certain nutrient deficits which were described. All products made from either whole wheat or enriched wheat flour, including quick breads, pastries, pies, cakes and cookies are included in the grain products group. Unless the other ingredients in flour products are good sources of certain vitamins and iron, nutrient "dilution" occurs, meaning that excess calories will be consumed to obtain adequate quantities of some of the nutrients in comparison to the kilocalorie content of the food (Wittwer et al., 1977).

Grain and grain products are recognized as important carriers of many nutrients needed for human requirements. Knowledge and food composition data are incomplete for many of these products. Many nutrients are partially lost in the milling process and are not adequately restored during enrichment. This emphasizes the importance of either revising the milling program or making more realistic restoration of many of the nutritional elements lost during milling.

One nutrient lost through milling is fiber. Burkett (1976) has indicated that an allowance of seven grams of fiber is assumed as a preferred daily fiber "allowance." The INQ approach, coupled with adequate compositional data, could materially ease professionals' efforts to help consumers learn how to make nutritionally advisable dietary modifications for most nutrients including fiber (Wittwer et al., 1977).

A survey of popular nutrition texts by Wittwer et al. (1977) showed that the texts used nutrient density criteria subjective modifiers inconsistently, and that various textbook writers misuse these modifiers when referring to different nutrients. There is an obvious need for adjectives that can have quantitative or semiquantitative meaning when used to describe each nutrient (Wittwer et al., 1977).

A range of INQ values were suggested but require that agreement be reached on educationally desirable terms, with suggested limits for their implication and use. Then, according to Wittwer et al. (1977), the INQ can be a basis and point of reference in nutrition education.

The INQ has proved capable of quantitatively describing the nutritional properties of foods and determining the relative adequacy of a food as a source of a nutrient. General food supplies can be evaluated by this method for their ability to meet nutritional needs. Wittwer et al. (1977) indicated that by using this approach, judgments can be made by professionals and lay persons concerning the contribution of individual foods and food categories to the diet. This technique facilitated evaluations of whether a food can significantly supply nutrients in supplementary quantities in the diet. As an educational tool, Wittwer et al. (1977) believed that the INQ will allow nutrition professionals to make inferences about potential clinical problems and allow educators to give practical and consistent counseling information to the individual. Wittwer et al. (1977) recognized that the usefulness of INQ is limited by the availability of accurate information on human dietary requirements and nutrient composition of foods which are being researched in many institutions at this time.

The Dietary Nutrient Guide

The Dietary Nutrient Guide was based on the co-occurrence of essential nutrients in foods which are commonly eaten and preferred by the American public. The feasibility of using one nutrient (index nutrient) to predict the presence of one or several other essential nutrients in daily diets was tested by Pennington (1976). Major interest was directed toward the determination of the minimum number of index nutrients which must be considered in a dietary evaluation.

Seven index nutrients were considered by Pennington (1976) to be the best possible combination, according to the available data on food composition and food consumption, and for judging dietary adequacy. The seven index nutrients are vitamin B_6, magnesium, pantothenic acid, vitamin A, folacin, iron, and calcium. It is assumed that if a "diet meets the suggested intake for these seven index nutrients and if a few simple dietary guidelines are followed, more than likely all 45 essential nutrients will be adequate in the diet" (Pennington, 1976, p. 7).

In this Dietary Nutrient Guide, major interest is directed toward the determination of the minimum number of index nutrients which must be considered in dietary evaluation. Index nutrients are selected by determining the correlation coefficients of 45 nutrients in serving size portions of selected foods. The value of selected nutrients for predicting other nutrients were tested by Pennington (1976) by analyzing numerous authentic diets and test diets.

Pennington (1976) used the "group method" in which foods of similar nutrient content are grouped together and mean nutrient values for each group are established according to food consumption or food preference data (weighted average) for each food within the group. A mini-list, developed by Pennington (1976), was based on direct food substitution. It was devised for the purpose of evaluating the coexistence of nutrients in foods and for evaluating diets.

It is impossible to include all commonly consumed foods in a mini-list, so provisions were made to substitute mini-list foods for unlisted items. A number of superficially "like" foods (according to the commonly recognized nutrients on a service-size basis) were grouped and an index item was chosen to represent the group in a mini-list. The shortened form of the mini-list is a direct food substitution. Pennington (1976) based this method of substitution on the assumption that the nutrient variation of any one nutrient in any one food (index item) is greater than the variation of the means of that same nutrient in all the foods included in that group. This method appears to be complicated and may be difficult to explain to the average individual.

Food Exchange System

Whitney and Hamilton (1977) reported that dietetic experts have devised a variety of systems by which similar foods can be grouped together. None of these systems has proved satisfactory for all purposes, yet there are many advantages of using some such system. The most widely used system in the Food Exchange System originally developed by the American Diabetes Association and The American Dietetic Association in 1950 and then revised in 1976 (Whitney and Hamilton, 1977). At first this system was intended for use in diet planning for diabetics only. Since 1950, this system has been adapted to a wide variety of uses by doctors, dietitians, nutritionists, and other health professionals, as well as by weight reduction groups, such as Weight Watchers. This system was used all over the world with some modifications, reported Whitney and Hamilton (1977).

The Food Exchange System is based on six groups of foods. These are: (1) milk, (2) vegetables, (3) fruits, (4) bread, (5) meat, and (6) fat. Almost every food commonly used by Americans is placed in one of these food groups. The only exceptions are foods containing large amounts of sucrose (cakes, candies, cola beverages) and alcoholic beverages. These items are omitted because they are forbidden items to the diabetic. Within each group all foods are similar in their content of carbohydrate, fat, and protein. By looking at the lists of foods, one can become familiarized with these groups. The American Diabetes Association, Inc. and The American Dietetic Association (1976) Food Exchange List was available from The American Dietetic Association, Chicago, Illinois.

The Food Exchange System includes four groups of food which contain carbohydrates and are classified according to carbohydrate content. These include: milk (12 grams per cup), vegetable (5 grams per half cup serving), fruit (10 grams per serving), and bread (15 grams per serving). The exchange list appears to be relatively simple but does require extensive explanation and training for those indviduals who choose to use this method. When therapeutic dietitians, who did patient diet counseling, were asked about this method, some indicated that it is not the easiest method to use with the general public (Wolf, personal interview, 1978).

Nutrition Education Challenges

Hicks (1977, p. 1) stated that "the standard educational approach to nutrition is rigid and inflexible" including which foods should be eaten and how much should be eaten of the four food groups. Hicks (1977) called this a "stilted approach" which she and many other nutrition educators severely criticized and questioned. Knowing "how to" meet the body's nutrient needs through proper selection of foods should be one of the primary results of nutrition education. Nutrition education must not stop here. Stimulating the individual to "want to" make proper food choices is as important as teaching the nutrition information.

Hicks (1977) suggested that the ultimate goal of nutrition education is to have people make rational decisions about food with a modification of existing food habits. The food groups are only guides to making rational decisions about food and food selection.

So much emphasis has been placed on the "Basic Four" to the exclusion of other more relevant areas of nutrition content that many nutrition educators believe that the food groups are the "ten commandments" of nutrition (Hicks, 1977).

Four changes were suggested by Spitze (1977) when teaching the Basic Four Food Groups as a "guide to good eating." These include that principles should be taught and emphasis should be shifted to the principle that diet affects health. The learners need help to discover which foods are most likely to promote health and why. Spitze (1977) indicated that the bread and cereal group contains refined, unenriched, and grain products which provide little but energy; that enriched products have been restored to whole grain levels in only four nutrients, and that whole grain products have several other important nutrients and fiber. The individual needs to know that these other important nutrients and fiber are missing in the refined and unrefined food products within this food group. Considerable variation within the fruit and vegetable group exists as related to vitamin A and vitamin C sources. Some fruits and vegetables are valuable for other vitamins and minerals and for fiber.

Spitze (1977) suggested that the meat group be called a "bean group." The biological value of the protein in eggs and milk products is higher than that of meat and that certain combinations of legumes and grain products are equal to meat in the biological value of their protein. It could be called a "Protein" group to include all areas of this food group. Dairy fats (butter and cream) are not in the milk group. Those who teach nutrition concepts need to be teaching about the servings needed in a balanced diet (Kincannon, 1977). Learners need to know what is a standard serving of the various kinds of foods and that the amount listed on nutrition labels is not a standard serving for selected foods such as most fruits and vegetables. A list of serving sizes available from the National Dairy Council (1977) was used with the Basic Human Nutrition student dietary project.

The Four Food Group pattern is much simpler than the alternate methods reviewed. The Four Food Group pattern is easier to memorize if individuals would use it. It is convenient for nutrition educators to have a pattern to recommend, and the simpler it is, the easier it is to get people to memorize it. This is not to say that people will use it in choosing their own diets. Basic Human Nutrition students indicate greater use of the Four Food Groups after taking the class, Basic Human Nutrition.

Nutrition educators can teach the relationship between intake of nutrient density and body function. Educators can explain that if the RDAs are met for these leader nutrients by consuming a wide variety of foods without any fortification, that people are likely to meet their needs for the many other essential nutrients with the exception of iron for women.

Educators such as Spitze (1977), Hicks (1977) and Peterkin (1977) taught that the RDAs are appropriate for planning and evaluating diets for individuals and population groups for which the sex-age composition is known. The RDAs can be used for preparing nutrition education materials or guides for use with a particular group, such as infants, preschool children, elderly persons, or pregnant and lactating women. The RDAs can be used for illustrating nutritional needs at various stages in the life cycle.

Peterkin (1977) indicated that the U.S. RDAs for adults and children four or more years of age are appropriate for such activities as developing materials and programs that help individuals to interpret and use nutrition information on food labels so that the individual can learn which foods are worthwhile sources of certain nutrients. This information is used in comparing the nutritional qualities of different foods and is the standard for helping individuals evaluate food purchases considering nutrient content as well as other factors such as cost per serving.

Neither the RDAs nor the U.S. RDAs are appropriate for use as rigid standards of requirements for the nutrient content of a day's food for a particular individual. These nutrient values are merely guides for use in estimating daily needs.

In general, most nutrition educators are ready to accept a new method to replace the "Basic Four" if it is simple and easy to use with the general public. Thus far no simple teaching device has been developed to replace the Basic Four.

According to Spitze (1977), nutrition educators need to teach the negative effects of excess amounts of protein in the diet; the financial cost of meat as a source of protein in relation to other sources; the cost in terms of land, labor and capital of high meat production; and the fat content of meats in relation to weight control and heart disease. The following need to be taught: low fiber content of meats; the possible relation of food intake to diseases of the colon; the absence of vitamins A and C in meats (with the exception of liver); and the positive benefits of meat in terms of iron, B-complex vitamins, trace minerals, and protein.

Latham and Stephenson (1977) reported the pros and cons of the United States Dietary Goals which were developed by the Senate Select Committee on Nutrition and Human Needs. These goals, released during spring, 1977, gave a new direction to nutrition education. They stress decreases in: (a) meat consumption, (b) high fat food consumption, (c) high cholesterol content food consumption, (d) high sugar content food and sugar consumption, and (e) high salt content foods and salt consumption. These recommended goals stress increasing the consumption of fruits and vegetables, whole grain foods, and poultry and fish. The goals emphasize substituting nonfat milk for whole milk and polyunsaturated fat for saturated fat. In December, 1977, the Dietary Goals for the United States (Senate Select Committee on Nutrition and Human Needs, 1978) were published in a second edition with some modifications including avoidance of overweight, some rewording within the goals and increasing the sodium intake to about five grams per day.

Spitze (1977) indicated that a person with a knowledge of nutrition and the ability to teach this material in an interesting manner will be in great demand. A Food Selection Score Card, if validated, can be utilized in conveying this knowledge in an interesting method as well as incorporating the many suggestions from these nutrition educators.

Gulp

A recent method to deliver nutrition education to the teenage public was reported by Mapes (1977) in the form of a comic book. The use of a comic format to deliver serious information was first used by the USDA who produced MULLIGAN STEW (Mapes, 1977). Comic books are read by thousands of students in high school and college. The most effective age level with comic books was age 16 years as reported by Mapes (1977) for her project Gulp. When tested on a selected group of students, Mapes concluded that a nutrition education comic book was better understood by the more literate student.

Gulp received more than a 70 percent approval rating which indicated that it was liked by the students sampled. The students suggested that it be in color and that it should have a conventional left-to-right balloons (for comments) so it would be less confusing to read. The comic format was found to be a most useful teaching technique for teenagers according to Mapes (1977).

Gulp offers a format to stimulate discussion and reach youth normally turned off by conventional nutrition education approaches. This approach can be thought of as one stimulant in an arsenal of tools to relay vital nutrition messages to an exciting group of the population. Young people have many nutritional concerns but few reliable sources that address the information directly to them. Many nutrition educators looking for an answer to nutrition education motivation agree that the use of the Four Foods Groups is not an infallible guide to nutritional adequacy and that alternate methods are needed to stimulate youth as well as others to improve dietary habits.

Food Selection Score Card

The "Basic Four" Daily Food Guide, as developed by the United States Department of Agriculture (1964), provides an easy way to give rough estimates of diet quality in rating diets. Various authors (Bogert, 1954, 1960; Justin, Rust, and Vail, 1933, 1940, 1948, 1956; Chaney and Ahlborn, 1934, 1943; Chaney and Ross, 1966, 1971; Mitchell and Bernard, 1954, 1958; Wilson, Fisher, and Fuqua, 1959; and Howe, 1976) have each used variations of a Food Selection Score Card in their respective nutrition textbooks. The Food Selection Score Cards were credited with being adapted from the Department of Agriculture by various authors (Chaney and Ahlborn, 1934, 1943; Bogert, 1954, 1960; Mitchell and Bernard, 1954, 1958; and Howe, 1976). The Food Selection Score Card was based on the Daily Food Guide and was often used to rate the nutritional quality of diets.

Various Food Selection Score Cards published in textbooks have listed an arbitrary point system for determining if the individual's food selection has been good, fair, or poor. Chaney and Ahlborn (1934) listed a score between 85 and 100 as good, between 75 and 85 as a fair standard, and below 75 as a low standard. Justin, Rust, and Vail (1956) listed a score of 95 to 100 as excellent, 80 to 95 as good, 75 to 80 as fair, and 75 and under as poor. Hinton (1962) arbitrarily established classifications of excellent, good, poor to fair, and poor for use with a Food Selection Score Card based on foods consumed as compared to the RDAs. This classification was based on the 1958 RDAs and is defined as follows:

Excellent-----100 percent of RDA for all nutrients.

Good----------within range of 66 to 75 percent and 100 percent of RDA for all nutrients.

Poor to fair--one or a few nutrients less than 66 percent of RDA.

Poor----------several nutrients less than 66 percent of RDA.

Eppright, Pattison, and Barbour (1963) utilized Hinton's scoring procedure.

Howe (1976) listed a score between 90 and 100 as good, between 75 and 85 as a fair standard, and below 75 as a low standard which is similar to Chaney and Ahlborn (1934). In each of these ways the amounts of food eaten were compared with the amounts recommended in a guide. Hill and Cleveland (1970, p. 4) indicated that "diets that provide at least the minimum servings suggested in the guide are often considered nutritionally adequate." Roberts (1954, p. 1100) suggested that the food guide "should be tested to see whether, if followed literally, it [the food guide] would safeguard the diet in important essentials."

Wilson (1977), in personal communication, indicated that there "was no established criteria" for the establishment of the score card and that it was derived from Page and Phipard's (1957) Essentials of an Adequate Diet.

Bogert (1960, p. 18) noted on her Food Selection Check Sheet as being "Courtesy of United States Department of Agriculture." This researcher wrote to Dr. Evelyn Johnson of the Home Economics Staff Extension Service of the U. S. Department of Agriculture requesting information about the development of this check sheet and possible validation of the check sheet. Dr. Johnson (personal communication, 1977) responded that "after checking appropriate offices in the Research Service, USDA, I cannot find any information in response to your questions. Dr. Page was one of my contacts." Therefore, it was concluded that the score cards were discontinued by many textbook authors due to lack of validation of them.

Roberts (1954) suggested that the food guides needed to be validated, but a review of the literature indicated no validation was conducted. McClinton (1971) evaluated the Canadian Food Guide as well as the "Basic Seven" and the "Basic Four" with major emphasis on the Canadian Food Guide. The Food Selection Score Card as such has not been evaluated.

CHAPTER III

RESEARCH AND DESIGN

The need for this research resulted from the dietary study used in FNIA 1113, Basic Human Nutrition, where each student recorded his/her dietary intake for two days and utilized a Food Selection Score Card. As a result of this dietary study, there is a need to validate a Food Selection Score Card (FSSC) which is used as part of this study.

The objectives of this research are as follows:

1. To test the concurrent validity of a system of assessing dietary intake in terms of the extent to which the scores on the Food Selection Score Card (FSSC) adequately predict the scores of the Nutritive Value Method (NVM) in terms of:
   a. total score
   b. selected nutrients
2. To assess the dietary adequacy of a selected group of college students on the basis of the current, 1974, Recommended Dietary Allowances including:
   a. percentage of RDAs met
   b. interrelationship among nutrients and food group consumed
   c. comparison of sex and age groups, and year groups.

The FSSC is a point system score card based on the individual's consumption of food consumed for one day. It is based on the Four Food Group concept. The NVM is based on the nutrient value of selected nutrients as listed in Nutritive Value of Foods, Home and Garden Bulletin No. 72 (USDA, 1971) and is expressed as a percentage of the RDA.

Hypotheses

The null hypotheses tested were:

H_1: The various scores on components of the FSSC method do not predict the scores on selected components of the NVM in terms of:

FSSC Components	NVM Components
a. total dietary score	a_1. the total score mean of all scores a_2. the kilocalorie value
b. Milk Group score	b_1. calcium value score b_2. riboflavin value score b_3. kilocalorie value
c. Meat Group score	c_1. protein value score c_2. iron value score c_3. thiamin value score c_4. kilocalorie value
d. All Fruit and Vegetable Group score	d_1. kilocalorie value
e. vitamin A subgroup of the Fruit and Vegetable Group score	e_1. vitamin A value score e_2. kilocalorie value
f. vitamin C subgroup of the Fruit and Vegetable Group score	f_1. vitamin C value score f_2. kilocalorie value
g. Enriched Bread and Cereal Group score	g_1. iron value score g_2. thiamin value score

H_2: There will be no difference in the FSSC scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 to 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters)

H_3: There will be no difference in the NVM scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 and 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters)

Subjects

The subjects for this study were the students (aged 17 through 22 years) enrolled during the school years fall, 1974, to 1976 in a Basic Human Nutrition class, FNIA 1113, at Oklahoma State University. There were 526 subjects in the study. As reflected in Table I, the majority of the students, 384 (73 percent), enrolled in the class were in the College of Home Economics with majors in Clothing, Textiles, and Merchandizing; Family Relations and Child Development; Food, Nutrition and Institution Administration; Housing, Design and Consumer Resources; Hotel and Restaurant Administration; and Home Economics Education. One hundred and forty-two (27 percent) of the students were enrolled in other colleges on the O.S.U. campus.

TABLE I

CLASSIFICATION OF SUBJECTS BY COLLEGE

College	1974	1975	1976	Total
Home Economics	73	151	160	384
Arts and Science	23	53	53	129
Business	-	3	2	5
Agriculture	-	1	1	2
Education	1	2	2	5
Engineering	1	-	-	1
Total Number	98	210	218	526

Summarizing data in Table II shows 63 (12 percent) of the subjects were males and 463 (88 percent) were females. The age distributions were 181 (34 percent), 19 years of age; 147 (28 percent), 18 years of age; 121 (23 percent), 20 years of age; 45 (9 percent), 21 years of age; 18 (3 percent), 22 years of age; and 14 (3 percent), 17 years of age; for a total of 526 subjects. Due to small numbers of 17-year-olds they were combined with the 18-year-olds and the 22-year-olds were combined with the 21-year-olds for analysis of data. The break down by age for each year is shown in Table II.

TABLE II

CLASSIFICATION OF SUBJECTS BY AGE, SEX, AND YEAR

Year	Age	Sex: Male	Sex: Female	Total
Fall, 1974	17	1	6	7
	18	4	23	27
	19	5	28	33
	20	2	17	19
	21	-	7	7
	22	1	4	5
1975	17	-	6	6
	18	3	59	62
	19	4	66	70
	20	5	39	44
	21	3	19	22
	22	2	4	6
1976	17	-	1	1
	18	11	47	58
	19	7	71	78
	20	9	49	58
	21	5	11	16
	22	-	7	7
Total Number		63	463	526

The researcher, with class record books and seating charts, identified each student dietary subject number for the various years for her sections of the course. The seating charts listed the age, sex, marital status, and major of each student.

The student dietary analyses utilized were for those 17 to 22 years of age and were classified either as freshmen or sophomores in the university. The total age range of students enrolled during the five semesters varied from 17 to 54 years of age, both male and female, and single or married students; therefore, 46 students did not meet the age criteria. Three hundred ninety-nine students were 18, 19, and 20 years of age and were female.

In designing the computer program for dietary analysis the Recommended Dietary Allowances for the 17 to 22 years age group for both males and females were used. The RDA for age groups above and below this range have different nutrient requirements for protein, calcium and the vitamins. The established criteria for this study was met by 526 students.

Instrumentation

For this study the FSSC and NVM which were used in the Basic Human Nutrition course since 1971 were used to provide data. The FSSC is a point system score card which was developed by the faculty in Food, Nutrition and Institution Administration at Oklahoma State University for use by the students in FNIA 1113, Basic Human Nutrition. It was used for the evaluation of the food eaten on one day based on the Basic Four Food Group concept. The student recorded everything eaten in one day, categorized these foods according to the Basic Four Food Groups, listed the number of servings for each group on the FSSC, and then gave a designated amount of points for each serving in each food group. The combined total score for this FSSC is a maximum of 100 points. There are no bonus points for consuming more than the designated number of servings in any of the food groups. Partial points are given for less than the recommended number of servings such as "one cup of milk equals 10 points." The FSSC is shown in Appendix A.

A computer program was developed to simplify scoring for the instructors of the Basic Human Nutrition course and to give more meaningful information to the students about their individual eating habits. This program was developed through the Computer Center at Oklahoma State University by the instructors of Basic Human Nutrition, including this researcher, based on the student dietary project needs. The FNIA Department had available the "deck" of computer cards for Nutritive Value of Foods, Home and Garden Bulletin No. 72 (USDA, 1971), which is a listing of nutrient values of different foods based on selected quantities. This bulletin was the foundation for the computer program. Other nutrient food values were added from Church and Church (1975) and information from different food processors such as Frito-Lay and Planters Peanuts.

Food Group classifications

The FNIA 1113 Basic Human Nutrition faculty had placed each food item in its food grouping. Appendix B (FNIA 1113 Dietary Assignment) shows the groupings of some of the more complex food items to categorize according to each food group. Some arbitrary decisions were made by the FNIA faculty on some food items and criteria established in the Meat Group and for vitamin A and vitamin C sources. A serving in the Meat Group was established arbitrarily as one which contained a minimum of

12 grams of protein. It was decided that for a good source of vitamin A, the serving portion should contain at least 1800 International Units (IU) of vitamin A. For a good source of vitamin C, the serving portion should contain 30 mg. or more of vitamin C.

Nutritive Value Method

The Nutritive Value Method (NVM) was used as the criterion and utilized the nutrient values (energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and ascorbic acid) for foods listed in Nutritive Value of Foods, Home and Garden Bulletin No. 72 (USDA, 1971). This bulletin is the standard source of nutritional values for all foods listed in this study. These nutrient values were compared with the RDAs and utilized as a percentage of the RDAs (see Appendix C).

Food Selection Score Card Method

The FSSC method is a point system developed for scoring the food consumed by the individual each day based on the Four Food Group concept. The scoring includes:

1. Two cups in the Milk Group equal 20 points
2. Two servings in the Meat Group equal 30 points
3. Four servings in the Fruit and Vegetable Group equal 10 points
4. One serving of a vitamin A fruit or vegetable equals 10 points
5. One serving of a vitamin C fruit or vegetable equals 10 points
6. Four servings in the Enriched Bread and Cereal Group equal 20 points.

The combined total of points for this score card is 100 points maximum.

Each food group was established based on the amounts of certain nutrients supplied by each food group (Page and Phipard, 1957). The Milk Group was based on each one cup (eight ounce) serving of milk supplying 288 mg. calcium, 0.42 mg. riboflavin, and 9 g. protein. The Meat Group was based on the fact that protein, iron and various B complex vitamins will be supplied when consuming a three-to-four ounce (cooked weight) serving of meat or meat alternate. The Fruit and Vegetable Group was based on the fact that certain items in this group will supply cellulose, some iron, and certain vitamins, especially vitamin A value and vitamin C. The Enriched Bread and Cereal Group was based on the fact that one slice (serving) of enriched bread will supply approximately 0.6 mg. each of iron and niacin, 0.06 mg. thiamin, 0.05 mg. riboflavin, and is an inexpensive source of energy.

Collection of Data

The researcher, as coordinator and instructor of three sections of Basic Numan Nutrition (FNIA 1113), collected the dietary analysis from each student dietary project each semester for five semesters. She reviewed approximately 116 dietary projects each semester as a part of grading student assignments. The review was necessary to check the accuracy of the code numbers and multiples for serving portions. The dietary analysis contained the total nutritive values of the food consumed as well as a comparison of each nutritive value with its respective RDA. This dietary analysis can indicate: "you need to improve your eating habits" without offending the student. A copy of each corrected dietary analysis was kept by the researcher-instructor for the purpose of this research project.

Student Information

As part of the course requirements for FNIA 1113, Basic Human Nutrition, each student recorded his/her name, sex, and student subject computer number (assigned by the instructor) as part of the dietary study. The student listed the desired body weight, hours of sleep, hours of light activity, hours of severe activity, as well as the name of each food item with the amount consumed as a decimal percentage (multiple) of the quantity listed. A code number was assigned each food item and the kilocalorie value of the day's food intake was determined. Each food item was listed in its respective food group if it met the criteria for this grouping. All information was recorded on specific forms as found in Appendix B for a two-day period.

Instructor Responsibilities

The instructor assigned each student a subject computer number and prepared an independent visual instruction unit utilizing food models. This visual unit acquainted the students with serving portions or sizes so they could describe the actual amounts of foods they were consuming. The instructor assigned the required work, gave assistance as needed, collected the data from each student, and "spot checked" the food code numbers and multiples for possible corrections. This information was hand delivered to the key punch operator who was responsible for obtaining the final computer dietary analysis for each class.

When the instructor received the final computer dietary analysis for each student, the dietary analysis was used to grade each student's work on the pages shown in Appendix B. The computer printout of the dietary analyses were given to all students so they could complete their own personal evaluation of their eating habits. Throughout this project the instructor emphasized that the student would not be graded on how he/she ate but rather on the evaluation of how well he/she ate according to the Basic Four Food Group Guide and to the NVM.

Student Use of Data

A determination of energy needs for each student was calculated using information shown in Appendix B, entitled "Computation of Your Total Kilocalorie Requirements." The student determined his/her desired weight in kilograms by the use of an Independent Instructional Unit administered outside of the regular class time. This unit involved determination of body build and used charts of desirable weight range for the body frame. Calculation of the basal metabolic kilocalorie needs reflected variations in body size, sex and amount of sleep. The student determined the total hours of light and severe activity and calculated the additional kilocalories needed. The specific dynamic effect of food which is the amount of energy required to digest and metabolize food was calculated on this form. The total kilocalories needed for basal metabolism, physical activity and specific dynamic effect of food represented the estimated daily kilocalorie need of the student. The total daily kilocalorie need was used for the calculation of possible weight gain or loss in the evaluation part of the project and protein requirement in the NVM.

In order to accomplish the evaluation for the student dietary project, the student completed the forms shown in Appendix B. The evaluation included an estimation of the kilocalorie requirements, and a listing of the foods consumed on each of the two days indicating the amounts consumed. The student recorded the foods consumed on the FSSC based on information from the specific forms showing the groupings of foods consumed according to each food group (see Appendix B). As part of the evaluation, the student answered questions dealing with his/her eating habits in the area of possible weight gain or loss, recognition of possible inadequacies in the diet when compared with the Basic Four Food Group concept, and possible nutritional problems which might develop as a result of consuming this type of diet over an extended period of time. In addition the student indicated means by which to improve the menu based on a comparision with the RDA for each day in order to supply needed nutrients.

In summary, the comparison of the FSSC method to the NVM in the student evaluation brought about the need to test the FSSC method for validity. It is not known how well this FSSC can predict the values obtained by the NVM. Therefore, this research was undertaken to determine the accuracy of the FSSC method in the prediction of the nutritive value for the individual.

Data Preparation

Data for this research project were collected by the researcher at the end of each semester that Basic Human Nutrition used a computer program for the student dietary project, beginning in 1971. The researcher accumulated the total dietary analyses for the entire student subjects for all sections of FNIA 1113, Basic Human Nutrition, with the intent that these analyses were of value for research.

A total of 526 students met the criteria for this research. Their computer dietary analyses were used which represented a total of 1052 days (two days for each subject).

For each dietary analysis, the subject's sex, age, and year of the study were indicated. The FSSC total score was a feature of the dietary analysis (see Appendix C) but the NVM total score was not. Each NVM total score (based on the RDA percentage) was hand calculated, with those percentages above 100 percent being calculated as 100 percent. For example, protein listed as 192 percent was scored as 100 percent. The scores for the eight nutrients: protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid, were totaled and divided by eight to arrive at a mean total score (expressed as a percentage) for the NVM.

In preparing for key punching, the following information was tabulated for each subject for each of two days: subject number, sex, age, year of enrollment, percentage of kilocalories for each day, scores for each of the subgroups of the FSSC--milk group, meat group, all fruit and vegetables, vitamin A source of fruit and vegetables, vitamin C source of fruit and vegetables, and enriched bread and cereal group--the total score for the FSSC, the percentage of the RDA for each subgroup of the NVM--protein, calcium, iron, vitamin A, thiamin, riboflavin, naicin, and ascorbic acid--and the total score for the NVM. As this part of data preparation was completed, the information was delivered to the computer center for key punching and validation of the key punching. The cards were processed through the computer to determine the accuracy of the key punching.

Data Analysis

A statistician was consulted and supervised the key punching of the program cards based on the Statistical Analysis System (SAS) utilizing the regression (Regr) procedure and the analysis of variance (ANOVA) procedure of this system. Statistics obtained from the analyses included means, variances, standard deviations, intercorrelation coefficients for all variables for both the FSSC method and the NVM; analysis of variance tables, regression coefficients, and statistics of fit for dependent variables; analysis of variance for total score of the FSSC and for total score of the NVM.

Consistent with the first objective and the first set of hypotheses (H_1) the concurrent validity of a system of assessing dietary intake was examined through testing by means of regression procedure of the extent to which the scores on the FSSC predict the scores of the NVM as follows:

a. FSSC total score predicts NVM total score

b. selected subscores including:

  i. FSSC milk group score predicts NVM calcium, riboflavin, and kilocalorie scores

  ii. FSSC meat group score predicts NVM protein, thiamin, iron, and kilocalorie scores

  iii. FSSC vitamin A fruit and vegetable subgroup score predicts NVM vitamin A value, and kilocalorie scores

  iv. FSSC vitamin C fruit and vegetable subgroup score predicts NVM vitamin C value, and kilocalorie scores

  v. FSSC enriched bread and cereal group score predicts NVM iron, thiamin, and kilocalorie scores.

Consistent with the second objective and second set of hypotheses (H_2) the dietary adequacy of a selected group of college students was assessed in terms of the current, 1974, Recommended Dietary Allowances and the significance of sex groups, age groups, and year groups as sources of variance on FSSC total score and each FSSC subgroup score was tested by analysis of variance.

Consistent with the second objective and the third set of hypotheses (H_3) the same procedures were used as for H_2. The data analyzed were NVM total scores and NVM scores for each selected nutrient.

The second and third set of hypotheses were tested by computing analysis of variance with multiple classifications (sex and age) and single classification (year) for: (a) each of seven variables of the FSSC including total score, milk group, meat group, all fruit and vegetable, vitamin A subgroup of fruit and vegetable, vitamin C subgroup of fruit and vegetable, and enriched bread and cereal; and (b) each of nine variables of the NVM including total score, protein, calcium, iron, vitamin A, thiamin, riboflavin, ascorbic acid, and kilocalories.

CHAPTER IV

FINDINGS

This study was concerned with testing the means of assessing the dietary adequacy of foods consumed by students enrolled in the Basic Human Nutrition class at Oklahoma State University during the years 1974 through 1976. The criterion was the Nutritive Value Method (NVM) of assessment. This chapter will discuss: (1) internal consistency within FSSC, (2) internal consistency within NVM, (3) concurrent validity of FSSC, (4) comparisons of groups on dietary adequacy by FSSC, (5) comparisons of groups on dietary adequacy by NVM, and (6) adequacy of diets.

Internal Consistency Within FSSC

Intercorrelations among the seven components of the FSSC were computed using the data from all 526 subjects. The correlation matrix shown in Table III was used in testing the reliability (internal consistency) of the FSSC.

Since the total score represents the sum of scores on all other components of this matrix, the correlations between total score and its various components are spurious. The method for scoring is explained in Chapter III under Instrumentation and indicates the components do not receive equal weights. The meat group can contribute 30 percent of the total score while the milk group and bread and cereal group can each

TABLE III

INTERCORRELATIONS AMONG GROUPS AND SUBGROUPS OF THE FSSC METHOD

FSSC	Total Score	Milk	Meat	Fruits and Vegetables: All	Fruits and Vegetables: Vitamin A	Fruits and Vegetables: Vitamin C	Breads and Cereals
Total Score:							
Milk Group	.62***						
Meat Group	.62***	.19***					
All Fruits and Vegetables	.44***	.07	.11				
Vitamin A Subgroup of Fruits and Vegetables Group	.46***	.16**	.10	.29***			
Vitamin C Subgroup of Fruits and Vegetables Group	.53***	.05	.12*	.55***	.28***		
Bread and Cereal Group	.52***	.20***	.21***	-.02	-.02	.09	

*p $\leq$ .01.

**p $\leq$ .001.

***p $\leq$ .0001.

contribute 20 percent. The all fruits and vegetable group includes the subgroups for vitamin A and vitamin C; therefore, the correlations between all fruits and vegetables group and vitamin A and vitamin C subgroups are spurious. It appears that each food group and subgroup is making a contribution to the total score and that significant and meaningful relationships exist. Meaningful relationships are those above .40 which is a number arbitrarily selected by the researcher for this study. A correlation of .40 indicates that 16 percent of the variance of the two variables is in common.

The intercorrelations among the food groupings indicate no meaningful relationships excluding the spurious correlations. Although some of the correlations of .21 or less were significantly different from zero as shown in Table III, they are not of significant magnitude to indicate meaningful relationships. They indicate that four percent or less of the variance is in common between the two variables. Foods consumed in one food group do not relate to food consumed in another food group. Each food group is independent of the other food groups. Empirically, it can be said that a total score for FSSC is a sum of unrelated scores depicting different aspects of one day's food consumption of various individuals. It can be concluded that the FSSC does not have internal consistency.

At the time of this study, the amount of nutrition education background of the subjects was unknown. Assuming that each subject had been exposed to the Four Food Groups concept at some time, this study indicated that nutritional knowledge is not utilized in food selection. To the extent that the subjects of this study represent the "educated type of individual," it can be concluded that nutrition education methods dealing with the Four Food Group concept have not succeeded in achieving practical application.

Internal Consistency Within NVM

Intercorrelations among the nine components of the NVM were computed using the data from all 526 subjects. The correlation matrix shown in Table IV was used in testing the reliability (internal consistency) of the NVM.

The total score represents the sum of scores on all other components of this matrix except kilocalories. All components have equal weighting in the total score since the total score is a mean of the scores on the eight nutrients of the original data. Niacin, one of the eight nutrients, was not included in Table IV because it is generally not lacking in the subjects' dietary intakes due to the amount of protein consumed. All scores for each nutrient were based on the percentage of the RDA for that nutrient and calculated as no more than 100 percent. The correlations between total score and each of the seven nutrients are spurious; however, each component appears to contribute meaningfully to the total score.

The kilocalories score is based on the percentage of the estimated energy needs of the subject and is not a part of the RDA. The five components, iron, calcium, riboflavin, total score and thiamin, have a meaningful relationship to kilocalories with 23 percent or more of the variance in common. None of the other components has a meaningful relationship with kilocalories although the correlations are significantly different from zero.

TABLE IV

INTERCORRELATIONS AMONG VARIABLES OF THE NVM[a]

NVM	Total Score	Kilocalories	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Ascorbic Acid
<u>Total Score</u>:									
Kilocalories	.59								
Protein	.56	.37							
Clacium	.75	.50	.44						
Iron	.70	.48	.34	.46					
Vitamin A	.69	.35	.26	.46	.33				
Thiamin	.81	.60	.45	.58	.53	.49			
Riboflavin	.83	.52	.55	.90	.51	.49	.67		
Ascorbic Acid	.60	.24	.26	.21	.28	.50	.45	.28	

[a]All correlations are significantly different from zero at or beyond the .001 level.

The intercorrelations among the seven nutrients in Table IV indicate that 14 of the 21 relationships are meaningful; that is, above .40, a number arbitrarily selected by the researcher. Protein correlates meaningfully with three of six nutrients. These are calcium, thiamin, and riboflavin. Calcium has meaningful relationships with four of five nutrients. Iron has meaningful relationships with three of five nutrients.

Vitamin A correlates meaningfully with three nutrients, thiamin, riboflavin, and ascorbic acid, with 24 percent or more of the variance in common. Thiamin correlates meaningfully with three nutrients, riboflavin, calcium and iron. Riboflavin correlates meaningfully with five nutrients. The riboflavin to calcium relationship has 90 percent of the variance in common. Ascorbic acid correlates meaningfully with the nutrients, vitamin A and thiamin. Other nutrients do not have meaningful interrelationships.

Concurrent Validity of FSSC

The concurrent validity of the FSSC was examined by determining the extent to which various components of the FSSC predict relevant components of the NVM which is used as the criterion and is assumed to be valid. Regression analysis was used to test the following hypotheses:

H_1: The various scores of components of the FSSC method do not predict the scores on relevant components of the NVM as follows:

FSSC Components	NVM Components
a. total dietary score	a_1. the total score mean of all scores a_2. the kilocalorie value
b. Milk Group score	b_1. calcium score b_2. riboflavin score b_3. kilocalorie value
c. Meat Group score	c_1. protein score c_2. iron score c_3. thiamin score c_4. kilocalorie value
d. All Fruit and Vegetable Group Score	d. kilocalorie value
e. vitamin A subgroup of the Fruit and Vegetable Group score	e_1. vitamin A score e_2. kilocalorie value
f. vitamin C subgroup of the Fruit and Vegetable Group score	f_1. vitamin C score f_2. kilocalorie value
g. Enriched Bread and Cereal Group score	g_1. iron score g_2. thiamin score g_3. kilocalorie value

The findings of the regression analyses involving all variables are summarized in Tables V, VI, and VII. Each subhypothesis is discussed. The significance of the effect of fitting the regression line is summarized in Appendix D (Table XIX). (For intercorrelations among components of FSSC and NVM, see Appendix E, Table XX.) A significant F value indicates that the regression analysis contributes some information and that a relationship exists between the two variables but the relationship is not necessarily linear. The F test alone does not provide enough information on which to judge the validity of the FSSC. The additional data regarding the precision of the prediction of the NVM from the FSSC are provided in the discussions for each of the components. Two of the criteria used in combination are the magnitudes

TABLE V

RESULTS OF REGRESSION ANALYSES FOR ALL SUBJECTS[a]

Predictor from FSSC	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Total Score	Total Score[b]	25.54	.76	.69	53.50	1159.78	.0001*
	Kilocalories	6.51	.97	.32	410.04	249.73	.0001*
Milk Group	Calcium[b]	29.94	3.43	.81	96.28	2264.38	.0001*
	Riboflavin[b]	54.10	2.24	.62	110.03	853.54	.0001*
	Kilocalories	53.31	1.66	.16	507.31	101.37	.0001*
Meat Group	Protein	84.66	.53	.19	39.66	121.93	.0001*
	Iron	14.05	1.86	.27	325.72	180.67	.0001*
	Thiamin	44.79	1.33	.18	264.97	114.29	.0001*
	Riboflavin	57.12	1.17	.15	244.95	94.78	.0001*
	Kilocalories	33.39	1.75	.16	505.78	103.26	.0001*
All Fruits and Vegetables Group	Kilocalories	63.16	1.64	.02	591.96	11.94	.0006*
Vitamin A Subgroup of Fruits and Vegetables Group	Vitamin A	61.12	3.98	.37	305.92	305.96	.0001*
	Kilocalories	75.23	.60	.01	601.37	3.56	.06
Vitamin C Subgroup of Fruits and Vegetables Group	Ascorbic Acid[b]	62.14	3.89	.53	208.75	598.72	.0001*
	Kilocalories	70.77	1.00	.03	589.73	13.97	.0002*

TABLE V (Continued)

Predictor from FSSC	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Bread and Cereal Group	Iron	36.37	1.57	.13	381.89	77.02	.0001*
	Thiamin	54.29	1.56	.17	267.95	107.21	.0001*
	Riboflavin	70.68	1.02	.08	265.72	46.40	.0001*
	Kilocalories	41.14	2.36	.21	480.18	136.71	.0001*

[a]N = 526.

[b]Validity of the relevant FSSC is accepted as a predictor.

*Significant at the .01 level or beyond.

TABLE VI

RESULTS OF REGRESSION ANALYSES FOR FEMALE SUBJECTS[a]

Predictor from FSSC	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Total Score	Total Score[b]	25.57	.75	.68	54.87	973.59	.0001*
	Kilocalories	5.55	.99	.34	390.85	235.13	.0001*
Milk Group	Calcium[b]	29.60	3.42	.80	104.03	189.73	.0001*
	Riboflavin[b]	53.79	2.26	.61	120.07	714.34	.0001*
	Kilocalories	52.98	1.65	.17	490.14	93.81	.0001*
Meat Group	Protein	83.96	.56	.20	43.52	112.96	.0001*
	Iron	20.53	1.43	.24	219.29	144.29	.0001*
	Thiamin	44.84	1.33	.18	273.65	99.77	.0001*
	Riboflavin	57.24	1.13	.14	262.80	75.99	.0001*
	Kilocalories	33.41	1.73	.17	489.13	95.26	.0001*
All Fruits and Vegetables Group	Kilocalories	63.45	1.46	.02	579.62	8.42	.004*
Vitamin A Subgroup of Fruits and Vegetables Group	Vitamin A	60.37	4.09	.38	303.50	285.32	.0001*
	Kilocalories	74.07	.57	.01	586.54	2.88	.09
Vitamin C Subgroup of Fruits and Vegetables Group	Ascorbic Acid[b]	59.86	4.13	.57	201.64	605.58	.0001*
	Kilocalories	69.11	1.06	.03	572.90	13.92	.0002*

TABLE VI (Continued)

Predictor from FSSC	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Bread and Cereal Group	Iron	39.76	1.06	.09	262.20	45.24	.0001*
	Thiamin	54.06	1.56	.17	276.70	93.59	.0001*
	Riboflavin	71.23	.93	.06	286.36	31.80	.0001*
	Kilocalories	41.84	2.28	.20	470.14	117.73	.0001*

[a]N = 463.

[b]Validity of the relevant FSSC is accepted as a predictor.

*Significant at the .01 level or beyond.

TABLE VII

RESULTS OF REGRESSION ANALYSES FOR MALE SUBJECTS[a]

Predictor from FSSC	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Total Score	Total Score[b]	42.05	.59	.58	31.78	84.71	.0001*
	Kilocalories	21.98	.79	.12	563.69	8.51	.0049*
Milk Group	Calcium[b]	46.11	2.70	.85	18.93	358.75	.0001*
	Riboflavin[b]	64.97	1.72	.59	30.58	89.54	.0001*
	Kilocalories	69.48	.95	.02	628.56	1.34	.25
Meat Group	Protein	101.54	-.07	.01	7.58	.43	.52
	Iron	79.99	.59	.09	38.00	5.85	.02
	Thiamin	50.46	1.16	.06	206.95	4.21	.04
	Riboflavin	94.49	.03	.001	75.70	.01	.93
	Kilocalories	57.67	1.00	.02	631.70	1.03	.32
All Fruits and Vegetables Group	Kilocalories	60.72	3.03	.08	592.08	5.18	.03
Vitamin A Subgroup of Fruits and Vegetables Group	Vitamin A	66.22	3.26	.29	316.42	24.47	.0001*
	Kilocalories	83.34	1.00	.02	630.37	1.16	.29
Vitamin C Subgroup of Fruits and Vegetables Group	Ascorbic Acid[b]	76.27	2.43	.36	190.07	34.26	.0001*
	Kilocalories	81.20	.84	.02	629.63	1.23	.27

TABLE VII (Continued)

Predictor FSSC Score	Criterion from NVM	Intercept	Slope	R^2	Mean Square Error S^2	F	Significance Level
Bread and Cereal Group	Iron	86.97	.54	.08	38.32	5.29	.02
	Thiamin	63.13	1.14	.07	206.63	4.31	.04
	Riboflavin	82.50	.71	.075	70.00	4.97	.03
	Kilocalories	37.90	2.69	.13	560.78	8.87	.004*

[a]N = 63.

[b]Validity of the relevant FSSC is accepted as a predictor.

*Significant at the .01 level or beyond.

for R^2 and mean square for error. The higher the R^2, the higher the percentage of variance explained by the regression line; the lower the mean square for error the smaller the prediction error.

Total Dietary Score

The regression line for the total score on the FSSC and NVM is shown in Figure 1. The regression line plotted in Figure 1 is expressed by the formula Y = .76 (X) + 25.54. From this figure it can be seen that there is a relationship (r = .83) between the total scores attained from the two methods.

Table V shows the regression analysis for total score (FSSC) as a predictor of total score (NVM) resulted in an intercept of 25.54 and a slope of .76. The R^2 of .69 indicates that 69 percent of the variance for the NVM total score is explained by fitting this regression line.

If there had been a perfect relationship, the intercept would be at 0 and the slope would be 1 with the regression equation expressed as Y = 1 (X) + 0. Based upon the magnitudes of R^2 and mean square for error, the FSSC method of obtaining the total score was accepted as a valid measure of dietary adequacy.

Of the 526 total subjects of this study, 463 were females and 63 were males. Table VI shows the results of the regression analysis on total score for females were similar to the results for all subjects. The validity of the FSSC in terms of the total score for females can be accepted.

Table VII shows the regression analysis for male subjects. The magnitude of R^2 and mean square for error is such that the FSSC total score is accepted as a valid measure of dietary adequacy.

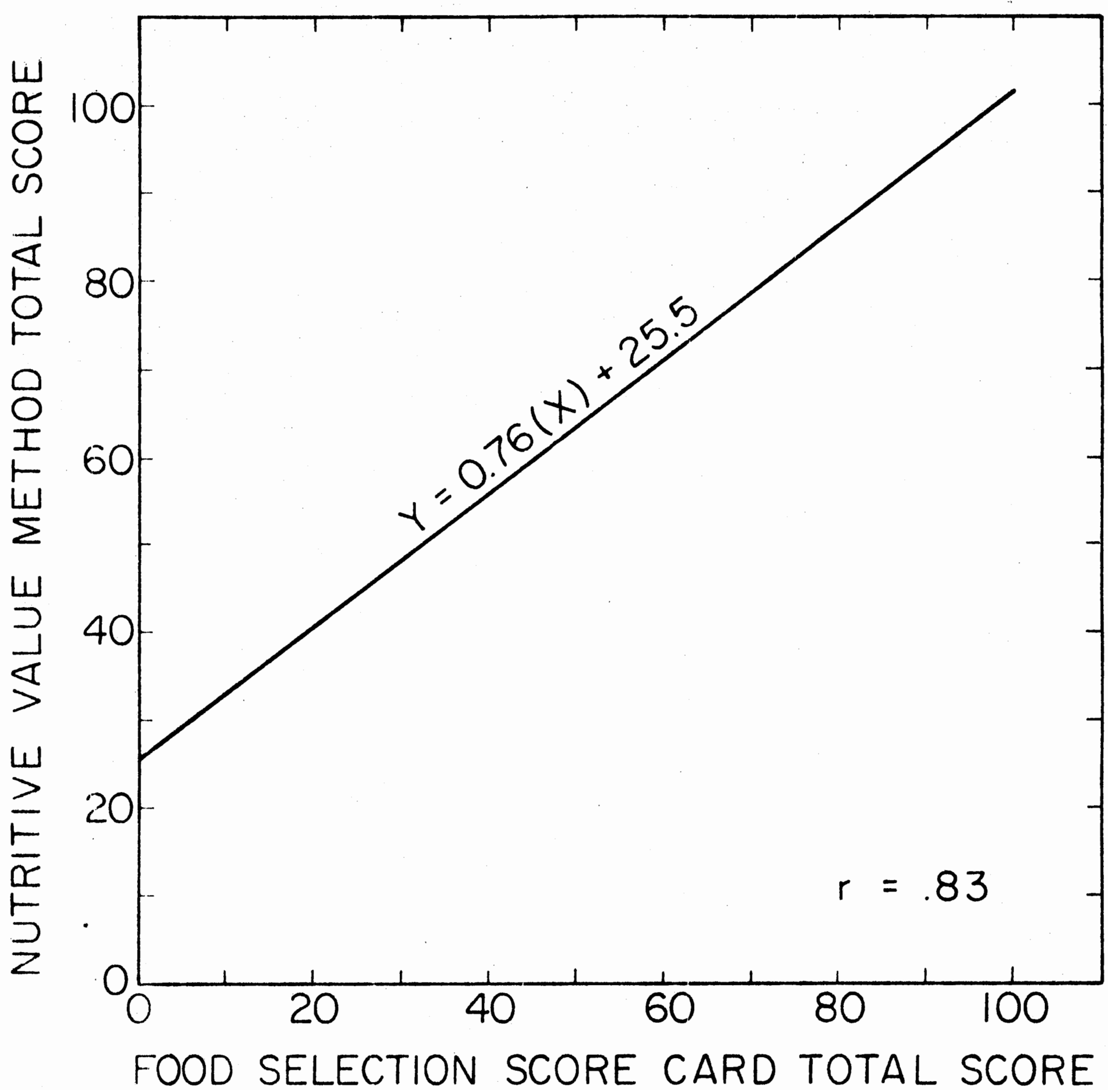

Figure 1. Regression Line for Total Scores

Milk Group Score

The relationship between the milk group of the FSSC and the calcium of the NVM is shown in the regression analysis in Table V. This regression analysis for predicting the calcium scores (NVM) from the milk group score (FSSC) resulted in an intercept of 29.94 and a slope of 3.43. The R^2 of .81 indicates that 81 percent of the variance on the calcium (NVM) is explained by fitting this regression model. The F value of 2264.38, significant at the .0001 level, indicates a significant effect from fitting the regression line and that some relationship does exist. Based upon the magnitudes of R^2 and mean square for error, the FSSC method of scoring the milk group is accepted as a valid measure reflecting the adequacy of calcium intake.

Table VI shows the results of the regression analysis for females were similar to the results for all subjects. The validity of the FSSC milk group score for reflecting the adequacy of calcium intake is accepted.

Table VII shows the regression analysis for male subjects. The magnitude of R^2 and mean square for error is such that the milk group FSSC is accepted as a valid measure of calcium intake.

The regression line for FSSC milk group and the NVM riboflavin is shown in the regression analysis in Table V. The R^2 of .62 indicates that 62 percent of the variance on the milk group is explained by fitting this regression model. The F value of 853.54, significant at the .0001 level, indicates a significant effect from fitting the regression line and that some relationship exists. Based upon the magnitude of R^2 and the mean square for error, the FSSC method for scoring the milk group is accepted as a valid measure reflecting the adequacy of riboflavin intake.

The regression analysis for females (Table VI) was similar to the analysis for all subjects. The validity of the FSSC milk group score for reflecting the adequacy of riboflavin intake is accepted for females.

Table VII shows the regression analysis results for male subjects. The magnitude of R^2 and mean square for error is such that the milk group is accepted as a valid measure of riboflavin intake. The regression analysis for all subjects by sex is summarized in Appendix D (Table XIX).

Based upon the magnitude of R^2 and the mean square of error, the FSSC method for scoring the milk group is not accepted as a valid measure for reflecting the adequacy of kilocalorie intake as shown in Tables V, VI, and VII.

Meat Group Score

Table V shows the results of the regression analysis for the meat group of the FSSC and for five variables of the NVM with a range of R^2 from .15 to .27. This indicates that 27 percent or less of the variance for each of the five variables (NVM) was explained by fitting this regression model to the meat group score. The F values range from 94.78 to 180.67, are significant at the .0001 level, and indicate a significant effect from fitting the regression lines. A relationship does exist for each NVM variable. Based upon the magnitudes of R^2 and the mean square for error, the FSSC method of scoring the meat group is rejected as a valid measure for reflecting intakes of the five variables, protein, iron, thiamin, riboflavin, and kilocalories.

Table VI shows the results of the regression analysis for females were similar to the results for all subjects. The validity of the FSSC in terms of the meat group score for reflecting the adequacy of the five variables for females is rejected.

Table VII shows the regression analysis for male subjects. The magnitudes of R^2 and mean square for error are such that the meat group is rejected as a valid measure of the five variables of the NVM for males. These regression analyses are summarized in Appendix D (Table XIX).

Fruit and Vegetable Group Score

This group is subdivided into three parts which include: (1) all fruits and vegetables, (2) vitamin A subgroup, and (3) vitamin C subgroup. Each of these subdivisions is examined separately.

All Fruits and Vegetables Subgroup. The results of the regression line for all fruits and vegetables group of the FSSC and the kilocalories of the NVM are shown in Table V. The R^2 of .02 indicates that less than two percent of the variance on the kilocalories is explained by fitting this regression model. Based upon the magnitudes of R^2 and the mean square for error, the FSSC method of scoring the all fruits and vegetables group for reflecting kilocalories intake is rejected.

Table VI shows the results of the regression analysis for females were similar to the results for all subjects. The validity of the FSSC in terms of all fruit and vegetable group for reflecting adequacy of kalocalorie intake for females is rejected.

Table VII shows the regression analysis for male subjects. The magnitude of R^2 and mean square for error are such that the "all fruit and vegetable group" is rejected as a valid measure of kilocalorie intake. This regression analysis is summarized in Appendix D (Table XIX).

<u>Vitamin</u> <u>A</u> <u>Subgroup</u>. The results of the regression analysis for the vitamin A subgroup of the FSSC and two variables of the NVM, vitamin A and kilocalories are shown in Table V. The R^2 of .37 indicates that 37 percent of the variance on the vitamin A is explained by fitting this regression model. The F value of 305.96, significant effect from fitting the regression line and that some relationship does exist. Based upon the magnitudes of R^2 and the mean square for error, the FSSC method of scoring vitamin A subgroup is rejected as a valid measure reflecting the adequacy of intakes of vitamin A.

Table VI shows the results of the regression analysis for females were similar to the results for all subjects. The validity of the FSSC in terms of the vitamin A subgroup score for reflecting adequacy of vitamin A intake is rejected.

Table VII shows the results of the regression analysis for male subjects. The magnitude of R^2 and mean square for error is such that vitamin A (FSSC) is rejected as a valid measure of vitamin A intake.

The regression analysis for FSSC vitamin A subgroup and the NVM kilocalories is shown in the regression analysis in Table V. The R^2 of .01 indicates that no relationship exists. This lack of relationship was shown for both female and male subjects and is summarized in Appendix D (Table XIX). Based upon the magnitudes of R^2 and the mean square for error, the FSSC method for scoring vitamin A subgroup is rejected as a valid measure reflecting the adequacy of the kilocalorie score.

Vitamin C Subgroup. The results of the regression analysis for vitamin C subgroup of the FSSC and the two variables of the NVM, ascorbic acid and kilocalories, are shown in Table V. The R^2 of .53 indicates that 53 percent of the variance on the vitamin C is explained by fitting this regression model. The F value of 598.72, significant at the .0001 level, indicates a significant effect from fitting the regression line and that some relationship does exist. Based upon the magnitudes of R^2 and the mean square for error, the FSSC method of scoring vitamin C subgroup is accepted as a valid measure reflecting adequacy of intake of ascorbic acid.

Table VI shows the results of the regression analysis for females were similar to the results for all subjects. The validity of the FSSC in terms of the vitamin C subgroup score for reflecting adequacy of ascorbic acid intake is accepted for females.

Table VII shows the results of the regression analysis for male subjects. The magnitude of R^2 and mean square for error are such that the vitamin C of the FSSC is accepted as a valid measure of ascorbic acid intake for males.

The regression analysis for FSSC vitamin C subgroup for NVM kilocalories is shown in Table V. The R^2 of .03 indicates that no relationship exists. This lack of relationship is shown for both female and male subjects and is summarized in Appendix D (Table XIX). Based upon the magnitudes of R^2 and the mean square for error, the FSSC method for scoring vitamin C subgroup is rejected as a valid measure reflecting the adequacy of the kilocalorie score.

Enriched Bread and Cereal Group

The results of regression analyses for the enriched bread and cereal group of the FSSC and the four variables of the NVM including a range of R^2 from .08 to .21 are shown in Table V. They indicate that less than 21 percent of the variance on any of the four variables is explained by fitting the regression model. Based upon the magnitude of R^2 and the mean square for error, the FSSC method of scoring enriched bread and cereal group is rejected as a valid measure of the intakes of four variables, iron, thiamin, riboflavin and kilocalories.

Table VI shows the results of the regression analyses for females were similar to the results for all subjects. The validity of the FSSC in terms of the enriched bread and cereal score for reflecting adequacy of the intake of four variables is rejected.

Table VII shows the results of the regression analyses for male subjects. The magnitude of R^2 and mean square for error are such that the enriched bread and cereal group of the FSSC is rejected as a valid measure of intakes of four variables. These regression analyses are summarized in Appendix D (Table XIX).

Comparing Groups on Dietary Adequacy by FSSC

Although only four NVM criteria were validly predicted by the relevant FSSC components, the dietary adequacy of the subjects grouped by sex, age and year of participation in the study was examined. The FSSC indicated the amounts of foods consumed by each FSSC grouping as accurately as was possible within the limitations of this study.

Although the other NVM criteria were not validly predicted by the relevant FSSC components, these criteria are included because they are supplied in the foods consumed in lesser amounts than anticipated. With this information the FSSC can be evaluated for revision.

Hypotheses tested were as follows:

H_2: There is no difference in the FSSC scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 and 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters)

This set of hypotheses was examined by analyses of variance which tested for systematic variations among and between groups. Results for H_2a and H_2b are shown in Table VIII. The hypotheses expressed in H_2a and H_2b were tested in a series of analyses of variance that took both sex and age into account for each component of the FSSC. H_2c was tested in another series of analyses of variance.

Sex Groups and Age Groups

Table VIII reveals that the analyses of variance between sexes and age groups on all the variables of the FSSC method do not show any

TABLE VIII

ANALYSES OF VARIANCE BY SEX AND AGE GROUPS ON ALL VARIABLES OF THE FSSC METHOD

Variable	Source of Variance	df	Mean Square	F[a]
Milk Group	Sex	1	24.38	.51
	Age	3	.31	.01
	Sex x Age	3	.88	.02
	Residual	1044	47.73	
Meat Group	Sex	1	32.66	.07
	Age	3	.89	.02
	Sex x Age	3	.38	.01
	Residual	1044	48.44	
Vitamin A Subgroup of Fruit and Vegetable Group	Sex	1	.14	.01
	Age	3	.20	.01
	Sex x Age	3	.33	.02
	Residual	1044	20.69	
Vitamin C Subgroup of Fruit and Vegetable Group	Sex	1	.38	.02
	Age	3	.77	.03
	Sex x Age	3	.82	.04
	Residual	1044	22.33	
Bread and Cereal Group	Sex	1	21.07	.63
	Age	3	.26	.01
	Sex x Age	3	.33	.01
	Residual	1044	33.43	
Total Score	Sex	1	198.68	.77
	Age	3	3.89	.02
	Sex x Age	3	6.53	.02
	Residual	1044	257.90	

[a]None of the F values is significant at the .01 level.

significant sources of variance. There were no significant differences between the males and females nor between the age groups on intakes of any of the food groups as assessed by the FSSC method. Therefore, hypotheses H_2a and H_2b are not rejected.

Table IX shows the means for this sample for all variables of the FSSC by age and sex. A graphic illustration of the mean scores on these components by sex and age are shown in Figure 2. It can be observed that there is some degree of variation in the actual means for this sample. The males in this study had a higher mean score for milk, meat, and bread and cereal groups. Females had a slightly higher mean score for vitamin A and vitamin C. However, these apparent differences can be attributed to sampling error.

It can be observed that in this study the 19-year-old females have the lowest mean total score. The 19-year-old males have the highest mean total score as well as the highest mean scores for all of the components of the FSSC except for the bread and cereal group which is highest for the 20-year-old males. Yet, the 20-year-old males have the lowest mean total score. None of these apparent differences between means in this study is significant at the .01 level. Figures 3 and 4 show graphically the variations between age groups in this sample and reflect the lack of significant differences between groups for either males or females. Figure 2 combines the variations for all age groups by sex.

Year Groups

The analyses of variance between year groups on all the variables of the FSSC method, as shown in Table X, reveals significant differences

TABLE IX

MEANS FOR ALL VARIABLES OF THE FSSC BY AGE AND SEX

Sex	N	Age	Milk Group (20)[c]	Meat Group (30)	Fruits and Vegetables All (10)	Fruits and Vegetables Vitamin A (10)	Fruits and Vegetables Vitamin C (10)	Bread and Cereal Group (20)	Total Score (100)
F	142	18	14.29	25.76	8.26	2.69	6.38	15.22	72.51
F	164	19	13.28	23.93	8.52	3.07	6.38	14.75	69.85
F	105	20	13.40	23.89	8.75	3.64	6.48	15.15	71.30
F	52	21	15.38	24.11	8.59	3.44	6.24	13.94	71.50
M	20	18	17.78	28.88	8.93	2.75	6.25	17.95	82.50
M	16	19	18.19	29.09	9.16	3.44	7.50	17.34	84.78
M	16	20	17.25	27.56	7.63	2.19	4.53	18.44	77.75
M	11	21	17.09	28.32	7.59	3.41	5.45	18.32	80.09
F		-[a]	14.08	24.42	8.50	3.21	6.37	14.77	71.31
M		-[a]	17.57	28.46	8.42	2.95	5.93	18.01	81.28
-[b]		18	16.03	27.32	8.34	2.72	6.32	16.59	77.50
-[b]		19	15.73	26.51	8.58	3.25	6.94	16.05	77.32
-[b]		20	15.32	25.73	8.60	2.92	5.50	16.79	74.52
-[b]		21	16.23	26.21	8.42	3.43	5.85	16.13	75.84

[a]Includes all age groups.

[b]Includes both sexes.

[c]Numbers in parentheses indicate point scores assigned.

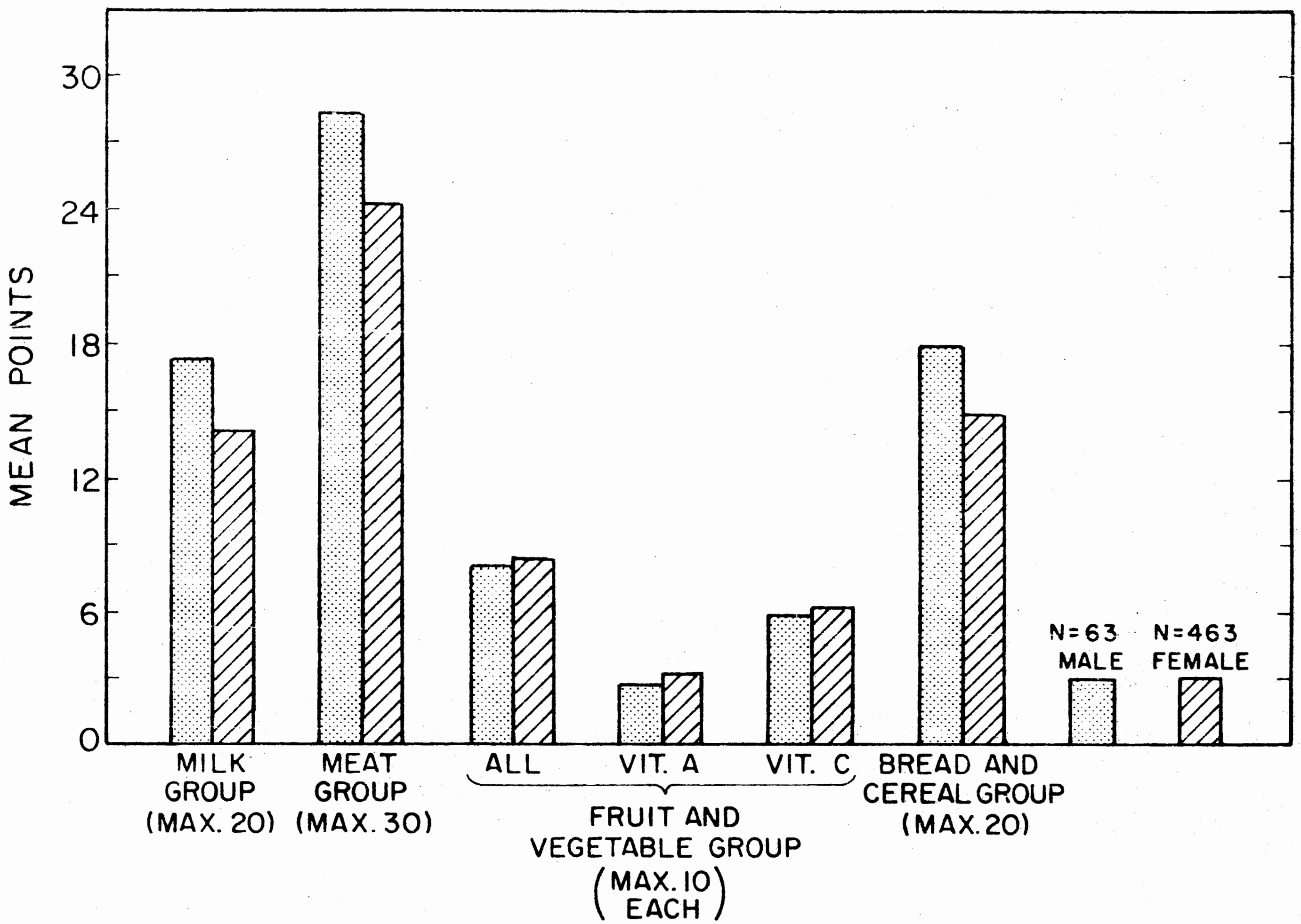

Figure 2. FSSC Mean Scores on All Components by Sex

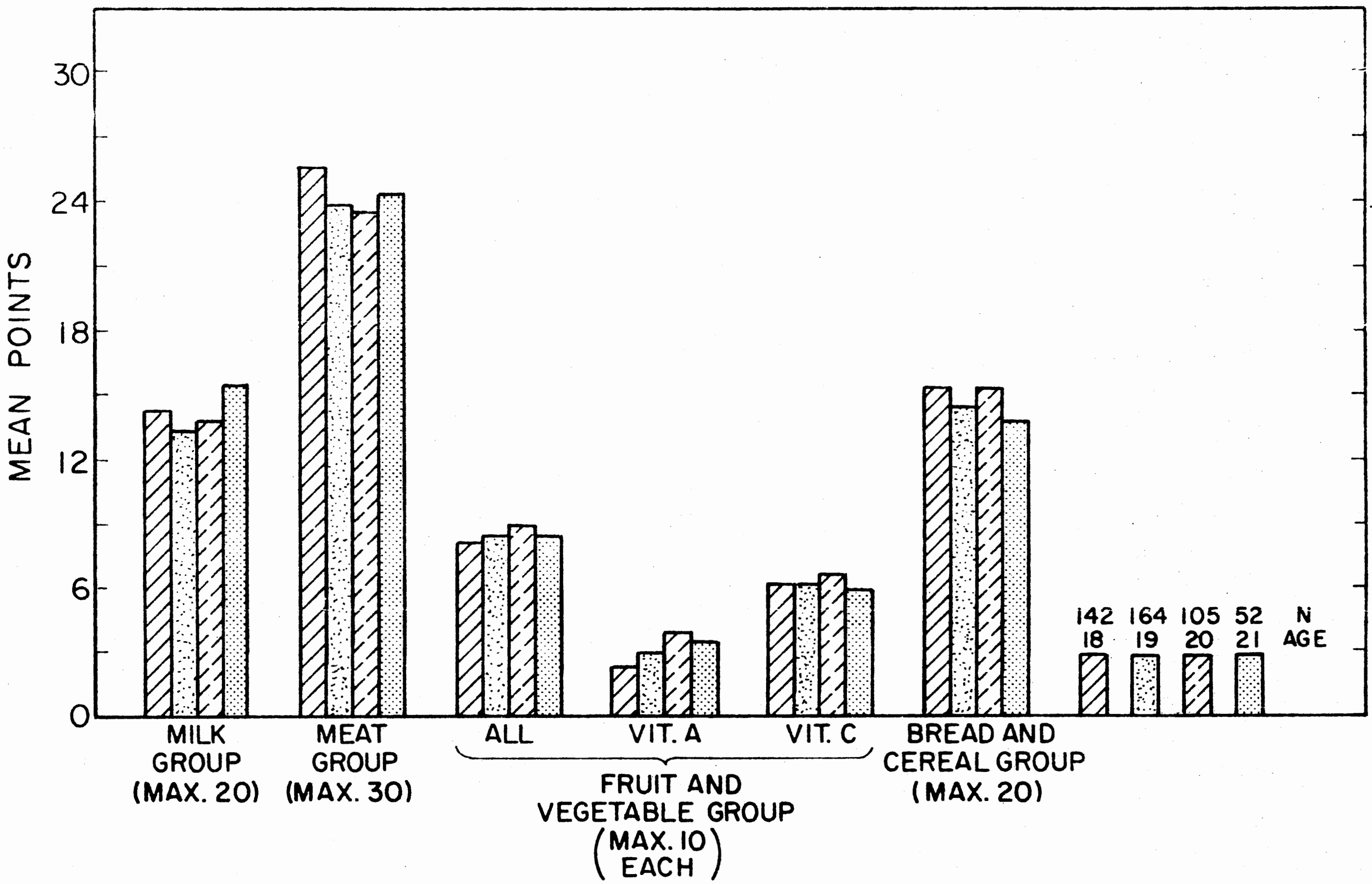

Figure 3. FSSC Mean Scores on All Components for Females by Age Groups

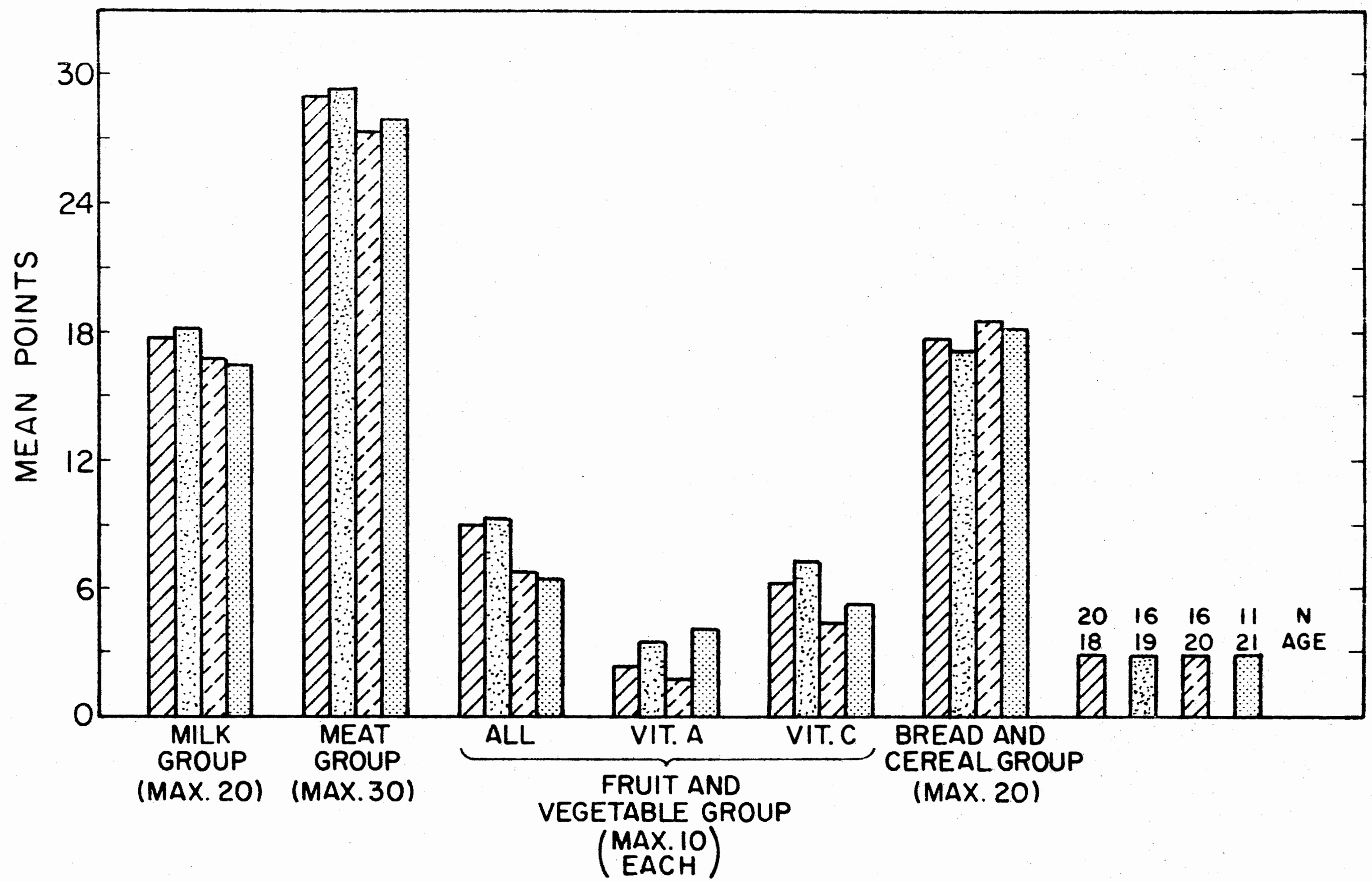

Figure 4. FSSC Mean Scores on All Components for Males by Age Groups

TABLE X

ANALYSES OF VARIANCE BY YEARS ON ALL VARIABLES OF THE FSSC METHOD

Variable	Source of Variance	df	Mean Square	F	Significance Level
Milk Group	Between Years	2	42.85	.87*	.58
	Within Years	1049	49.38		
Meat Group	Between Years	2	9.13	.18	.84
	Within Years	1049	50.54		
Fruit and Vegetable Group					
Vitamin A Subgroup	Between Years	2	177.02	8.67*	.004
	Within Years	1049	20.41		
Vitamin B Subgroup	Between Years	2	117.13	5.28*	.006
	Within Years	1049	22.16		
Bread and Cereal Group	Between Years	2	18.21	.53	.59
	Within Years	1049	34.40		
Total Score	Between Years	2	2094.84	7.88*	.001
	Within Years	1049	265.70		

*Significant at the .01 level or beyond.

between years for vitamin A, vitamin C and for the total score. In Table XI the mean score for each component of the FSSC is shown. Based on an examination of least significant differences, the mean scores for vitamin A, vitamin C, and total scores in 1974 differed significantly from the other years.

TABLE XI

COMPARISON OF MEANS FOR ALL VARIABLES OF THE FSSC BY YEAR

		Milk	Meat	Fruit and Vegetable		Bread and	Total
Year	N	Group	Group	Vitamin A	Vitamin C	Cereal Group	Score
1974	196	14.52	24.96	1.89	5.38	14.88	68.64
1975	420	14.55	25.13	3.41	6.52	15.39	74.24
1976	436	13.96	24.84	3.33	6.61	15.32	72.57
Overall Means							
	1052	14.30	24.98	3.10	6.34	15.27	72.42

The sampling for 1974 differed from the other two years in that the decision was made to include only students whose dietary data records had been recorded on the basis of the new, 1974, RDA. Inclusion of the spring, 1974, subjects would have involved recalculation of the NVM. The RDAs were revised and took effect during the fall semster, 1974. This study did not test for differences between food intakes for the spring semester subjects and the fall semester subjects.

Hypothesis H_2c was not rejected for milk group, meat group and bread and cereal group but was rejected for vitamin A subgroup, vitamin C subgroup, and total score.

Comparing Groups on Dietary Adequacy by NVM

Because the NVM was assumed to be a valid measure of dietary adequacy for this study, the dietary adequacy of the subjects grouped by sex, age, and year of participation in the study was examined.

The hypotheses tested were as follows:

H_3: There is no difference in the NVM scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 and 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters)

This set of hypotheses was examined by analyses of variance which tested for systematic variation among and between groups. Results for H_3a and H_3b are shown in Table XII. The hypotheses expressed in H_3a and H_3b were tested by analyses of variance that took both variables of

TABLE XII

ANALYSES OF VARIANCE BY SEX AND AGE GROUPS ON ALL VARIABLES OF THE NVM

Variable	Source of Variance	df	Mean Square	F
Protein	Sex	1	6.05	.08
	Age	3	.44	.01
	Sex x Age	3	.29	.004
	Residual	1044	73.06	
Calcium	Sex	1	523.50	.79
	Age	3	3.26	.005
	Sex x Age	3	7.92	.01
	Residual	1044	659.64	
Iron	Sex	1	3301.84	9.03*
	Age	3	.42	.001
	Sex x Age	3	4.75	.01
	Residual	1044	365.69	
Vitamin A	Sex	1	7.10	.01
	Age	3	13.06	.02
	Sex x Age	3	8.85	.01
	Residual	1044	764.26	
Thiamin	Sex	1	76.33	.17
	Age	3	2.22	.005
	Sex x Age	3	4.59	.01
	Residual	1044	458.84	
Riboflavin	Sex	1	185.94	.48
	Age	3	.20	.001
	Sex x Age	3	8.96	.02
	Residual	1044	388.30	
Niacin	Sex	1	55.40	.13
	Age	3	4.79	.01
	Sex x Age	3	2.73	.01
	Residual	1044	440.07	
Ascorbic Acid	Sex	1	26.10	.04
	Age	3	22.64	.04
	Sex x Age	3	38.98	.06
	Residual	1044	630.37	

TABLE XII (Continued)

Variable	Source of Variance	df	Mean Square	F
Total Score	Sex	1	223.13	1.05
	Age	3	.66	.003
	Sex x Age	3	3.46	.02
	Residual	1044	211.63	
Kilocalories	Sex	1	276.70	.38
	Age	3	12.69	.001
	Age x Sex	3	26.72	.04
	Residual	1044	731.92	

*Significant at the .01 level or beyond. This same identification is used on all tables throughout the dissertation. F .01 (1, 1044) = 6.66; F .01 (3, 1044) = 3.80.

sex and age into account for each component of the NVM. H_3c was tested by analyses of variance for the years.

Sex Groups and Age Groups

Table XII reveals that the analyses of variance between sex groups and age groups on all variables except iron of the NVM do not show any significant differences. The significant difference was expected for iron because the RDA for males is 10 mg. while the RDA for females is 18 mg. The iron RDA for females is 66 percent higher than the RDA for males. Females have more difficulty meeting this RDA than any other RDA for the various nutrients. The RDAs for vitamin A, thiamin, riboflavin, niacin are slightly higher for males than for females (see Appendix B) but the two sexes and age groups did not differ significantly on their scores on these variables. The scores are expressed as percentages of the RDA for the nutrients.

There is no significant interaction between sex groups and age groups on any of the 10 variables. The hypotheses H_3a and H_3b are not rejected with the one exception of iron. There are no significant differences between males and females or between age groups on measures obtained from the NVM except for the significant difference between males and females for iron.

Table XIII shows the mean scores in this sample for all variables of the FSSC by age and sex. A graphic illustration of the mean scores on these components by sex and age are shown in Figures 5, 6, and 7.

Figure 6 shows a comparison of the mean scores in this sample for all variables of the NVM by age of females. The 21-year-old females had the highest mean total score with associated high mean scores for calcium, iron, vitamin A, riboflavin, and ascorbic acid. The 20-year-old females had the lowest total mean score but not necessarily the lowest component mean scores. The average percentage of kilocalories for females decreased somewhat with age. None of these apparent differences were significant, however.

Figure 7 shows a comparison of the mean scores in this sample for all variables of the NVM for males by age. The 19-year-old males had the highest total mean score with associated high scores for calcium, vitamin A, thiamin, and riboflavin. The 21-year-old males had the lowest total mean score with associated lowest mean scores for protein, iron, thiamin, riboflavin, and niacin. Even with these slight variations there were no significant differences between the various age groups.

TABLE XIII

MEANS FOR ALL VARIABLES OF THE NVM BY AGE AND SEX

Sex	Age	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid	Kilo-calories	Total Score
F	18	97.98	78.46	55.65	70.71	79.01	86.25	81.73	85.06	80.94	79.33
F	19	97.95	75.14	54.87	72.79	76.12	83.87	82.90	86.18	75.31	78.55
F	20	97.32	75.40	54.89	74.59	77.13	83.83	80.16	87.53	71.98	79.08
F	21	97.38	81.35	58.37	78.08	76.93	87.79	80.06	87.21	71.55	80.88
M	18	100.00	93.00	96.68	73.35	83.20	94.58	87.03	97.65	82.55	90.50
M	19	99.22	96.19	96.44	80.31	86.81	97.38	87.03	95.41	91.88	92.29
M	20	100.00	92.78	98.50	72.91	82.12	96.31	88.56	81.06	83.25	89.02
M	21	18.36	93.09	94.68	77.14	81.77	92.05	83.05	86.32	89.14	88.29
F	–[a]	97.66	77.59	55.94	74.04	77.30	85.43	81.21	86.50	74.94	79.46
M	–[a]	99.40	93.76	96.57	75.93	83.48	95.08	86.47	90.11	86.70	90.02
–[b]	18	98.99	85.73	76.16	72.03	81.11	90.41	84.49	91.36	81.74	84.91
–[b]	19	98.58	85.66	75.65	76.55	81.47	90.62	84.96	90.79	83.59	85.42
–[b]	20	98.66	84.09	76.69	73.75	79.63	90.07	84.36	84.30	77.61	84.05
–[b]	21	97.87	87.22	76.52	77.61	79.35	89.92	81.55	86.77	80.34	84.58

[a]Includes all age groups.

[b]Includes both sexes.

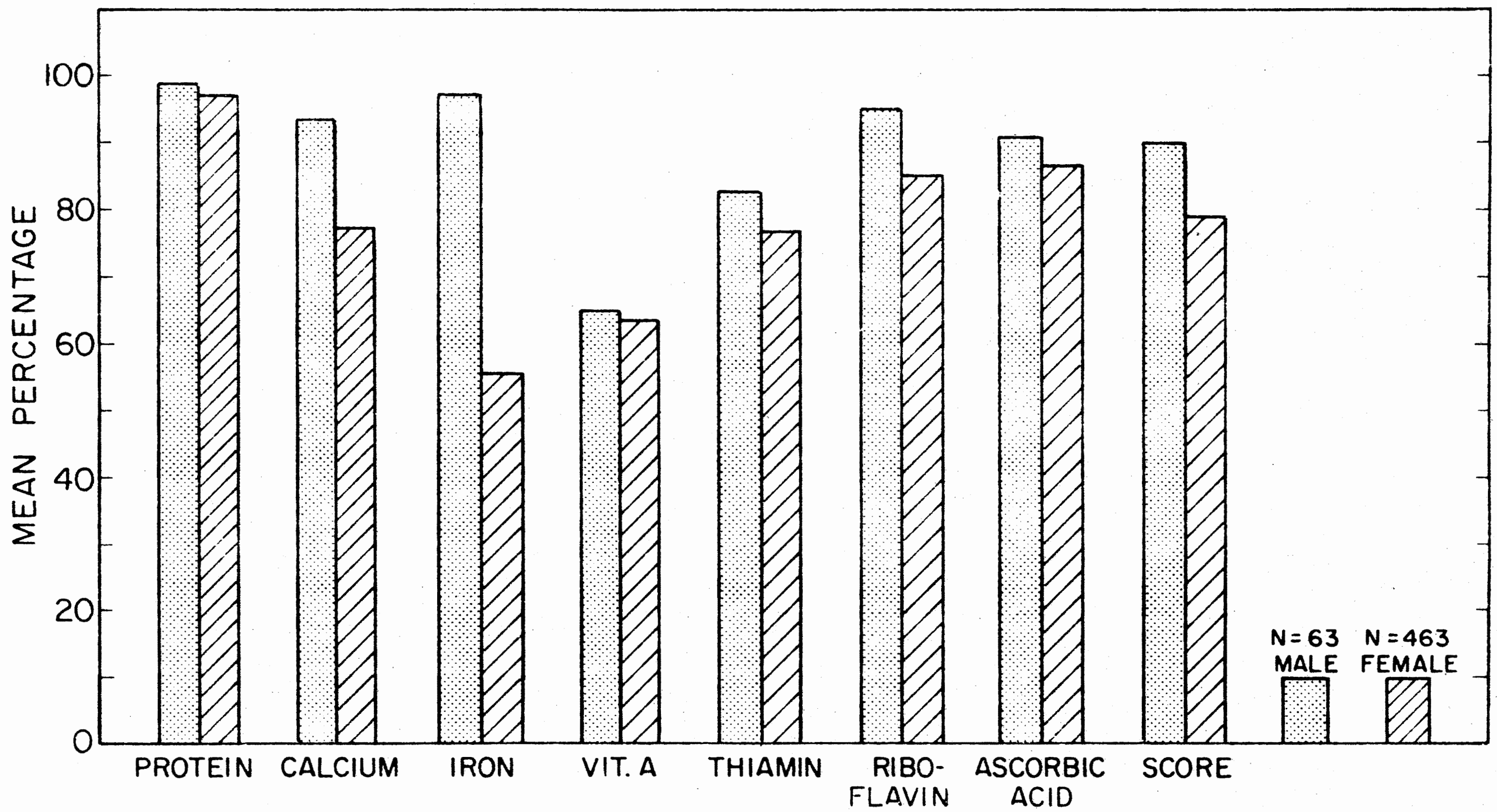

Figure 5. NVM Mean Scores on All Variables by Sex

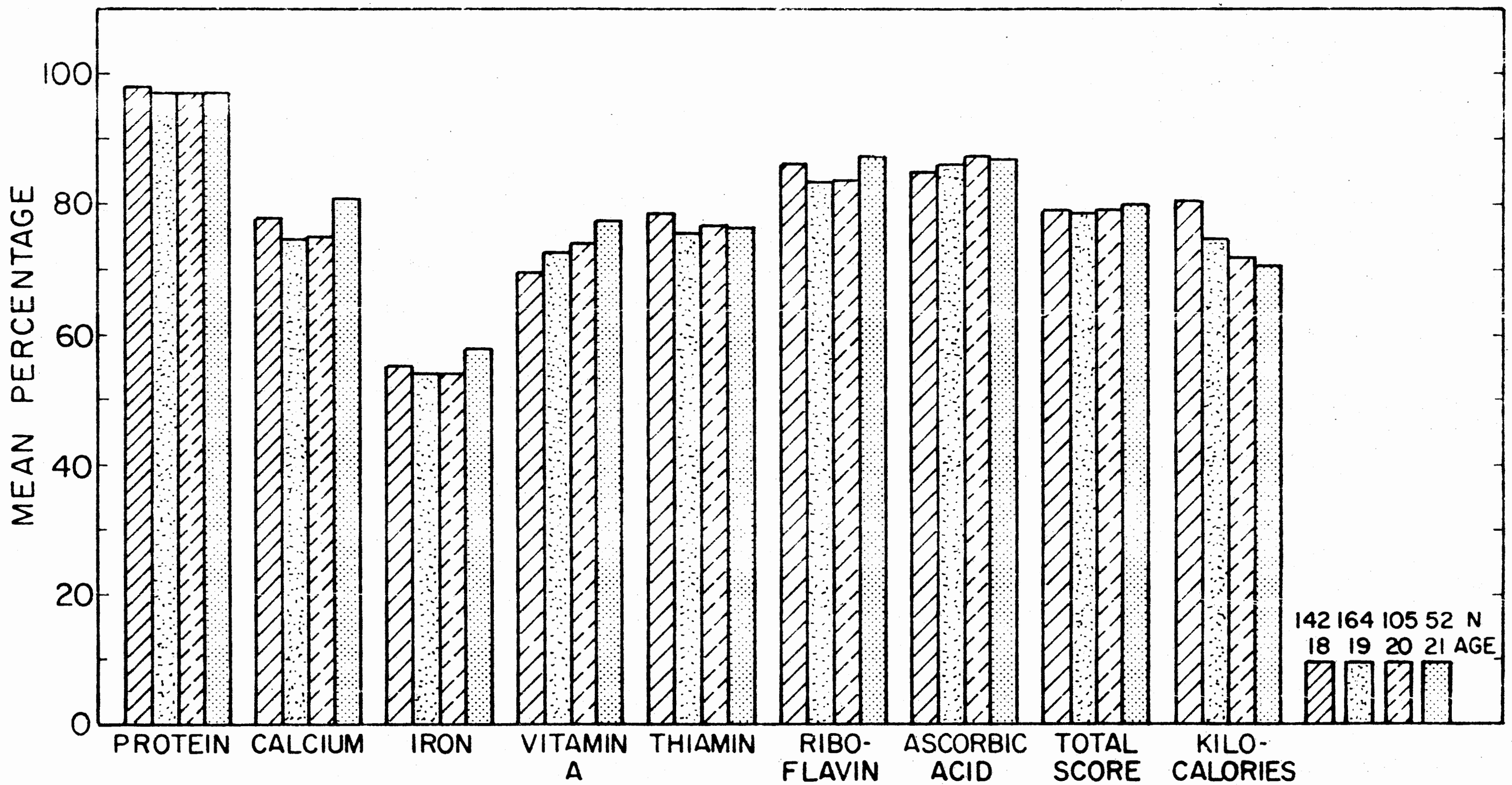

Figure 6. NVM Mean Scores for All Variables for Females by Age

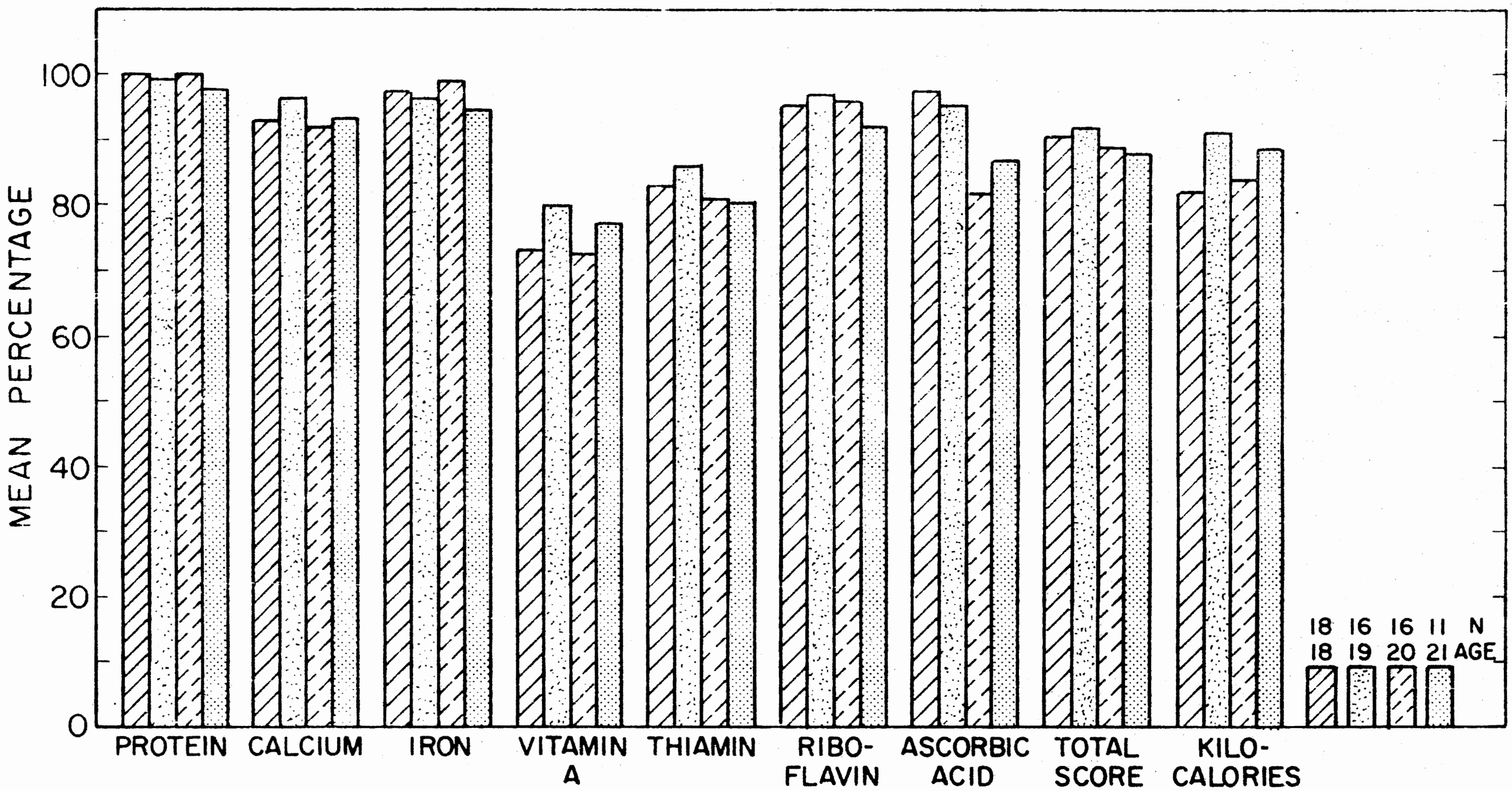

Figure 7. NVM Mean Scores for All Variables for Males by Age

Year Groups

Table XIV shows the results of the one-way analyses of variance for the differences between years on all variables of the NVM. There were significant differences between years for niacin and ascorbic acid. Table XV shows the mean scores for each component of the NVM based on a range of scores from 14 to 100 percent. Again, the one semester used for data from the students of 1974 is the source of the significant differences. The entire year was not used for the data base because the RDAs were revised and became effective during the fall semester, 1974.

Hypothesis H_3c, as it relates to the year groups, is not rejected except for the three components, niacin, ascorbic acid, and kilocalories. The 1975 Health and Nutrition Examination Survey (HANES) indicated that the most prevalent low risk deficiency signs were found due to vitamin C and niacin deficiency.

The significant difference in scores for ascorbic acid between the years is associated with the 1974 subjects. This is consistent with the finding for the vitamin C scores on the FSSC.

Table XV shows the mean scores in this sample for all variables of the NVM by years. It can be observed that there is little variation in these mean scores.

Adequacy of Diets

The adequacy of diets utilizing the FSSC is shown in Table IX. This table reports the mean score for each food group and subgroup by age and sex. The milk group yields a possible score of 20 with a range

TABLE XIV

ANALYSES OF VARIANCE BY YEAR ON ALL VARIABLES OF THE NVM

Variable	Source of Variance	df	Mean Square	F	Significance Level
Protein	Between Years	2	3.81	.05	.95
	Within Years	1049	73.16		
Calcium	Between Years	2	483.24	.70	.50
	Within Years	1049	689.90		
Iron	Between Years	2	169.22	.31	.74
	Within Years	1049	544.53		
Vitamin A	Between Years	2	1140.26	1.49	.22
	Within Years	1049	764.73		
Thiamin	Between Years	2	401.97	.87	.58
	Within Years	1049	461.74		
Riboflavin	Between Years	2	36.15	.09	.91
	Within Years	1049	399.77		
Niacin	Between Years	2	2147.79	4.90**	.01
	Within Years	1049	438.31		
Ascorbic Acid	Between Years	2	2294.15	3.63*	.03
	Within Years	1049	631.80		
Total Score	Between Years	2	92.47	.41	.67
	Within Years	1049	233.95		
Kilocalories	Between Years	2	2760.75	3.69*	.02
	Within Years	1049	748.46		

*Significant at the .05 level or beyond.

**Significant at the .01 level or beyond.

TABLE XV

MEANS FOR ALL VARIABLES OF THE NVM BY YEAR

Year	N	Protein	Calcium	Iron	Vitamin A	Thiamin	Ribo-flavin	Niacin	Ascorbic Acid	Kilo-calories	Total Score
1974	196	98.11	80.34	60.35	70.47	79.72	86.69	78.96	82.85	79.63	79.65
1975	420	97.98	77.84	59.82	74.54	78.13	86.34	84.42	86.74	78.71	80.56
1976	436	97.88	79.35	61.08	73.75	77.29	85.98	81.57	88.67	74.40	80.80
Overall	1052	97.96	78.93	60.44	73.46	78.08	86.26	82.22	86.81	77.10	80.49

of means from 13.28 to 18.19. The meat group yields a possible score of 30 with a range from 23.89 to 29.09. The all fruit and vegetable group yields a possible score of 10 with a range from 8.26 to 9.16. The vitamin A subgroup of the fruit and vegetable group yields a possible score of 10 with a range of means from 2.19 to 3.64. The vitamin C subgroup of the fruit and vegetable group yields a possible score of 10 with a range of means from 4.53 to 7.50. The bread and cereal group yields a possible score of 20 with a range of means from 13.94 to 18.44. The total score which is the summation of all other components, has a possible score of 100 with a range of means from 69.85 to 82.50. The mean scores do not differ significantly by sex. The scores reflect that on the average the subjects are underconsuming the amounts recommended in each group.

The adequacy of diets utilizing the NVM is shown in Table XIII. This table reports the mean percentage of the RDA for each nutrient, for kilocalories, and for the total score by age and sex. The possible score for each nutrient, kilocalories and total score is 100 percent. The range of means for protein was from 97.32 to 100.00. The range of means for calcium was from 75.14 to 96.19. The range of means for iron was from 54.89 to 98.50. The RDA for women is 18 mg. of iron while the RDA for men is 10 mg. and there was a significant difference between the sexes for this one nutrient.

The range of means for vitamin A was from 70.71 to 80.31. The range of means for thiamin was from 76.12 to 86.81. The range for riboflavin was from 83.83 to 97.38. The range of means for niacin was from 80.06 to 88.56. The range of means for ascorbic acid was from 81.06 to 97.65. The range of means for kilocalories was 71.55 to 91.88.

The range of means for total score was from 78.55 to 92.29. The mean scores do not differ significantly by sex except for iron. The scores reflect that on the average the subjects were underconsuming the amounts for each nutrient, for kilocalories, and for total.

Table XVI summarizes the dietary adequacy for the subjects of this study based on total score, NVM. There were 1052 days of dietary intake examined and compared to the 1974 RDAs. Only four percent of these dietary analyses met 100 percent of the RDAs for all nutrients. Other studies that investigated the dietary adequacy of their subjects used two-thirds of the RDAs for determining dietary adequacy, including Pearson (1971). In contrast, however, the Food and Nutrition Board, National Research Council (1974, p. 14), in the publication Recommended Dietary Allowances, stated in reference to dietary adequacy "that such general statements as 'RDA include a large safety factor; therefore a diet that meets two thirds of the RDA standard should be adequate' have no validity." Because most nutritional studies have included the two-thirds of the RDA values for the subjects, this is included in Table XVI.

As shown in Table XVI, a higher percentage of males than females had total scores of 100 indicating they met 100 percent of the RDA on all variables. The females are limited by the larger requirement for iron (18 mg.) than the males (10 mg.). When using the two-thirds of the RDA for determining dietary adequacy, this study shows that 84 percent of the dietary analyses met at least 66 percent of the RDAs.

TABLE XVI

PERCENTAGE OF ALL SUBJECTS BY AGE AND SEX WHO MET AT LEAST 66 OR 100 PERCENT OF RDA[a]

Age	Sex	Percent of RDA	
		66%	100%
17-18	M	68	18
	F	82	3
19	M	88	19
	F	83	3
20	M	100	12
	F	83	2
21-22	M	100	27
	F	88	2
Total All Subjects		84	4

[a]N = 1052 dietary analyses.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Summary

The primary purpose of this study was to test the validity of a Food Selection Score Card (FSSC) for its ability to predict the nutritive value of foods consumed. A FSSC has been used at Oklahoma State University since 1971. A review of literature revealed that various Food Selection Score Cards have been in use since 1933. One FSSC used by Chaney and Ahlborn (1934) lists an arbitrary point system for determining if the individual's food selection was good, fair, or poor. Hinton (1962) arbitrarily established classifications of excellent, good, poor to fair, and poor for use with a FSSC based on foods consumed as compared to the 1958 RDAs. A review of literature indicated a need for testing the validity of any FSSC used as a nutrition education teaching tool.

Other newer methods for nutrition education such as Index of Food Quality, Index of Nutritional Quality, the Dietary Nutrient Guide and the Food Exchange System were reviewed and were judged by the researcher to be more difficult to explain than the Basic Four Food Group concept. The Basic Four Food Groups still appear to be the easiest method of teaching food selection. Suggestions for explaining food groupings and serving sizes are utilized as part of the student project in the course

Basic Human Nutrition which incorporates the use of one FSSC. It is this FSSC which was examined in this study.

The goal of this nutrition educator was to continue use of a relatively simple nutrition education teaching device through its validation. A Food Selection Score Card (FSSC) was developed for use as a teaching device in the Basic Human Nutrition course at Oklahoma State University in 1971. The FSSC will continue to be used as part of the Basic Human Nutrition course and as a nutrition education tool with adult education.

The objectives of this research were as follows:

1. to test the concurrent validity of a system of assessing dietary intake in terms of the extent to which the scores on the Food Selection Score Card (FSSC) adequately predict the scores of the Nutritive Value Method (NVM) in terms of
   a. total score
   b. selected nutrients
2. to assess the dietary adequacy of a selected group of college students on the basis of the current, 1974, Recommended Dietary Allowances including
   a. percentages of RDAs met
   b. interrelationship among nutrients and food group consumed
   c. comparison of sex and age groups, and year groups.

The null hypotheses tested were:

H_1: The various scores on components of the FSSC method do not predict the scores on selected components of the NVM in terms of

FSSC Components	NVM Components
a. total dietary score	a_1. the mean total score of all scores
b. Milk Group score	b_1. calcium value score b_2. riboflavin value score b_3. kilocalorie value
c. Meat Group score	c_1. protein value score c_2. iron value score c_3. thiamin value score c_4. kilocalorie value
d. All Fruit and Vegetable Group score	d_1. kilocalorie value
e. vitamin A subgroup of the Fruit and Vegetable Group score	e_1. vitamin A value score e_2. kilocalorie value
f. vitamin C subgroup of the Fruit and Vegetable Group score	f_1. vitamin C value score f_2. kilocalorie value
g. Enriched Bread and Cereal Group score	g_1. iron value score g_2. thiamin value score g_3. kilocalorie value

H_2: There will be no difference in the FSSC scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 and 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters)

H_3: There will be no difference in the NVM scores between:

a. sex groups

i. males

ii. females

b. age groups

i. 17 and 18 year olds

ii. 19 year olds

iii. 20 year olds

iv. 21 and 22 year olds

c. year groups

i. fall, 1974

ii. year 1975 (two semesters)

iii. year 1976 (two semesters

Consistent with the first objective and the first set of hypotheses (H_1) the concurrent validity of a system of assessing dietary intake was examined through testing by means of regression procedure of the extent to which the scores on the FSSC predict the scores of the NVM as follows:

a. FSSC total score predicts NVM total score

b. selected subgroups including:

i. FSSC milk group score predicts NVM calcium, riboflavin, and kilocalorie scores

ii. FSSC meat group score predicts NVM protein, thiamin, iron, and kilocalorie scores

iii. FSSC vitamin A fruit and vegetable subgroup score predicts NVM vitamin A value, and kilocalorie scores

iv. FSSC vitamin C fruit and vegetable subgroup score predicts NVM vitamin C value, and kilocalorie scores

v. FSSC enriched bread and cereal group score predicts NVM iron, thiamin, and kilocalorie scores.

Consistent with the second objective and second set of hypotheses (H_2) the dietary adequacy of a selected group of college students was assessed in terms of the current, 1974, Recommended Dietary Allowances and the significance of sex groups, age groups, and year groups as sources of variance on FSSC total score and each FSSC subgroup score was tested by analysis of variance.

Consistent with the second objective and the third set of hypotheses (H_3) the same procedures were used as for H_2. The data analyzed were NVM total scores and NVM scores for each selected nutrient.

The second and third set of hypotheses were tested by computing analysis of variance with multiple classifications (sex and age) and single classification (year) for: (a) each of the seven variables of the FSSC including total score, milk group, meat group, all fruit vegetable group, vitamin C and A subgroups of fruit and vegetable group, and enriched bread and cereal group, and (c) each of nine variables including total score, protein, calcium, iron, vitamin A, thiamin, riboflavin, ascorbic acid, and kilocalories.

The age classification, 17 through 22 years, represented 526 students involved in this study which utilized the 17 to 22 year age grouping of the 1974 RDAs as a criterion base. Based on the foods consumed by these 526 students, the FSSC was compared to the NVM of the same foods. The FSSC was developed by Food, Nutrition and Institution Administration faculty for use in the Basic Human Nutrition course at Oklahoma State University. This researcher accumulated the dietary analysis of all her students for five semesters for use on this research project.

The internal consistency of the FSSC within the food groups indicated no meaningful relationships existed excluding the spurious correlations. Foods consumed in one food group did not relate to food consumed in another food group indicating that each food group is independent of the other food groups.

The intercorrelations among the seven nutrients of the NVM indicated that 14 of the 21 relationships were meaningful (see Table IV). The intercorrelations indicated that the NVM had more internal consistency than the FSSC. The intercorrelations among all parts are significantly different from zero. Excluding ascorbic acid, all components have meaningful interrelationships except for vitamin A with protein or iron and iron with protein. The total score reflects the sum of related component parts.

Validation of a system of assessing dietary intakes by scores on a FSSC in terms of the extent to which these scores adequately predicted the scores on the NVM were validated by regression analyses. Each part of the FSSC was tested for prediction of relevant specific components of the NVM. The FSSC is composed of the total dietary score, milk group score, meat group score, all fruit and vegetable group score, vitamin A subgroup of the fruit and vegetable group score, vitamin C subgroup of the fruit and vegetable group score, and the enriched bread and cereal group score. The components of the NVM are the total score, protein score, calcium score, iron score, vitamin A score, thiamin score, riboflavin score, ascorbic acid score, and the kilocalories score.

The results of the statistical analyses were as follows:

1. The total scores indicated that there was a relationship between the FSSC total score and the NVM total score based on R^2 and mean square for error. The correlation coefficient was .83. The FSSC method of obtaining the total score was accepted as a valid measure of dietary adequacy.
2. The FSSC method of scoring the milk group is accepted as a valid measure reflecting the adequacy of calcium, and riboflavin intake. The FSSC method of scoring the milk group is not accepted as a valid measure for reflecting the adequacy of the kilocaloric intake.
3. The FSSC method of scoring the meat group is rejected as a valid measure reflecting the intakes of protein, iron, thiamin, riboflavin, and kilocalories.
4. The validity of the FSSC "all fruit and vegetable group" for reflecting the adequacy of kilocaloric intake is rejected.
5. The FSSC method of scoring the vitamin A subgroup of fruit and vegetable group is rejected as a valid measure for reflecting the adequacy of intake of vitamin A, and as a predictor of kilocalories.
6. The FSSC method of scoring the vitamin C subgroup of fruit and vegetable group is accepted as a valid measure for reflecting the adequacy of intake of vitamin C but is rejected as a predictor of kilocalories.
7. The FSSC method of scoring the enriched bread and cereal group is rejected as a valid measure for reflecting the adequacy of the intake of iron, thiamin, riboflavin, and kilocalories.

Analysis of variance was computed on both methods (FSSC and NVM) by sex by age groups, and year groups. Comparison of groups by sex (males or females) for ages of 17 and 18, 19, 20, and 21 and 22 year olds; and for years of 1974, 1975, and 1976 for dietary adequacy by the FSSC method determined that there was no significant difference between year groups on measures obtained from the FSSC except for vitamin A, vitamin C subgroupings of the fruit and vegetable group, and for the total score. This difference was related to the 1974 group.

In comparing the groups by sex of males or females, by ages of 17 and 18, 19, 20, and 21 and 22 year olds, and by years of 1974, 1975, and 1976 for dietary adequacy by the NVM method it was found that there was no significant difference between sex groups or age groups. There was no significant difference between year groups except for the two components niacin and ascorbic acid. The significant difference in ascorbic acid between the year groups was related to the 1974 subjects which was consistent with the finding for the vitamin C score on the FSSC. The 1975 Health and Nutrition Examination Survey (HANES) indicated that the most prevalent low risk deficiency signs were found due to vitamin C and niacin deficiency. It appeared that these subjects were typical of the United States population in general.

Recommendations

From the analyses of these data, the general conclusion was that the FSSC total score adequately predicted the NVM total score. The researcher felt that this ability to predict the NVM could be improved. It is recommended that the following changes be made in the scoring of the FSSC for each group and for the total score in an attempt to improve the accuracy of the FSSC based on information obtained in Table V:

1. Change the scoring for the meat group from 30 points to 20 points maximum with 10 points per serving.
2. Change the scoring for "all fruit and vegetable group" from 10 points to 16 points maximum with four points per serving.
3. Change the scoring for the enriched bread and cereal group from 20 points to 24 points maximum with six points per serving.

The recommendations to change the scoring for the meat group resulted from the information in Table V which indicated that the FSSC was weighted too heavily for scoring purposes and should be changed. Based on the R^2 and mean square for error in Table V, the recommendation to increase the scoring for the entire "all fruit and vegetable" group can be made. The R^2 and mean square for error for each variable for the bread and cereal group were the justification for recommending the increase in scoring for the bread and cereal group.

Further changes which should be considered are the effect of total fat content on the FSSC total score by use of a score for restricted fat intake. A validation of the kilocalorie determination of the student dietary project should be considered based on RDAs. Total kilocalories for each day should be reflected in a score on the FSSC and would be for receiving no more than the recommended kilocalories. The fat intake and kilocalorie content influence total food consumption and are not presently reflected on the FSSC.

These changes are recommended as the result of the analyses of the FSSC in this study. Proposed changes in the point system are based on the 1977 U. S. Dietary Goals as reported by Latham and Stephenson (1977) which emphasize a decrease in total consumption of meat with a concurrent increase in fresh fruits and vegetables and increased use of whole grain and natural bread and cereal products.

Once the FSSC is validated by food groups and total score with the NVM as the criterion, a periodic validation will be needed each time the RDAs are revised by the Food and Nutrition Board of the National Research Council. This study validated the FSSC based on the 1974 RDAs. Revisions occur approximately every five years based on the latest available research for each nutrient.

A study comparing the effect of season on food selection would be interesting. The foods selected by all fall semester subjects could be compared within the semesters as well as between the spring semester subjects' food selections. This could be utilized to ascertain the effect of season on the percentages of RDAs for each nutrient of the NVM.

In view of the need to determine change in eating behavior of subjects, it is recommended that a comparison of food selections be conducted at the beginning of a semester as well as toward the end of the semester. The FSSC can be utilized for this comparison to determine the extent of changes made in food selection by food groups and total score between the two time periods. From such a study better methods of behavior modification as they affect nutrition education can be developed.

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APPENDIXES

APPENDIX A

FNIA 1113 FOOD SELECTION SCORE CARD

Name ______________________

Subject Number ______________________

Sex ____________

FOOD SELECTION SCORE CARD

FOOD GROUPS	MILK	MEAT	FRUIT & VEGETABLES			BREAD & CEREAL
			All	Vit. A	Vit. C	
TOTAL Servings for Day 1						
Recommended Servings from the Food Group						
SCORE for DAY 1						

Total ________

TOTAL Servings for Day 2						
Recommended Servings from the Food Group						
SCORE for DAY 2						

Total ________

GUIDE FOR SCORING -

MILK GROUP: Milk or milk products as cheese and ice cream		4 2 cups	= 40 20 points
MEAT GROUP: Meat, fish, poultry, egg, (animal source) or Meat alternates (dried beans, peanut butter)	1st serving = 15 points 2nd serving = 15 points	2 servings	= 30 points
FRUIT & VEGETABLE GROUP: 1. 'All' includes all fruits & vegetables including sub-divisions for vitamin A and vitamin C		4 servings	= 10 points
2. Vegetable, dark green leafy or deep yellow (vitamin A)		1 serving	= 10 points
3. Citrus fruit, strawberries, tomato, vegetable in cabbage family (vitamin C)		1 serving	= 10 points
ENRICHED OR WHOLE GRAIN BREAD AND CEREAL: Whole grain or enriched cereals or breads		4 servings	= 20 points
		TOTAL	= 100 points

APPENDIX B

FNIA 1113 DIETARY ASSIGNMENT

FNIA 1113

A. Dietary Study of your food habits for the semester

I. Dietary studies provide a means of evaluating your food habits in relation to the National Research Council's Recommended Dietary Allowances (Appendix C pg. 444) based on your age, size, sex, and activity.

This problem consists of:

1. Keeping a weight chart for the semester.
2. Keeping an accurate two-day record of your food intake.
3. Computing your total calorie requirements.
4. Comparing your estimated energy needs with the energy value of the food eaten during a two-day period.
5. Evaluation of the diet for a two-day period.

II. Suggestions for making the dietary study:

a. Pages 12 and 13 of packet*

1. Write the exact amount of food eaten for a typical two-day period (school days, not week-ends) on pages 12 and 13 in this packet.
2. List all the foods you put into your mouth and swallow.
3. Include all extras, as butter and jelly for bread; butter or sauce on the vegetables; dressing for salads.
4. List separately the different foods that compose one diet item. Example - Ham sandwich: 2 slices bread, 2 oz. ham, 1 Tbsp. mayonnaise. Should you select a salad composed of several items, you would list these as 1 lettuce leaf, 1 slice pineapple, 2 Tbsp. cottage cheese, etc.
5. Observe the size of the serving and visualize the amount of food served (tablespoons, cups, slices, etc.). List the amount (in household measure) you actually ate, under column heading "amount eaten".
6. List food as soon as eaten. Preferably at the table. Do not trust your memory.
7. List code number for each food item from Home & Garden Bulletin #72.
8. Calculate the portion of the amount listed in the Bulletin #72 that you actually ate.

   Example: Frozen orange juice, diluted (code number 298) is listed in Bulletin 72 as 1 cup. If you consume 4 oz. (1/2 c) the "multiple of amount listed" is .5. Always use decimals instead of fractions.
9. Determine the food group in which each item belongs (following the guidelines on pages 7, 8, 9).

Guidelines for Determining the Serving Portion as Related to the Basic Four Food Groups.

The four food groups are used as a guideline for a balanced diet. The food and amount will be recorded by meals on the sheets provided. Draw lines across the page for easier reading. It is absolutely necessary that the unit of measure for "a" and "b" be alike. The multiple should be recorded as a decimal.

Example of recording the dietary information:

Food	Bul. #72 Code No.	(a/b) Multiple	(a) Amt. Eaten	(b) Bul. #72 Amt. Listed	Calories	Food Groups Fruits & Veg (all)	Vit. A	Vit. C
Milk	001	.25/1=.25	¼ cup(.25c)	1 cup	80	(not enough for a serving)		
Lettuce	205	.25/1=.25	¼ head(.25)	1 head	15	1		
Bacon	077	3/2=1.5	3 slices	2 slices	135	(not enough for a serving)		
Cantaloupe	263	.25/.5=.5	¼ melon(.25)	½ melon	30	1	1	1

The amount of a serving is shown in demonstration #3 page 21. The minimum amount of each kind of food item that will be considered a serving will be listed here for reference according to food groups.

MILK GROUP - one serving is one of the following items or a similar item. FOOD GROUP

Milk	1 cup = 1 serving
Cheese	1 cu in., 1 oz., or 1 slice serving .75 milk
Cottage Cheese	½ cup serving = .3 milk
Ice Cream	½ cup serving = .25 milk
Custard, Pudding, Tapioca	½ cup serving = .5 milk
Yoghurt	½ cup serving = .5 milk

MEAT GROUP

One serving from the meat group must contain a minimum of 12 gm protein.

Nuts	½ cup = 1 serving
Beans, dry, cooked	1 cup = 1 serving
Egg	2 = 1 serving

Special information	1 serving	Food Group(s)
#077 Bacon	5 slices = 1 serving	
#093 Beef & Veg Stew	1 cup = 1 serving	(meat, veg. Vit A)
#094 Beef Pot Pie	1 pie = 1 serving	(meat, veg., Vit A, cereal)
#101 Chicken Pot Pie	1 pie = 1 serving	(meat, veg., Vit A, cereal)
#127 Link Sausage	5 links = 1 serving	

#130 Vienna Sausage	6 = 1 serving
#137 Fish Sticks	3 = 1 serving
#142 Sardines	2 = 1 serving
#160 Peanut Butter	4 Tbsp. = 1 serving

VEGETABLE AND FRUIT GROUP--one serving is 1/2 cup or as normally served.

List each serving in column "ALL" on pgs. 12 & 13. Some will also be shown in either Vit. A or Vit. C or both of these.

Special Information

#199 Cucumber	1/4 = 1 serving
#204, 205 Lettuce	1/4 head = 1 serving
#240 Tomato	1/2 med. = 1 serving
#263 Cantaloupe	1/4 melon = 1 serving
Juices	1 glass = 1 serving
Dried Apricots, Prunes, Peaches, Dates	1/3 cup = 1 serving

The vegetable and fruit group is further subdivided into Vitamin A and Vitamin C groups. For a good source of Vitamin A the serving portion should contain at least 1800 IU of Vitamin A. For a good source of Vitamin C the serving portion should contain 30 mg or more of Vitamin C.

The following would be considered good sources of Vitamin A and Vitamin C per serving portion:

Vitamin A	Vitamin C	
Greens	Broccoli	Grapefruit
Broccoli	Brussels Sprouts	Lemon
Carrot	Cabbage family	Lime
Pumpkin	Cauliflower	Orange
Spinach	Greens	Orange juice comb.
Squash, yellow	Green Pepper	Papaya
Sweet Potato	Avocado	Strawberries
Apricot	Cantaloupe	Watermelon
Cantaloupe		
Dried Peaches		
Watermelon		

ENRICHED BREAD AND CEREAL GROUP--one serving is one of the following items or a similar item.

Bread	1 slice = 1 serving
Cereal, cooked	1/2 cup = 1 serving
Cereal, dry (1 oz)	1 cup = 1 serving
Brownie	1 = 1 serving
Cookies	3 = 1 serving
Crackers	4 = 1 serving
Cake	1 piece or 1 cupcake = 1 serving
Pie	1 sector= 1 serving
Fruit Pie	1 sector= 1 serving fruit, 1 serving cereal
Custard Pie	1 sector=.5 serving milk, 1 serving cereal

Pecan Pie	1 sector	= .5 serving meat, 1 serving cereal
Pumpkin Pie	1 sector	= 1 serving veg. & Vit. A, 1 serving cereal
Pancake	1	= 1 serving
Waffle	1	= 1 serving
Pizza	1 sector	= .5 serving meat, 1 serving cereal
Macaroni, cooked	1 cup	= 1 serving
Macaroni & cheese	1 cup	= 1 serving meat, 1 serving cereal
Noodles cooked	1 cup	= 1 serving
Rice, cooked	1/2 cup	= 1 serving
Spaghetti	1 cup	= 1 serving
Spaghetti & Meat Balls	1 cup	= 1 serving meat, 1 serving cereal

SOUPS - - Special information	Serving	Food Group(s)
The soups made with milk	1 cup	= .5 serving milk
#585 Tomato with milk	1 cup	= .5 serving milk, 1 serving veg.
#586 Bean with pork	1 cup	= .5 serving meat
#592 Minestrone	1 cup	= 1 serving veg., & Vit. A
#593 Split Pea	1 cup	= .5 serving meat
#594 Tomato	1 cup	= 1 serving veg.
#595 Vegetable Beef	1 cup	= 1 serving veg., & Vit. A
#596 Vegetarian	1 cup	= 1 serving veg., & Vit. A

B. Evaluation of your food habits will include two methods:

1. Score Card - page 14 of packet

2. Analysis of nutritive value as outline in Evaluation I and II (pages 15, 17 and 18 of packet).

*Duplicates are included for worksheets.

Please hand in only 1 copy of all pages, but be careful to have nutritive values of foods in the corresponding lines with Code No. following each item.

Draw line across page under each item listed.

Carry all figures to the decimal place as shown in Bulletin #72.

Name________________________

Subject Number________________

Sex_________________________

COMPUTATION OF YOUR TOTAL KILOCALORIE REQUIREMENTS (Approximation)

Energy expenditure is dependent upon:

I. INTERNAL WORK - Basal Metabolism

a. Body Size
Change your DESIRED weight _______lb to kg (2.2 lb = 1 kg). 1._______kg
(carry decimal one place.)

b. Age
Adults allow 1 kcal per kg (1 kcal x kg body wt. x 24 hr) 2._______kcal

c. Sex - Females subtract 5% of above figure 3. -_______kcal
Difference 3 from 2 4._______kcal

d. Subtract kilocalories saved while sleeping
0.1 kcal x kg x hr in sleep = kcal saved No. of hours_____ 5. -_______kcal

Total kilocalories for Basal Metabolism 6._______kcal

II. EXTERNAL WORK - Physical Activity

Determine the hours spent in light or severe activities

Light exercise examples	or	Severe exercise examples
Studying		Dancing
Sitting in class		Games
Standing		Fast walking
Walking slowly		Physical education classes

a. Total hrs in light activity____hr x 0.792 x ____kg = ____kcal 7.

b. Total hrs in severe activity____hr x 1.69 x ____kg = ____kcal 8.

c. Total hrs in sleep ____hr
Total hours 24

Total kilocalories for physical activity (7 + 8) = 9._______kcal

Total kilocalories (Basal Metabolism 6 + physical activity 9) = 10._______kcal

III. SPECIFIC DYNAMIC EFFECT of Food (SDE) - cost of food intake in energy

Add 10% of the total kilocalories on Line 10. 11. +_______kcal

Estimated daily TOTAL kilocalories (10 + 11) = 12._______kcal

Name: ______________________ Sex: __________
Subject No.: ______________________ Day 1
Eating Place: ______________________________

Name of Food and Description	Code No. Appendix A	Multiple a/b	a Amount of food eaten	b Amt. listed Appendix A	Kilo-calories	Milk	Meat	Fruits & Veg. All	 Vit. A	 Vit. C	Bread and Cereal
Breakfast:											
Lunch:											
Dinner:											
Snacks:											
TOTALS											
					(Cal.)	(Food Groups)					

Name: ______________________ Sex: __________
Subject No.: ________________ Day 2
Eating Place: ____________________________

Name of Food and Description	Code No. Appendix A	Multiple a/b	a Amount of Food Eaten	b Amt. listed Appendix A	Kilo-calories	Milk	Meat	Fruits & Veg.			Bread and Cereal
								All	Vit. A	Vit. C	
Breakfast:											
Lunch:											
Dinner:											
Snacks:											
TOTALS											
					(Cal.)	(Food Groups)					

Name ____________________

Subject Number ____________________

Sex __________

FOOD SELECTION SCORE CARD

FOOD GROUPS	MILK	MEAT	FRUIT & VEGETABLES: All	FRUIT & VEGETABLES: Vit. A	FRUIT & VEGETABLES: Vit. C	BREAD & CEREAL
TOTAL Servings for Day 1						
Recommended Servings from the Food Group						
SCORE for DAY 1						
						Total ______
TOTAL Servings for Day 2						
Recommended Servings from the Food Group						
SCORE for DAY 2						
						Total ______

GUIDE FOR SCORING -

MILK GROUP:	Milk or milk products as cheese and ice cream		2 cups	= 20 points
MEAT GROUP:	Meat, fish, poultry, egg, (animal source) or Meat alternates (dried beans, peanut butter)	1st serving = 15 points 2nd serving = 15 points	2 servings	= 30 points
FRUIT & VEGETABLE GROUP:	1. "All" includes all fruits & vegetables including sub-divisions for vitamin A and vitamin C		4 servings	= 10 points
	2. Vegetable, dark green leafy or deep yellow (vitamin A)		1 serving	= 10 points
	3. Citrus fruit, strawberries, tomato, vegetable in cabbage family (vitamin C)		1 serving	= 10 points
ENRICHED OR WHOLE GRAIN BREAD AND CEREAL:	Whole grain or enriched cereals or breads		4 servings	= 20 points
			TOTAL	= 100 points

AN EVALUATION OF YOUR FOOD HABITS

A. Calculations

1. From packet pages 12 and 13, calculate the calorie value of the two-day diet and show average:__________________cals.

2. Considering your size, age, sex, and types of activity, determine your estimated calorie needs on page 11 of packet and use throughout study for your RDA for calories:__________________cals.

3. Compute your protein needs according to size and age:____________ (0.8 gm protein required per kilogram body weight)

B. Evaluation of Calories for Energy

1. Compare your weight with the standard set for your height and build:

   Your height:_____________ Build:_________________ Age:__________

   Your weight:_____________ Desirable weight:________________

2. Would you expect to gain or to lose weight, or to maintain present weight under the conditions of activity and food intake of this study? How many pounds would you gain or lose in one month? (Show calculations)

C. Evaluation by Rapid Method

1. Compare your food intake with the "Food Selection Score Card" (pg. 14 packet). If your diet is inadequate in any respect, list amount of food in each group that should be added to bring your intake to a perfect score for each day. Give examples of these foods.
   Day 1 Day 2

2. Were your breakfast and snack habits desirable? Explain.

TABLE XVII

RECOMMENDED DAILY DIETARY ALLOWANCES

	(Years) From Up to	Weight (kg)	Weight (lbs)	Height (cm)	Height (in)	Energy (kcal)[2]	Protein (g)	Fat-Soluble Vitamins: Vitamin A Activity (RE)	Vitamin A Activity (IU)	Vitamin D (IU)	Vitamin E Activity (IU)	Water-Soluble Vitamins: Ascorbic Acid (mg)	Folacin (µg)	Niacin (mg)	Riboflavin (mg)	Thiamine (mg)	Vitamin B_6 (mg)	Vitamin B_{12} (µg)	Minerals: Calcium (mg)	Phosphorus (mg)	Iodine (µg)	Iron (mg)	Magnesium (mg)	Zinc (mg)
Infants	0.0-0.5	6	14	60	24	kg x 117	kg x 2.2	420	1400	400	4	35	50	5	0.4	0.3	0.3	0.3	360	240	35	10	60	3
	0.5-1.0	9	20	71	28	kg x 108	kg x 2.0	400	2000	400	5	35	50	8	0.6	0.5	0.4	0.3	540	400	45	15	70	5
Children	1-3	13	28	86	34	1300	23	400	2000	400	7	40	100	9	0.8	0.7	0.6	1.0	800	800	60	15	150	10
	4-6	20	44	110	44	1800	30	500	2500	400	9	40	200	12	1.1	0.9	0.9	1.5	800	800	80	10	200	10
	7-10	30	66	135	54	2400	36	700	3300	400	10	40	300	16	1.2	1.2	1.2	2.0	800	800	110	10	250	10
Males	11-14	44	97	158	63	2800	44	1000	5000	400	12	45	400	18	1.5	1.4	1.6	3.0	1200	1200	130	18	350	15
	15-18	61	134	172	69	3000	54	1000	5000	400	15	45	400	20	1.8	1.5	1.8	3.0	1200	1200	150	18	400	15
	19-22	67	147	172	69	3000	52	1000	5000	400	15	45	400	20	1.8	1.5	2.0	3.0	800	800	140	10	350	15
	23-50	70	154	172	69	2700	56	1000	5000	-	15	45	400	18	1.6	1.4	2.0	3.0	800	800	130	10	350	15
	51+	70	154	172	69	2400	56	1000	5000	-	15	45	400	16	1.5	1.2	2.0	3.0	800	800	110	10	350	15
Females	11-14	44	97	155	62	2400	44	800	4000	400	10	45	400	16	1.3	1.2	1.6	3.0	1200	1200	115	18	300	15
	15-18	54	119	162	65	2100	48	800	4000	400	11	45	400	14	1.4	1.1	2.0	3.0	1200	1200	115	18	300	15
	19-22	58	128	162	65	2100	46	800	4000	400	12	45	400	14	1.4	1.1	2.0	3.0	800	800	100	18	300	15
	23-50	58	128	162	65	2000	46	800	4000	-	12	45	400	13	1.2	1.0	2.0	3.0	800	800	100	18	300	15
	51+	58	128	162	65	1800	46	800	4000	-	12	45	400	12	1.1	1.0	2.0	3.0	800	800	80	10	300	15
Pregnant						+300	+30	1000	5000	400	15	60	800	+2	+0.3	+0.3	2.5	4.0	1200	1200	125	18+	450	20
Lactating						+500	+20	1200	6000	400	15	60	600	+4	+0.5	+0.3	2.5	4.0	1200	1200	150	18	450	25

Source: Food and Nutrition Board, National Research Council, Recommended Dietary Allowance, 8th ed., 1974.

PART II

EVALUATION OF YOUR DIETARY ANALYSIS:

1. Average the percentage of each nutrient listed on "print out" for the two days. Place this average percentage of each nutrient in the appropriate place:

Percentage of R.D.A.

100+ - 90%	89 - 65%	64% and below

2. What nutritional problems might develop as a result of consuming this type of diet over an extended period of time?

3. What foods should have been added to or substituted in the diet to meet the R.D.A.? (Example: Diet inadequate in thiamin. Pork chop (.63 mg thiamin) substituted for chicken drumstick (.03 mg thiamin) provides .60 mg thiamin.)

Day 1 Day 2

4. What have you learned from making this study?

5. Review the "Food Selection Score Card" (pg. 14) for each day. Note any inadequacies in the Four Food Groups. How does this correlate with the nutrient content for each day on the print out? Do you believe that the Four Food Group Guide is sufficient on which to base your daily diet? Why?
   <u>Day 1</u>   <u>Day 2</u>

6. If you take a vitamin and/or mineral supplement, evaluate the need or place that a supplement should take in your diet.

APPENDIX C

COMPUTER DIETARY ANALYSIS LISTING FOOD

CONSUMED, SCORE FOR FSSC METHOD

AND NUTRIENT VALUES

FOR NVM

TABLE XVIII

COMPUTER DIETARY ANALYSIS LISTING FOOD CONSUMED, SCORE FOR FSSC METHOD AND NUTRIENT VALUES FOR NVM

					FOOD SELECTION SCORE CARD METHOD						NUTRITIVE VALUE METHOD							
							Fruit & Vegetable			Bread &								
Code No.	Portion	Food Description	Serving Amount	Calories	Milk	Meat	All	Vit. A	Vit. C	Cereal	Prot	Calcm	Iron	Vit. A	Thia	Ribo	Niac	Asco
							Day 1											
27	1.00	Cheese, American	28.	105.	0.75						7.	198.	0.3	350.	0.01	0.12	0.0	0.
501	2.00	Fat, Margarine	10.	70.							0.	2.	0.0	340.	0.0	0.0	0.0	0.
355	2.00	Bread, White, Sliced	40.	110.						2.00	4.	34.	1.0	0.	0.10	0.08	1.0	0.
433	0.50	Cereal, Macaroni	100.	215.	0.50					0.50	9.	181.	0.9	430.	0.10	0.20	0.9	0.
96	2.00	Chicken, Breast	188.	310.		1.00					50.	18.	2.6	140.	0.08	0.34	22.4	0.
98	1.00	Chicken, Drumstick	59.	90.		1.00					12.	6.	0.9	50.	0.03	0.15	2.7	0.
227	1.00	Vegetable, Potatoes	195.	185.			2.00				4.	47.	0.8	330.	0.16	0.10	1.9	18.
423	2.50	Crackers, Saltine	28.	125.						2.50	3.	5.	0.2	0.	0.0	0.0	0.2	0.
190	0.50	Vegetable, Carrots	73.	23.			1.00	1.00			1.	24.	0.4	7610.	0.04	0.03	0.3	5.
59	9.00	Milk, Chocolate	2250.	1710.	9.00						72.	2430.	4.5	1890.	0.90	3.60	2.7	27.
216	0.50	Vegetables, Peas, Carrots	125.	83.			1.00				5.	25.	2.1	560.	0.11	0.06	1.1	11.
Totals				3025.	10.25	2.00	4.00	1.00	0.0	5.00	165.	2970	13.8	11700.	1.53	4.69	33.3	61.
Recommended				3578	2.00	2.00	4.00	1.00	1.00	4.00	69.	800.	10.0	5000.	1.50	1.80	20.0	45.
Portion				0.85	5.13	1.00	1.00	1.00	0.0	1.25	2.39	3.71	1.38	2.34	1.02	2.61	1.66	1.34
Score					20.	30.	10.	10.	0.	20.	TOTAL POINTS = 90.					Mean = 100		
							Day 2											
27	1.00	Cheese, American	28.	105.	0.75						7.	198.	0.3	350.	0.01	0.12	0.0	0.
355	2.00	Bread, White, Sliced	40.	110.						2.00	4.	34.	1.0	0.	0.10	0.08	1.0	0.
501	2.00	Fat, Margarine	10.	70.							0.	2.	0.0	340.	0.0	0.0	0.0	0.
224	1.00	Vegetable, Potatoes	57.	155.			1.00				2.	0.	0.7	0.	0.07	0.04	1.8	12.
1	5.00	Milk, Whole, 1	1220.	800.	5.00						45.	1440.	0.5	1750.	0.35	2.05	1.0	10.
387	1.00	Cake, White, 1	71.	250.						1.00	3.	70.	0.4	40.	0.01	0.06	0.1	0.
283	2.00	Fruit, Grape Juice	432.	790.							2.	44.	1.8	80.	0.26	0.44	3.0	0.
530	1.00	Candy, Chocolate	28.	145.							2.	65.	0.3	80.	0.02	0.10	0.1	0.
96	2.00	Chicken, Breast	188.	310.		1.00					50.	18.	2.6	140.	0.08	0.34	22.4	0.
227	1.00	Vegetable, Potatoes	195.	185.			2.00				4.	47.	0.8	330.	0.16	0.10	1.9	18.
382	1.00	Cake, Devil's Food	69.	235.						1.00	3.	41.	0.6	100.	0.02	0.06	0.2	0.
Totals				3155.	5.75	1.00	3.00	0.0	0.0	4.00	122.	1968.	9.0	3210.	1.08	3.39	31.5	40.
Recommended				3578.	2.00	2.00	4.00	1.00	1.00	4.00	69.	800.	10.0	5000.	1.50	1.80	20.0	45.
Portion				0.88	2.88	0.50	0.75	0.0	0.0	1.00	1.77	2.46	0.90	0.64	0.72	1.88	1.57	0.89
Score					20.	15.	8.	0.	0.	20.	TOTAL POINTS = 63.					Mean = 89		
Averages				3090.	20.	23.	9.	5.	0.	20.	2.08	3.09	1.14	1.49	0.87	2.24	1.62	1.12
											TOTAL AVERAGE = 76.							

(Kcal eaten - Kcal needed) * 30 days/3500 Kcal per pound = weight gain per month. (3090. - 3578.) * 30./3500 = -4.19 pounds per month.

APPENDIX D

REGRESSION ANALYSES FOR ALL, FOR FEMALE, AND FOR MALE SUBJECTS

TABLE XIX

F VALUES FROM REGRESSION ANALYSES FOR ALL, FOR FEMALES, AND FOR MALE SUBJECTS

Predictor FSSC Method	Criterion NVM Method	F Values: All Subjects	F Values: Female Subjects	F Values: Male Subjects	Significance Level[a]
Total Score	Total Score	1159.8	973.6	84.7	.0001*
	Kilocalories	249.7	235.1		.0001*
				8.5	.005*
Milk Group	Calcium	2264.4	1891.7	358.7	.0001*
	Riboflavin	853.5	714.3	89.5	.0001*
	Kilocalories	101.4	93.8		.0001*
				1.3	.25
Meat Group	Protein	121.9	113.0		.0001*
				.43	.52
	Iron	180.7	144.3		.0001*
				5.9	.018*
	Thiamin	114.3	99.8		.0001*
				4.2	.04
	Kilocalories	103.3	95.3		.0001*
				1.0	.32
All Fruit and Vegetable Group	Kilocalories	11.9			.0006*
			8.4		.004*
				5.2	.03*
Vitamin A Subgroup of Fruit and Vegetable Group	Vitamin A	306.0	285.3		.0001*
				24.5	.001*
	Kilocalories	3.6			.06
			2.9		.09
				1.2	.29
Vitamin C Subgruop of Fruit and Vegetable Group	Vitamin C	598.7	605.6	34.3	.0001*
	Kilocalories	13.97	13.9		.0002*
				1.2	.27

TABLE XIX (Continued)

Predictor FSSC Method	Criterion NVM Method	F Values All Subjects	Female Subjects	Male Subjects	Significance Level[a]
Bread and	Iron	77.0	45.2		.0001*
Cereal Group				5.3	.02
	Thiamin	107.2	93.6		.0001*
				4.3	.04
	Kilocalories	136.7	117.7		.0001*
				8.9	.004*

[a]The significance level shown for any row applies to all F values in that row.

*Significant at the .01 level or beyond.

APPENDIX E

INTERCORRELATIONS AMONG COMPONENTS OF

FSSC AND NVM

TABLE XX

INTERCORRELATIONS AMONG COMPONENTS OF FSSC AND NVM[a]

FSSC	NVM Kilo-calories	Protein	Calcium	Iron	Vitamin A	Thiamin	Ribo-flavin	Ascorbic Acid	Total Score
Total Score	.57	.50	.70	.56	.58	.69	.71	.52	.83
Milk Group	.40	.34	.90	.32	.34	.44	.79	.10	.59
Meat Group	.41	.43	.27	.51	.21	.42	.39	.20	.49
All Fruit and Vegetable Group	.15	.18	.11	.19	.45	.30	.18	.71	.45
Vitamin A Sub-group of Fruit and Vegetable Group	.08	.12	.21	.16	.61	.20	.23	.25	.34
Vitamin C Sub-group of Fruit and Vegetable Group	.16	.19	.15	.15	.30	.40	.18	.73	.45
Bread and Cereal Group	.45	.22	.32	.36	.10	.41	.29	.08	.35

[a]N = 463.

VITA[2]

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