EATING PATTERNS OF KANSAS FIFTH GRADE STUDENTS

by

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INTRODUCTION

Eating patterns have been defined as the actual process of consuming foods on specific occasions, over any given period of time (1). Meal frequency and eating habits are important determinants of dietary adequacy. The appropriate combinations of foods, not the presence or absence of any one food, promote good health. Because of the availability of a vast array of food products in western societies the potential for selecting foods that do not support good health is high. Of the many factors that influence health, individuals have the greatest control over their diets.

Food habits and eating patterns of individuals and populations have been the focus of studies for many years. Food consumption patterns may in fact be more meaningful than the intake of individual foods or nutrients when examining the relationship between nutrition and health.

In the 1969 White House Conference on Food, Nutrition and Health a recommendation was made that a federal program be instituted to examine "the relationship of food consumption and patterns of eating to the health of our population" (2). Nutrition education is the most important method for improving nutrition knowledge, attitudes, and behavior that may result in better eating patterns. Since school children are in the process of learning and establishing lifetime habits, the school is an ideal environment for offering nutrition education. As a result of national concern that children need to be taught to select diets that provide sufficient nutrients and maintain good nutritional status, funds were allocated, in 1977, under P.L. 95-166 (3), for nutrition education in every state. Subsequently Kansas State University was contracted by the Kansas State Department of Education to conduct a needs assessment survey

as part of the Nutrition Education and Training Program (NETP), during the 1979-80 school year.

In this study dietary data (4) from the needs assessment survey were used to examine the eating patterns of Kansas fifth grade students. The objectives of this project were as follows:

1) to classify foods consumed by Kansas fifth grade students into groups and major categories, based on similar composition, to determine eating patterns;
2) to study the frequency of consumption of foods in designated groups and categories by Kansas fifth graders;
3) to evaluate the adequacy of students' diets by calculating quality scores or mean adequacy ratios (5);
4) to determine the effect of consumption of foods in designated groups and categories on dietary quality scores of Kansas fifth grade boys and girls and
5) to establish ranges of quality scores and group Kansas fifth grade students by sex, according to their mean adequacy ratio (MAR) values.

REVIEW OF LITERATURE

Dietary Quality Scores

Since the late 1930s attempts have been made to obtain reasonably accurate food or nutrient consumption information from individuals and groups. Calculations of nutrient intakes from dietary recall data have usually been compared with the Recommended Dietary Allowances (6). With the expansion of food assistance and nutrition education programs sponsored by federal, state and private agencies an increasing need has arisen for techniques which are less time-consuming, less costly and can be used easily by non-professional personnel. For these reasons nutritionists have developed systems for scoring dietary quality, which are based on food groups or selected nutrients. Such systems provide rapid methods of evaluating dietary adequacy and serve as the basis for educating and counseling individuals. In addition they are easily understood and require little training for use.

Scores Based on Food Groups

In 1954 Thomas et al. (7) designed and tested a method for evaluating food intakes from seven day or 24-hour dietary records. Data were collected from 1,128 black and white women living in Detroit. The objective of the study was to determine qualitative differences in intakes of groups of individuals in order to identify zones or extreme levels of intake rather than to evaluate precisely individual intakes. The system used was based on the following 14 food groups: milk and milk products; eggs; legumes; red meats, fowl and fish; pork; liver; citrus fruits and analagous foods; other fruits; leafy green and yellow vegetables; other

cooked vegetables; raw vegetables; white potatoes; whole grain or enriched bread and cereals; butter and fortified margarine. Points were allotted to groups with maximum scores of 100 percent being equivalent to 125, 139 and 160 points for non-pregnant, pregnant and lactating women, respectively. Substitutions were allowed within major groups only when requirements had been met for specific food groups. The number of servings was set to meet the Recommended Dietary Allowances (RDA) for energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and ascorbic acid. This method was a reliable, but simple way to assess dietary adequacy of pregnant women, especially those from low socioeconomic levels, who may have been poor subjects for more accurate, time-consuming and costly studies.

An additional part of this research was the collapsing of groups into seven. A designated number of servings from each group was required to meet the RDA for pregnancy. If this criterion was met or exceeded the resulting score was described as "high," below 60 percent of the recommended levels as "low" and scores between the two as "intermediate." There was good correlation between the high scores (80 to 100 percent) in the 14 food group system and the RDA, but the latter classifications based on seven groups were closely correlated with protein intakes only.

Hinton et al. (8) investigated the relationship of certain psychological, sociologic and physiological factors to eating behavior and selection of a diet which approximates the Recommended Dietary Allowances. Seven day food records for summer and three day food records for winter were collected from 140 Iowa girls, between the ages of 12 and 14 years. To evaluate dietary adequacy they used the scoring system developed by Thomas et al. (7), based on the 14 groups of the basic food plan.

In Ontario, Canada, Trenholme and Milne (9) collected seven day food records from 2,436 ninth grade students and assessed dietary quality using a scoring technique based on Canada's Food Guide (10). At that time the Guide included ten food groups as follows: milk and cheese, eggs, meat and alternatives, potatoes, vegetables, fruit, sources of vitamin C, bread, whole grain cereals and vitamin D. Scores of zero to one were given depending on the quantity of the food group recommended and its nutrient composition. Individual foods were scored first then groups and finally a weekly score was assigned. When all foods were consumed in amounts equal to or greater than the recommended amounts and not more than three or four portions per day of "sweet foods" were reported an "excellent" rating was given. If 75 percent or more of the recommendations was met for eight or nine, six or seven, four or five and three or fewer food groups the ratings were "good," "fair," "poor" and "very poor," respectively. When foods within specified major groups (fruit and vegetables, bread and whole grain cereals, meat and meat alternatives), were consumed in greater than the recommended amounts they were allowed to compensate for other foods.

Milne and co-workers (11) used the data from 250 of the food intake records from the Ontario study (9) to evaluate the diet scoring method. The nutrient content of the diet was calculated and compared to the dietary score based on food groups. In a few instances individual food intake records received low dietary scores but still contained the recommended amounts of the majority of nutrients. The Canadian Food Guide, if followed, ensured adequate nutrient intake with flexibility of food choice and provided a valid education tool for use in health programs. The researchers noted that the quantity of food eaten, as well as its quality, positively affected the dietary score. They recommended that

protective foods should be emphasized to ensure sufficient sources of nutrients when caloric intakes are reduced.

Schorr et al. (12) used a Guttman scale or scalogram (13) to evaluate three day food records of 118 New York state seventh to twelfth grade students in order to better understand the factors affecting teenage food habits. The Guttman scale reflects the complexity of the eating patterns of individuals and groups within a population. The scale is cumulative, for example a diet which includes food items within a given scale step also includes all foods contained in preceding steps. Knowledge of a subject's position on the scale allows for an accurate prediction of the foods he or she has consumed, which is particularly useful when the sample is large and there are many food items. Position on the scale also specifies the level of dietary complexity and the scale is unidimensional as dietary complexity is the single concept which is measured. A perfect Guttman scale is rarely obtained and statistical procedures are used to measure the degree of error as well as the correlation between the food scale and other selected variables.

In the Schorr study (12) a seven-step version of the scale was developed, which included food items in the following order of increasing complexity: whole milk, breads and rolls, beef, sweet foods and snack foods, fruits, orange juice, dark-green leafy and deep-yellow vegetables. With each succeeding scale step, the percentage of students included decreased while the level of dietary complexity increased. Because of a high number of scale errors many items eaten by students were eliminated. Thus each student was given one point per item consumed from a list of all foods eaten by 10 percent or more of the subjects. On the basis of these

scores students were ranked into four groups, which were closely correlated with respective positions on the scale.

AuCoin et al. (14) examined an average of two day dietary intakes of 10, 13 and 15 year old students in Nova Scotia, Canada using a scoring system based on five food groups. The groups included were milk, fruit, vegetable, bread and cereal as well as meat, with recommended numbers of servings for each group to meet nutrient requirements. Each group was assigned 20 points, with a possible total of 100 points. An overall score of 70 or 14 points per group was considered adequate. Based on the findings of the Ontario study (9) these scores were considered sufficient to meet all recommendations of Canada's Food Guide. Excess consumption was not considered as the study was a qualitative not quantitative evaluation of nutrient intakes. The same scoring system was used by Haley et al. (15) in subsequent studies in Canada, in 1973 and 1975.

Bowering and others (16) recognized that assessment based on nutrient intakes may be of limited usefulness as it does not provide direct information on food consumption practices. Consequently they became interested in dietary changes over time expressed in terms of food group consumption. They developed a simple method for assessing dietary adequacy based on the United States Department of Agriculture (USDA) Basic Four Food Guide (17), which suggests a minimum number of servings from the four food groups to provide a "foundation" for an adequate diet. This technique was tested on 119 pregnant women from three major ethnic groups in New York. Twenty-four hour dietary recalls were obtained from the subjects when they attended the Maternal, Infant and Child (MIC) clinic. In the dietary score for pregnant women six points were assigned to the milk and meat groups, three or four of which were for the milk group. Fruit and vegetable as

well as the bread and cereal group were each allotted four points, to give an overall total of 14. For post-partum women, a total score of 12 points was possible with the milk and meat groups each being assigned two points. The other groups retained the same number of points as previously allotted. Individual dietary scores were then compared to the nutrient analyses expressed as percentages of the RDA. They concluded that the dietary score was limited because of the differences in the nutrient content of foods which "scored equally." The researchers attributed the variation to both ethnic and individual differences in food selection. In addition, they suggested that simple methods for determining the initial nutritional status of individuals and monitoring changes in their eating patterns were needed.

King and colleagues (18) observed that although the RDA had been revised four times since 1953, the Basic Four Food Guide which was designed in 1956 was still being used. Therefore, they questioned whether the Basic Four remains a useful guide for selecting a well-balanced diet as judged by the RDA. To test their hypothesis they planned a study to compare the nutrient content of published menus, based on the Basic Four, with the 1974 RDA. If they found that any of the nutrients provided by just those foods in the Basic Four fell below two-thirds of the allowances, they intended to modify the Guide. Well-balanced menus published for adults, which were based on the Guide, were analyzed separately for the Basic Four food groups and supplemental foods. The latter category included sugar, fats, sweets and additional servings of the four food groups. When the Basic Four plan was met, only eight of the 17 nutrients calculated were provided at their respective RDA levels. Folacin, thiamin and niacin met two-thirds of the RDA but iron, zinc,

magnesium, vitamin E, vitamin B_6 and energy were supplied in quantities equal to or less than 60 percent of the allowances. By including the supplemental food group nutrient intakes of the nutrients mentioned above increased by an average of 20 percent. As a result of these findings the researchers modified the Basic Four plan by dividing the protein group (formerly the meat group) into animal and legume-nut subgroups. The fruit and vegetable group was subdivided into three parts, which included a vitamin C-rich, a dark-green and an other fruit and vegetable group. They assigned four points to each major group and one point to a fat and oil group for a total score of 17 points when the requirements of the modified plan were met. Although King et al. (18) recognized that the Modified Basic Four Food Guide was less flexible, they thought it was more important to provide a guide that was nutritionally sound than one which considered food preferences and was not optimal nutritionally. They stated that a food guide should provide nutrient adequacy because it is frequently used for institutional menu planning and for evaluating the dietary quality of different population groups. In order to increase the flexibility of their modified plan they designed four food guides for special preferences. These included low-cost, no meat, no dairy products and no legumes.

Guthrie and Sheer (19) developed a dietary quality score based on the four food groups to evaluate 24-hour dietary recalls collected from 212 university students. Four points were assigned to each food group for a possible total score of 16 points. They were unable to use the Modified Basic Four Food Guide as designed by King and co-workers (18) as only two subjects reported consumption of legumes or nuts. This method was tested against a score based on 12 nutrients. When dietary scores of 16 were recorded all 12 nutrients were present in the recommended amounts, but

when dietary scores dropped to between 12 and 15 there were lower levels of iron, zinc and vitamin B_6. The researchers suggested that this simple dietary score could be substituted for the more comprehensive and time-consuming dietary analysis when evaluating program effectiveness.

Later when Guthrie and Scheer (20) reanalyzed the food intakes of the university students for 17 nutrients and compared the results with those of King et al. (18), the findings were similar. However, they preferred the Basic Four scoring system to the Modified Basic Four Food Guide of King and co-workers (18) because it was less restrictive. They noted that if a goal of 80 percent of the RDA is acceptable the current guide is satisfactory.

Recently, MacDonald and others (21) examined the variables which differentiate between good and poor dietary intakes of Canadian adolescent girls. Twenty-four hour dietary recalls were obtained from 276 female students, between the ages of 14 and 18 years. Dietary quality was based on Canada's Food Guide (22) which, for adolescents, recommends four servings of milk or milk products, five servings of bread and/or cereals, five servings of fruits and/or vegetables and two servings of meat or meat alternatives per day. Each serving was allotted one point for a maximum score of 16. The researchers selected the students with the highest and lowest 50 scores, and designated them as "good" and "poor" quality intakes, respectively. Further data were then collected from these 100 students to investigate the relationships between their scores and other variables, such as anthropometric, demographic, self-esteem and physical activity.

Scores Based on Nutrients

The Recommended Dietary Allowances (RDA) are recognized as nutritional goals for groups, and failure of individuals to achieve these levels

of intake is not necessarily indicative of nutritional risk. The USDA has specified two-thirds of the RDA as the standard for identifying subjects at possible risk in the Household Dietary Surveys (23).

Many different scoring systems for assessing dietary adequacy, based on the RDA, have evolved. Cosper (24) developed one such method in 1972, which was subsequently used by Howe and Vaden (25) to compare differences in nutrient adequacy of secondary school students participating and not participating in the school lunch program. Twenty-four hour dietary interviews were conducted and percentages of the RDA for protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and ascorbic acid were calculated. If intakes were equal to or greater than 100 percent of the RDA for all eight nutrients, the diet was classified as "excellent." The other categories were rated as "good" for equal to or greater than 66.7 percent, "fair" for equal to or greater than 50 percent and "poor" for less than 50 percent of the RDA. Caloric intakes were classified by the same system.

Madden and Yoder (5) used the nutrient adequacy ratio (NAR) which is stated as a percentage of the RDA for a single nutrient according to the subject's sex and age category. They extended its use by calculating a mean adequacy ratio (MAR) which includes the NAR values for selected nutrients, that have been truncated to a maximum of 100 percent, totaled and the mean value obtained. Truncation of values prevents excess intakes of some nutrients from compensating for inadequacies of others.

Madden and co-workers (26) used MAR values to compare the validity of 24-hour dietary recall data collected from 76 elderly subjects with their food intake recorded by trained observers. Likewise, Guthrie and Scheer (19) used MAR to test the validity of a quality score based on the Basic Four Food Guide (17).

In 1973 Hansen (27) observed that 30 percent of food consumed by the American public provided kilocalories almost devoid of nutrients. Because he believed that consumers needed to be educated as to the nutrient density of foods, the researcher formulated an Index of Nutritional Quality (INQ). This index ensured that high quality foods received higher nutrient values than those of lesser quality, in relation to energy content, and was calculated as follows:

$$INQ = \frac{\text{nutrients in a food quantity that contains X number of kilocalories}}{\text{RDA for those nutrients based on X number of kilocalories}}$$

Schafer (28) used a method developed by Yetley (29) to study whether positive self-concept resulted in or was related to better dietary quality. Young married women were interviewed and the amounts of food consumed as well as food frequencies were recorded. Daily intakes of six nutrients, including protein, calcium, iron, vitamin A, thiamin and ascorbic acid, were calculated. A diet which met or exceeded the RDA for all six nutrients was assigned a score of three and rated as "excellent." "Good" and "poor" diets were represented by two points or 67 to 99.9 percent and one point or less than 67 percent of the RDA, respectively.

Gilbert et al. (4) modified the method described above to rate the 24-hour dietary intakes of about 1,300 Kansas fifth grade students. The same six nutrients were considered, but a four-point system was applied to each nutrient. Four points were assigned to intakes equal to or greater than 100 percent of the RDA. Scores of three, two or one were allotted to intakes of 66 to less than 100 percent, from 50 to less than 66 percent and less than 50 percent of the RDA, respectively. If a diet met or exceeded

100 percent of the RDA for all six nutrients a score of 24 points was assigned.

Johnson and colleagues (30) developed and tested the Nutrient Adequacy Reporting System (NARS) for use by extension home economists and their assistants. The System included a food record form on which 150 foods with designated portion sizes were divided into 16 groups on the basis of their unique nutrient contribution. The number of food portions eaten in one day was recorded on the form. If a specified number of food portions were consumed the RDA for 12 nutrients were met. These nutrients included protein, calcium, magnesium, iron, vitamin A, ascorbic acid, vitamin B_6, vitamin B_{12}, thiamin, riboflavin, niacin and pantothenic acid, which could be rapidly calculated by using a simple computer program. The researchers tested the NARS on seven day and 24-hour dietary records obtained from 65 Expanded Food and Nutrition Education Program (EFNEP) assistants. Results of this short method were compared with a long method. Although the method of dietary data collection was not an influencing factor there were differences for six of the 12 nutrients, but the magnitude did not exceed 12 percent in any one case. They concluded that this rapid method for calculating dietary intakes was efficient and effective for monitoring and evaluating the nutrition education programs.

In 1974, Abdel-Ghany (31) designed a Nutrient Sum (NS) technique to measure the quality of household food intake. The total number of nutrients that met or exceeded 67 percent of the RDA was equivalent to the NS. Thus the problem of the intake of one nutrient compensating for another was avoided but there was no way to differentiate between marginally deficient and drastically inadequate dietary intakes because both would receive a score of zero.

Later Abdel-Ghany (32) reviewed some of the methods used for assessing dietary quality. He concluded that MARs still did not completely avoid the problem of compensation, and furthermore that neither MARs nor the NS weighted nutrients that were considered more important than others. Subsequently the researcher chose to use the INQ to evaluate the quality of dietary intakes of 676 North Carolina households. Twenty-four hour dietary recalls were collected and INQ scores calculated for protein, thiamin, riboflavin, niacin, iron, calcium, vitamin A and ascorbic acid. A score of less than one indicated that the diet had a less than proportional content of the nutrient in relation to its caloric content. The disadvantage of this method was that it was limited to those subjects consuming sufficient kilocalories to meet the RDA. Abdel-Ghany (32) stated that the INQ was still a useful supporting measure to evaluate the quality of household diets, because it showed the degree of balance of different nutrients in the diet.

Studies of Eating Patterns

National Surveys

The 1968-70 Ten-State Nutrition Survey was conducted to identify the extent to which malnutrition and health-related problems existed in the United States (U.S.), especially in those areas where the largest percentage of families lived in poverty (33). As a result of the Ten-State survey findings the need to assess and monitor the nutritional status and health of the U.S. population became apparent. Between 1971 and 1974 the first phase of the National Health and Nutrition Examination Survey (NHANES 1) was conducted (34,35). Dietary data from the Ten-State survey and NHANES 1 were analyzed for nutrient adequacy, but no attempt was made

at that time to explore possible relationships between eating patterns and health.

Schwerin et al. (36) were the first researchers to examine the Ten-State and NHANES 1 findings by using an eating pattern concept as a model for associating food intake with nutritional health of selected groups. To study these relationships biochemical, clinical and 24-hour dietary recall data collected from 11,337 Ten-State survey and 20,749 NHANES 1 subjects were used. The study population in the Ten-State survey included pregnant and lactating women, children between the ages of 10 and 16 years as well as adults over 60 years of age. In NHANES 1 subjects were between the ages of one and 74 years. Data from the dietary recalls were classified into 15 food groups in the Ten-State survey and 18 in the NHANES 1 study. For this research the 18 NHANES 1 food groups were reduced to 15. In an alternate analysis a 99 food group system was used to replace the 15 food groups, but the latter provided reasonable differentiation between food groups that was large enough to be meaningful beyond one meal or meal component. The 15 food groups included: dairy products; meats; poultry; shellfish; fish; eggs; soups; fats; legumes and nuts; cereals and grains; fruits, vegetables, and juices; foods primarily sugar; desserts; non-sugary beverages and condiments; as well as mixed protein dishes.

A factor analysis technique based on the quantity of foods consumed rather than caloric values was selected to classify individuals into groups. Seven dominant factors or eating patterns emerged when the number of grams of each food consumed was calculated and statistically analyzed. A score was calculated for every participant for each of the seven eating patterns, whichever factor had the highest score was the eating pattern to which the individual was assigned. The seven factors or eating patterns

had the following characteristics:

1) more dairy, soups--less sugary foods or beverages.
2) more non-sugary beverages--less dairy.
3) more eggs, legumes, nuts, cereal and grain.
4) more meats, vegetables, fruits, juices and desserts.
5) more poultry--less meats.
6) more mixed protein and shellfish.
7) more fish, fats and oils.

These factors were then cross-tabulated with health indices (biochemical and clinical signs), as well as with key demographic data.

Findings from both surveys showed that individuals with the first eating pattern had the fewest clinical symptoms while those with the second pattern had the most. Correlations with biochemical values were less pronounced, but individuals in the Ten-State survey who had eating patterns one and six showed the lowest incidence of biochemical signs. The highest frequency of such signs occurred with the third eating pattern. For subjects in the NHANES 1 study eating patterns three, five and seven had more biochemical signs than individuals with other patterns. NHANES 1 dietary pattern, biochemical and clinical data were analyzed by age group. The most common eating patterns for 10 to 17 year olds were the third and fourth, whereas pattern two was the least common. Subjects with the second and third pattern had more clinical symptoms while those with eating patterns one, four and six had the lowest incidence. For this age group the incidence of biochemical signs was associated with the same eating pattern, with the exception of pattern three. Demographic variables influenced eating patterns of individuals in a variety of complex ways.

Schwerin and co-workers (36) suggested that the major value of the eating pattern concept was that it provided a model by which nutritionists and clinicians could explore the relationship between food consumption and incidence of nutrition-related diseases. They stated that only with continued exploration and evaluation by other researchers would this concept become established as a valid approach to explore relationships between nutrition and health.

The USDA's 1965 Household Food Consumption Survey and 1977-78 Nationwide Food Consumption Survey were planned primarily to gather data regarding the food intakes of individuals representative of the nation's population and to monitor changes in eating patterns. Pao (37) used data from the USDA 1977-78 Nationwide Food Consumption Survey (NFCS) to describe the eating frequencies and patterns of 2,787 children between the ages of three and 18 years, that may be relevant to dental health. Dietary intake information was collected by obtaining 24-hour recalls from the subjects, or their mothers in the case of those under 12 years of age. In general most children ate three or four times (36 and 32 percent, respectively), although one-fourth ate on five or more occasions daily. Teenagers ate the least frequently; 10 percent of the girls and six percent of the boys ate only once or twice daily. Almost all children ate meat or meat mixtures and over 50 percent included them two or more times. Eighty percent drank milk and over half consumed it twice or more daily. On the day of the interviews, 25 percent ate eggs and 20 percent reported eating cheese; legumes, soups, nuts and seeds were less popular foods. Only one-third of the subjects included fruits and the same number did not eat vegetables. Slightly fewer than half of the children ate potatoes. Bread was included in the diets of 80 percent of the children; about half consumed bread two

or more times daily. Ready-to-eat cereals were eaten by 50 percent of the subjects, whereas pasta, crackers, cooked cereals and salty snack foods were mentioned by one-fifth or fewer. Between one-tenth and one-fifth of the children reported consumption of cake, cookies, doughnuts, sweet rolls, pies and candy, although nearly half included sugars and sweet spreads. With the exception of milk, soft drinks were the most popular beverage followed by juices and tea or coffee, they were included by 50 percent, 30 percent and 20 percent, respectively. Fats and oils appeared in the dietary recalls of half of the subjects.

Snacks were eaten by two-thirds of the children, with 35 percent eating one, 20 percent eating two and 12 percent eating three or more per day. Evening snacks were consumed by half, while one-third ate their snacks in the afternoon and fewer in the morning. Snack preferences of younger children were milk, bakery products especially cookies and soft drinks, in that order. Male teenagers (12 to 14 years of age) consumed the following snacks in order of preference: carbonated beverages, milk, bakery products, bread, milk desserts, salty snacks, nuts and fruits; while their female counterparts selected carbonated beverages, bakery products, milk desserts, salty snacks, fruits, milk, candy, bread and meats. Of the age groups studied, teenagers ate salty snacks most frequently and candy was least popular with teenage boys.

Cronin et al. (38) reported food usage and average frequency of consumption of foods based on three day food records of 1,923 individuals included in the USDA 1977-78 NFCS. Data were presented for 65 food groups and a number of demographic variables. Ten commodity-based food groups were subdivided into 65 on the basis of similar composition, ease

with which data could be extracted and similar ways in which foods are used. The researchers emphasized the need for care in the interpretation of findings as multiple factors affect food usage.

The 11 to 14 year olds consumed two and a half servings of bread and cereals, two servings each of vegetables and milk, as well as slightly less than two servings of the high protein foods daily. Sugary products were eaten one to two times, whereas fruits and fats were consumed slightly more than once daily. This age group tended to include slightly more bread, cereals, milk and vegetables but slightly less fruit, high protein foods, fats, sugary products and non-sugary beverages than the sample population. Students between seven and 14 years of age ate the lowest percentage of whole grain bread and cereals of any age group. Total sweet food consumption had decreased during the previous decade but candy was still very popular with children under 15 years; 25 percent of them ate candy compared to 15 percent of the total population. Sugar-based beverages were most popular and soups were the least among 15 to 17 year olds. Those under 18 years of age, especially males, had the highest consumption of desserts. Condiments and salty snack foods were most often used by children from seven to 17 years of age, and milk was more popular with children and adolescents than adults.

Student Surveys

Since food habits and eating patterns are dynamic and developmental, behaviors that develop during childhood should be examined. Meal frequency as well as the number and composition of snacks play an important role in the quality of children's and more especially adolescents' food intakes.

Hinton et al. (8) assessed the quality of diets consumed by 12 to 14 year old Iowa girls by calculating the percentage intake of foods in the basic food plan. They found that students seldom missed meals nor did they consume many snacks. In general, winter dietary intakes were better than those diets consumed during the summer, probably because children were in school and ate more regularly at that time. Intakes of milk, tomatoes, leafy green vegetables, deep-yellow fruits and vegetables were low. The researchers noted that good diets were highly related to milk intake while the percentage of missed meals was closely associated with poor diets. They suggested that milk intake was a reliable index of dietary quality, regardless of the season. The number of servings of food as well as the variety of food items consumed daily, were highly correlated with dietary adequacy which reinforced the importance of a varied diet.

A scoring system based on 10 food groups was used by Trenholme and Milne (9) to study seven day food records of ninth grade students. Although boys had better diets than girls, over half of the students had poor dietary intakes. Only one-third of the boys and one-fourth of the girls met the weekly milk intake requirement. Cheese was eaten by more than half of the students. Less than one-fifth of the girls and only one-tenth of the boys ate more than two servings of fruit per week. Apples were the most popular fruit consumed by students. About 20 percent of the subjects ate no vegetables and only five percent met the weekly requirements. Potatoes, frequently as French fries, were consumed by most students. Almost all of the subjects (95 percent) met the meat requirement, but fewer than 20 percent ate liver during the week of the study. Boys ate more eggs than girls, but nearly 20 percent did not consume that food. Bread was consumed in large quantities, especially by boys, with

80 percent of them and 50 percent of the girls reporting that they ate more than four slices daily. Although whole grain cereals and breads were selected by half of the students the total quantities eaten were minimal. Less than half of the teenagers ate sweet foods three to four times daily, but about 75 percent of the subjects consumed slightly less than four sweetened drinks weekly. At the time of the study 13 percent of the students were taking a vitamin D supplement.

Trenholme and Milne (9) found that low ratings were associated with diets consisting primarily of meat, bread, potatoes and sweets. Boys' diets were superior to those of girls because the girls drank less milk and were often preoccupied with food fads or slimming diets.

Fábry and colleagues (39) studied the effect of meal frequency on the incidence of obesity in 226 children, between the ages of six and 16 years, living in three Czechoslovakian boarding schools. The study was conducted over a period of one year, during which time the schools provided three, five or seven meals per day. Findings showed that weight to height ratios and skinfold thicknesses were highest for 10 to 16 year olds, especially girls, who attended the school with a three meal regimen. Meal frequency was not related to the incidence of obesity in younger children.

In a statewide study of 80,000 Massachusetts first to twelfth grade students Callahan (40) noted that good eating habits decreased with increasing age. Fourth to sixth grade boys had better food intakes than girls. When the dietary intakes of this age group were assessed for adequacy on the basis of the Basic Four Food Guide more children (82 percent) met the milk requirement than any other age group. Although two-thirds of the children in this age range ate enough meat, only 50 percent met the fruit and vegetable requirement. Citrus fruits and tomatoes were

more popular than dark-green and deep-yellow vegetables. Sweet foods including desserts, snack foods and sugar-coated cereals were eaten by more than three-fourths of the children three or more times daily.

Patterson et al. (41) collected 24-hour dietary recalls from 92 high and low income fourth to sixth grade students and evaluated them according to the Basic Four Food Guide. Only about 10 percent met the Guide recommendations and most children were confused about which foods they needed to consume to have an adequate diet. Most of the children in both income groups obtained one-fifth of their energy requirements from snacks. The high income group of students consumed the following snack items in order of preference: soft drinks, cookies, milk, ice cream, candy and fresh fruit; whereas their low income counterparts selected: milk, cookies, soft drinks, bread, fresh fruit and cake in that order.

Three day diet records of 118 seventh to twelfth grade students were evaluated by Schorr and others (12) using the Guttman scale (13). Whole milk, yeast breads and rolls as well as beef were the first three steps of the scale and all were consumed by over 90 percent of the students. The fourth step included sweet foods and salty snack items, which were eaten by 92 percent of the subjects. The last three steps of the scale were fruits, orange juice and dark-green or deep-yellow vegetables, which were consumed by 69 percent, 54 percent and 28 percent of the adolescents, respectively. As each successive step of the scale indicated increasing complexity of eating patterns, it was not surprising that the quality of the diet was positively related to its complexity. At step seven, the first level at which all major food groups were present, less than one-third of the subjects met the requirements for inclusion which suggested that few diets were adequate.

Another study of adolescents' dietary intakes was conducted by AuCoin et al. (14). They assessed dietary quality of 10, 13 and 15 year olds using a score based on Canada's basic food groups. Again boys had higher dietary scores than girls. Of the age groups studied, 10 year olds were the only group in which more than half of the children met the recommendations. Three-fourths of the younger students, but only half of the older students had adequate milk intakes. Meat consumption was sufficient for over 90 percent of the three age groups. Fruits, which were generally limited to apples, bananas or oranges, were eaten by about half of the 10 and 13 year olds, but by only one-fourth of the oldest group. About 50 percent of subjects in all age groups met the vegetable intake recommendations. Bread consumption was adequate for about 80 percent of all students, while cereals were the least popular of any major food group.

Follow-up studies were conducted by Haley et al. (15) to determine whether or not the diets of 10 year olds, as studied by AuCoin and co-workers (14) deteriorated with increasing age. The findings supported those of the earlier study. Intakes of milk, fruit, cereals and meats were found to decrease most markedly with age. Fifteen year olds in 1970 not only had the poorest diets of the three age groups, but those of the same age in 1975 were considerably worse than in 1970, with the exception of milk and vegetable consumption. In the diets of 15 year olds milk was often replaced by fruit juices, soft drinks, tea or coffee.

Howe and Vaden (25) studied the differences between teenage participants and non-participants in the school lunch program. They noted that school lunch program participants had superior intakes to those of non-participants, and that boys had better quality diets than girls. About one-fifth of the students (12 boys and eight girls) were taking vitamin

supplements, which made a positive contribution to the diets of boys with inadequate intakes. Whereas 21 percent omitted breakfast, less than half that number missed lunch or dinner. Snacks were an important part of adolescents' eating patterns, regardless of sex or school lunch participation, as they provided 22 to 45 percent of the day's nutrient intake. They recognized the critical role snacks play in the adequacy of teenagers' diets and emphasized the importance of teaching students how to select nutritious snack foods.

The seven day food intake records of 657 children, between the ages of five and 12 years, were examined by Cala et al. (42). The purpose of the study was to determine the role of snacks in grade-school children's diets. Initially foods were classified into 94 groups which were subsequently combined into the following 12 groups: beverages other than milk; fruit and vegetables; milk; cookies; salted snack foods (SSFs); frozen confections; cakes, pies and other desserts; candy; bread and cereal; mini-meal items; small pastries and other dairy products. Sandwiches, pizza and casseroles were included as mini-meal items. Beverages other than milk, such as carbonated and non-carbonated sweetened beverages; fruit juices; fruit ades; tea and coffee were the most frequently consumed snack items. Milk was the single most popular food, but rated third after fruits and vegetables. Other food groups that were selected by more than 10 percent of the children were cookies, SSFs, frozen confections and the dessert group in that order of preference. Afternoon and evening snacks were consumed by about twice as many students as morning snacks, and they were also more substantial in nature. Cala and colleagues (42) noted that although an increased number of snacks meant additional kilocalories, the snacks often provided essential nutrients as well as kilocalories. When

no snacks were consumed subjects ate larger, but not necessarily more nutritious meals, which resulted in higher total caloric intakes than when snacks were eaten.

Morgan and others (43) used the same dietary data as Cala et al. (42) to evaluate whether or not salted snack foods have a negative impact on the nutritional adequacy of children's diets. Salted snack foods (SSFs) included popcorn, pretzels, cheese twists, potato sticks, bacon rinds, potato, corn and tortilla chips. Total SSF consumption for one week as well as average weekly and daily values were calculated for each of the eight snack items. Eighty-three percent of the children consumed these foods, but less than one percent ate what they considered excessive quantities (more than 20 percent of the daily caloric intake). Only at the excessive intake level was there a trend towards lower intakes of some key nutrients. The researchers stated that children should be educated to use these popular foods in moderation, without compromising the nutritional quality of their diets.

Stults and others (44) used seven day food records to investigate beverage consumption habits of 1,135 students, between the ages of five and 18 years. The following six beverage groups were selected: milk and milk products, carbonated sweetened beverages, non-carbonated sweetened drinks, fruits and vegetable juices, tea and coffee. The data were analyzed on the basis of weekly consumption because considerable day to day variability existed. Based on this observation they stated that 24-hour dietary recalls were thus unsuitable for predicting average beverage intakes. Although milk and milk products as well as carbonated sweetened beverages were both used by 80 percent of the subjects the milk group was consumed in larger quantities. Milk was also the most popular beverage at all

meals and as a snack item. The volume of fruit and vegetable juices that students drank was surprisingly low. The consumption of carbonated sweetened drinks and tea increased with age. Because no data were collected on the availability of beverages at the time of consumption they were unable to determine whether or not children substituted carbonated drinks for milk.

As part of the Nutrition Education and Training Program (NETP) Lai and Shimabukuro (45) conducted a needs assessment survey in Hawaii in 1979. Twenty-four hour dietary recalls were obtained from 890 elementary, junior and senior high school students. The average ages were 10, 13 and 16 years, respectively and about equal numbers of male and female students were included in the study. In terms of nutritional quality the diets deteriorated with increasing age. Students who ate breakfast had significantly better eating patterns than those who missed that meal. Snacks contributed about the same number of kilocalories as one meal for elementary school pupils, but substantially more, sometimes twice as much, for senior high students.

At about the same time the State Department of Education contracted Kansas State University to conduct a statewide needs assessment, using NETP funds (4). According to the 24-hour dietary recall data from approximately 1,300 Kansas fifth grade students meals were rarely missed. Breakfast was consumed by 92 percent of the children, lunch by 99 percent and dinner by 97 percent. Three-fourths, one-half and less than one-tenth of the students ate afternoon, evening and morning snacks, respectively. Snack items contributed between 10 and 40 percent of some of the key nutrients. About one-third of the boys and girls took nutrient supplements on the day of the interview, but almost half reported taking

supplements. Males had significantly better quality diets than females, with and without nutrient supplements.

MacDonald et al. (21) examined the nutritional quality of 24-hour dietary intakes of adolescent girls. When the diets rated as "good" or "poor" were cross-tabulated with a number of selected variables they found that students with "good" diets consumed more food and more kilocalories from each food group than their counterparts with "poor" diets. Those with food intakes classified as "good" included three to four servings of milk or milk products, four to five servings of bread and cereals, about four servings of fruit and vegetables as well as approximately two servings of meat or meat alternatives, daily. Whereas students who consumed "poor" diets ate considerably fewer numbers of servings from all the major food groups. In addition, more adolescents with "poor" dietary intakes were dieting on the day of the interview, had attempted to lose weight previously and favored skipping one or more meals to lose weight, than their counterparts with "good" diets. Students with food intakes designated as "poor" also tended to be heavier and have increased skinfold thicknesses, than adolescent girls with "good" diets.

METHODOLOGY

Data Collection and Analysis in the Kansas Needs Assessment Project

During the 1980 Nutrition Education and Training Program (NETP) needs assessment project, data were collected from 3,231 fifth grade students in 97 randomly selected Kansas elementary schools. The collection period included 16 weeks between February and May 1980, during which a five-member research team made on-site visits to schools. Standard procedures were used to conduct 24-hour dietary recall interviews (25, 46-48) on a randomly selected subsample of 1,309 students. No data were obtained on Mondays as weekend dietary intakes could be atypical (49,50). Nutrient and energy intakes of Kansas fifth grade students were calculated from the data.

The meal at which foods were consumed was coded to permit analysis of nutrient intake, with and without nutrient supplements, by meal as well as for the whole day. Breakfast, lunch, dinner; a.m., p.m., and the evening snack were classified as meals one to six, while nutrient supplements constituted the seventh meal. As students were frequently unaware of the brand name of the supplement they had consumed, the value of a standard multivitamin[1] was used, unless a specific brand or type was reported.

The data base of the DIETCHECK developed at the University of Nebraska Extension Service was used for nutrient input data for a computer program to convert food intake data into nutrient values by meals.

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[1]Miles Laboratory, "One-A-Day brand."

Dietary intakes of energy and 13 nutrients were calculated on the basis of all fifth grade students who reported eating each meal. The 13 nutrients included protein, total fat, carbohydrate, vitamin A, ascorbic acid, thiamin, riboflavin, niacin, vitamin B_6, calcium, phosphorus, magnesium and iron. As there are no established RDA (6) for fat and carbohydrate, these two were omitted when the analysis for energy and nutrients were computed as percentages of the RDA. Seven interviews were eliminated because of incomplete records, thus reducing the sample to 1,302 students. Initially the RDA for seven to 10 and 11 to 14 year old boys and girls were used, but because 92.1 percent of those less than 11 years were between 10.5 and 10.9 years, using the younger age category gave a skewed distribution. It was decided to apply the RDA for 11 to 14 years and exclude data for students less than 10.5 years of age, as they were a relatively small group. This resulted in a further reduction in the sample size to 1,251 subjects (4).

Assignment of Foods to Groups and Categories

The one day diet records of Kansas fifth grade students included 525 of the 1,000 foods listed in the data base. The first step in this data analysis was to reidentify the foods consumed by students from the food codes. Systems of classifying foods into related groups were reviewed, including those employed in the Ten-State survey (33), NHANES 1 (34), and the USDA 1977-78 NFCS (37,38,51). A modification of the NFCS system was used to group foods on the basis of similar composition. Foods were then divided into 49 related groups of which the first 45 consisted of foods and the remainder were nutrient supplements (Table 1). In order to show meaningful trends in eating patterns of Kansas fifth grade students food

Table 1 Definition of 49 food groups

	food group	foods included
1.	cheese	American, cheddar, cottage, cream, Swiss, Parmesan
2.	milk desserts	ice cream, ice milk, cereal-milk puddings
3.	milk, plain	whole, skim, 2%, buttermilk, plain yogurt
4.	flavored-milk products	flavored milks, fruit yogurt
5.	eggs	raw, cooked, egg dishes
6.	red meats	beef, lamb, veal
7.	liver	beef
8.	pork	chop, roast, ham, ham salad, Canadian bacon
9.	luncheon meats	frankfurters, sausages, sausage dishes, luncheon meats
10.	poultry	chicken, turkey, other poultry
11.	fish	fish and fish dishes
12.	shellfish	shellfish
13.	protein casseroles	meat and vegetable, meat and grain, fish and grain, dairy and grain, meat and legume
14.	soup	vegetable, dairy, meat-based soups
15.	legumes	dried beans, peas, lentils
16.	nuts and seeds	coconut, pecans, walnuts, peanuts, peanut butter, sunflower seeds, sesame seeds
17.	breads	yeast breads and rolls
18.	cereals, cooked	cooked breakfast cereals, e.g. wheat, corn, oats, rice
19.	cereals, ready-to-eat	ready-to-eat cereals, e.g. puffs, flakes, sugar-coated
20.	crackers	sweet and non-sweet crackers
21.	pasta	pasta, e.g. noodles, except in soups and protein casseroles
22.	quick breads	quick breads, e.g. biscuits, muffins, baking powder breads
23.	snack foods	grain-based chips, popcorn, pretzels
24.	cake	cup cakes, sheet cakes, brownies
25.	cookies	all varieties
26.	doughnuts and sweet rolls	doughnuts, sweet rolls, breakfast bars

Table 1 Definition of 49 food groups (continued)

	food group	foods included
27.	pies and pastries	fruit crisps, all fruit and cream pies
28.	condiments	pickles, olives, relishes, tomato sauces, catsup, mustard, soy sauce, sweet and sour sauce
29.	potatoes	white potato items, potato chips
30.	deep-yellow vegetables	sweet potatoes, carrots
31.	dark-green vegetables and tomatoes	broccoli, spinach, tomatoes
32.	starchy vegetables	corn, peas
33.	other vegetables	all other vegetables excluding those in groups 29 through 32
34.	citrus fruits	fresh, canned or frozen citrus fruits and juices
35.	non-citrus fruits	all other fresh, canned or frozen fruits and juices
36.	candy	all candy
37.	gelatin desserts	gelatin desserts and fruit-gelatin salads
38.	sugars and sweet spreads	sugars, sirups, honey, preserves, popsicles
39.	alcohol	beer
40.	fruit ades	fruit-flavored drinks and ades
41.	carbonated beverages	sweetened carbonated beverages
42.	fats and oils	fats, oils, table spreads, salad dressings, mayonnaise, bacon except Canadian
43.	cream,sauces and gravies	dairy sauces, gravies, cream, cream substitutes
44.	coffee and tea	coffee and tea
45.	low-calorie beverages	artifically sweetened carbonated beverages
46.	vitamins	vitamin supplements
47.	minerals	mineral supplements
48.	vitamins-minerals	vitamin-mineral supplements
49.	protein	protein supplements

groups were reduced into a smaller number of major categories. The 49 food groups were collapsed into 11 food categories, of which 10 consisted of foods and one of nutrient supplements (Table 2). The food classification used was a modification of the system used in the USDA Nationwide Food Consumption Survey (1977-78 (51).

Calculation of Mean Adequacy Ratios (MARs)

The NETP needs assessment project data from the 24-hour dietary recalls were expressed as percentages of the RDA for energy and 11 nutrients. For this study only nine of the 11 nutrients and energy were used to calculate quality scores or mean adequacy ratios (MARs) (5). Phosphorus was excluded because intake of this mineral is almost always higher than that of calcium and is thought to be entirely adequate in most individuals' diets (52). Niacin was omitted because average diets in the United States supply 500 to 1,000 mg tryptophan and eight to 17 mg of niacin daily for a total of 16 to 34 mg of niacin equivalents (6), which far exceeds the RDA. For the nine nutrients and energy, nutrient adequacy ratios (NARs) (5) or percentages of the RDA were calculated for each student. Since the NAR represents an index of adequacy based on the appropriate RDA, the age and sex of each subject must be considered. To judge overall dietary quality, mean adequacy ratios (MARs) (5) were calculated. All NAR values exceeding 100 percent were truncated to 100 to prevent intakes in excess of the RDA for one nutrient compensating for inadequacies of others. The mean adequacy ratios (MARs) were obtained by using the following equation:

$$MAR = \sum_{i=1}^{K} \chi_{i/K} \quad \text{when } \chi_i = NAR \text{ if } NAR \leq 100 = [NAR-100] \text{ if } NAR > 100$$

Table 2 Definition of 11 food categories

	food category	food groups included
1.	milk and milk products	cheese (1), milk desserts (2), plain milk (3), flavored-milk products (4)
2.	high protein	eggs (5), red meats (6), liver (7), pork (8), luncheon meats (9), poultry (10), fish (11), shellfish (12)
3.	mixed protein dishes	protein casseroles (13), soups (14)
4.	legumes and nuts	legumes (15), nuts and seeds (16)
5.	grain products	breads (17), cooked cereals (18), ready-to-eat cereals (19), crackers (20), pasta (21), quick breads (22), snack foods (23), cake (24), cookies (25), doughnuts and sweet rolls (26), pies and pastries (27)
6.	vegetables	condiments (28), potatoes (29), deep-yellow vegetables (30), dark-green vegetables and tomatoes (31), starchy vegetables (32), other vegetables (33)
7.	fruits	citrus fruits (34), non-citrus fruits (35)
8.	sugary products	candy (36), gelatin desserts (37), sugars and sweet spreads (38), alcohol (39), fruit ades (40), carbonated beverages (41)
9.	fats	fats and oils (42), cream, sauces and gravies (43)
10.	non-sugary beverages	coffee and tea (44), low-calorie beverages (45)
11.	supplements	vitamin (46), mineral (47), vitamin-mineral (48), protein (49)

[1]Numbers in parentheses refer to the food group numbers in Table 1.

Two MAR values, with and without nutrient supplements (MAR 1 and MAR 2, respectively) were calculated. The MAR indexes were computed by sex, which eliminated another nine subjects because of missing sex data. The final sample consisted of 1,242 subjects, 633 girls and 609 boys.

Establishment of Ranges of Mean Adequacy Ratios (MARs)

The MAR values were grouped into six ranges as follows:

100
90 to <100
75 to <90
66 to <75
50 to <66
<50

Because two-thirds of the RDA has been used routinely in group assessment for signifying nutrient adequacy, that value was used as a starting point for establishing ranges. When an average value such as MAR is used it is possible that a number of high nutrient values may compensate for low values, resulting in an "acceptable" MAR. For this reason the cutoff point for nutrient adequacy may need to be higher. Since an increase in sample size improves the quality of information obtained from 24-hour dietary recalls (53), the data also were analyzed using a four range system as follows:

90 to 100
75 to <90
66 to <75
<66

Data Analysis

Standard statistical coding procedures (54) were followed to assign new variable names to food groups and categories which were then entered on the computer terminal. A computer program was written to combine data

from the 24-hour dietary recalls and the new variables, so that food frequencies expressed as percentages, were generated for 49 food groups and 11 food categories. This analysis enabled the eating patterns of Kansas fifth grade students to be examined.

Regression analysis was used to examine the effects of consumption of foods in categories on the MAR values of boys and girls. A stepwise regression procedure, adjusted for sex, was used to study the effect of consumption of a food group or category on the MAR value, including nutrient supplements. A significance level of 0.15 was the criterion for the inclusion of the food group or category in the statistical model. A food group or category entered the model according to its relative contribution to the MAR value. The group or category was subsequently eliminated from the model if after the introduction of other groups or categories it no longer made an important contribution to the MAR index. The same procedure was used for the MAR value, excluding nutrient supplements, by eliminating the appropriate food groups or food category from the models.

For each of the six and four ranges of MAR 1 and MAR 2, average values for frequency of consumption of foods in the 11 categories were calculated. In order to examine possible sex differences, values for boys and girls were compiled separately.

RESULTS AND DISCUSSION

Frequency of Consumption of Foods in Designated Groups

The number of times that Kansas fifth graders ate specified foods in one day is listed in Table 3. In the milk and milk products group, plain milk was most popular with two-thirds of the students drinking milk once or twice daily and nearly 20 percent three times. Flavored-milk products were consumed by less than half, while cheese and milk desserts were eaten by approximately 20 percent of the subjects. About half of the students included red meats, primarily beef, in their daily diet, whereas one-fifth consumed eggs, pork and luncheon meats. Poultry and fish appeared to be less popular. Mixed protein dishes, especially casseroles, were consumed at least once daily by 50 percent of the boys and girls, while less than one-tenth mentioned soups. Although one-fifth of the students included nuts and seeds, very few ate legumes.

Breads, which included yeast breads and rolls only, were eaten by 85 percent of the boys and girls, often on two or three occasions. Cooked cereals and pasta were not selected often, but on the day of the interview about half of the students consumed ready-to-eat cereals. Variety breads, pies and pastries were eaten by less than 20 percent, while at least one-quarter of the subjects had eaten cakes and cookies.

Fruits were consumed on more occasions than vegetables. Tomatoes, dark-green and deep-yellow vegetables were eaten infrequently, perhaps because of seasonal availability or cost, but one-third had eaten starchy vegetables such as peas and corn. Potatoes and non-citrus fruits or juices were mentioned by half of the students. Fewer than 50

Table 3 Percentage of 1251 Kansas fifth graders eating specified foods designated number of times in 1 day

	food groups	number of times				
		0	1	2	3	4 and over
1.	milk and milk products					
	cheese	73.8	22.1	4.0	0.1	0.0
	milk desserts	78.1	19.3	2.6	0.0	0.0
	plain milk	15.4	29.1	33.8	17.5	4.2
	flavored-milk products	55.5	38.0	5.7	0.7	0.1
2.	high protein					
	eggs	81.2	17.6	1.2	0.0	0.0
	red meats	49.6	42.5	7.7	0.2	0.0
	liver	99.1	0.9	0.0	0.0	0.0
	pork	77.7	21.0	1.3	0.0	0.0
	luncheon meats	75.0	21.3	3.3	0.4	0.0
	poultry	88.5	9.4	2.1	0.0	0.0
	fish	88.6	11.1	0.3	0.0	0.0
	shellfish	99.0	1.0	0.0	0.0	0.0
3.	mixed protein dishes					
	protein casseroles	46.9	43.4	8.8	0.9	0.0
	soups	91.5	8.1	0.4	0.0	0.0
4.	legumes and nuts					
	legumes	93.3	6.5	0.2	0.0	0.0
	nuts and seeds	78.6	19.5	1.8	0.1	0.0
5.	grain products					
	breads	15.6	40.2	31.2	11.1	1.9
	cooked cereals	90.5	8.9	0.6	0.0	0.0
	ready-to-eat cereals	54.3	43.2	2.5	0.0	0.0
	crackers	83.1	15.4	1.4	0.1	0.0
	pasta	94.5	5.3	0.2	0.0	0.0
	quick breads	83.3	14.5	1.9	0.2	0.1
	snack foods	85.8	12.4	1.7	0.1	0.0
	cake	71.9	23.1	4.5	0.4	0.1
	cookies	64.4	28.1	6.1	1.4	0.0
	doughnuts and sweet rolls	82.6	15.2	2.1	0.1	0.0
	pies and pastries	91.1	8.7	0.2	0.0	0.0

Table 3 Percentage of 1251 Kansas fifth graders eating specified foods designated number of times in 1 day (continued)

food groups	number of times				
	0	1	2	3	4 and over
6. vegetables					
condiments	59.0	25.6	10.3	4.0	1.1
potatoes	38.9	43.2	16.2	1.6	0.1
deep-yellow vegetables	87.3	12.0	0.7	0.0	0.0
dark-green vegetables and tomatoes	87.7	11.4	0.8	0.1	0.0
starchy vegetables	65.7	29.2	5.0	0.1	0.0
other vegetables	49.0	37.1	12.0	1.6	0.3
7. fruits					
citrus fruits	55.0	33.6	9.8	1.4	0.2
non-citrus fruits	39.4	43.0	12.8	3.6	1.2
8. sugary products					
candy	76.8	18.5	3.6	0.9	0.2
gelatin desserts	87.9	11.5	0.5	0.1	0.0
sugar and sweet spreads	37.6	39.7	16.3	4.9	1.5
alcohol	99.9	0.1	0.0	0.0	0.0
fruit ades	83.0	13.6	2.8	0.6	0.0
carbonated beverages	70.2	25.3	3.8	0.5	0.2
9. fats					
fats and oils	23.7	36.9	26.6	9.0	3.8
cream, sauces and gravies	77.5	20.4	1.9	0.2	0.0
10. non-sugary beverages					
coffee and tea	81.0	16.4	2.1	0.4	0.1
low-calorie beverages	98.4	1.3	0.2	0.1	0.0
11. supplements					
vitamin	68.3	27.3	4.0	0.2	0.2
mineral	98.3	1.4	0.3	0.0	0.0
vitamin-mineral	95.7	4.3	0.0	0.0	0.0
protein	99.8	0.2	0.0	0.0	0.0

percent of the boys and girls reported consumption of citrus fruits or juices.

Sugars and sweet spreads were included by 60 percent of the students, whereas one-quarter ate candy and drank carbonated beverages. The fats and oils group, which included table spreads, cooking fats or oils, and salad dressings, was recorded several times daily by most students; but gravies and sauces were mentioned less frequently. About one-third of the students took nutrient supplements daily, especially vitamin tablets.

Food frequency data from the 1977-78 USDA Nationwide Food Consumption Survey (NFCS) were used by Pao (37) to examine eating patterns of three to 18 year olds, in relation to their dental health. The average frequency of consumption of foods by Kansas fifth grade students was similar to that of their national counterparts. Kansas students however, consumed more flavored-milk products, breads, cake, cookies, potatoes, fruits, fats and oils but fewer eggs than was true in the national survey.

Frequency of Consumption of Foods in Designated Categories

When the 49 food groups were reduced to 11 food categories similarities in eating patterns were found. Average frequency of consumption of foods, in the 11 food categories, by Kansas fifth grade students is listed in Table 4. Milk and milk products were consumed by all but 3 percent of the students, with the majority consuming them at least two or three times daily. High protein foods, including eggs, poultry, fish and meats were eaten by 90 percent of the subjects, usually once or twice per day. Over half of the Kansas fifth grade students consumed

Table 4 Percentage of 1251 Kansas fifth graders eating foods within specified categories designated number of times in 1 day

food categories	number of times						
	0	1	2	3	4	5	6 and over
1. milk and milk products	3.4	13.6	28.4	28.8	16.2	6.6	3.0
2. high protein	10.0	40.2	34.8	11.8	2.8	0.4	0.0
3. mixed protein dishes	40.9	46.6	11.4	1.1	0.0	0.0	0.0
4. legumes and nuts	73.5	22.8	3.5	0.2	0.0	0.0	0.0
5. grain products	0.2	4.6	15.2	27.4	26.4	15.9	10.3
6. vegetables	7.2	16.6	24.5	20.2	17.6	6.7	7.2
7. fruits	21.2	37.3	26.3	10.1	3.8	1.0	0.3
8. sugary products	12.0	25.4	25.6	19.8	10.2	4.2	2.8
9. fats	19.7	31.9	28.8	12.6	4.5	2.2	0.3
10. non-sugary beverages	79.7	17.3	2.3	0.6	0.1	0.0	0.0
11. supplements	63.5	31.6	4.0	0.5	0.2	0.0	0.2

mixed protein dishes in their daily diets, while only about one-quarter ate legumes, nuts or seeds.

More than 99 percent of the students ate grain products and most included this category three or more times per day. Vegetables were consumed more frequently than fruits, when all types of vegetables were combined. Sugary products such as candy, fruit ades, carbonated beverages and sugars were consumed by half of the students one or two times daily. The majority of the fifth graders included fats and oils once or twice daily and one-fifth consumed them three or more times. Fewer than one-fifth reported no intake of this food category. Non-sugary beverages, such as tea, coffee and low-calorie drinks were consumed by about 20 percent of the students. Again one-third of the students included nutrient supplements daily. These data indicate that milk and grain products were consumed most frequently, followed by high protein foods, vegetables and sugary products.

When compared to the data reported by Cronin et al. (38) based on the USDA 1977-78 NFCS, some similarities in the eating patterns of Kansas students and their national counterparts, were evident. Boys and girls in Kansas ate grain products considerably more frequently than children of the same age in the nationwide survey. Average consumption of foods from the milk and milk product, fruit, sugary product and fat categories also was greater in Kansas than for students nationally. Intakes of high protein foods, mixed protein dishes, legumes and nuts as well as non-sugary beverages was similar for both groups.

Effect of Consumption of Foods in Designated Categories on Mean Adequacy Ratios (MARs)

In a regression analysis the 11 food categories were used as estimators of MAR values, with and without nutrient supplements (Table 5). Milk and milk products had the greatest positive effect on both MAR indexes. Vegetables were second in importance as an estimator of quality scores. The next two categories which affected the MAR 1 values were mixed protein dishes followed by nutrient supplements. When the nutrient supplements were excluded (MAR 2) fruits preceded mixed protein dishes in order of importance. Fruits, high protein foods and grain products followed in decreasing order of importance to MAR 1 indexes, but the relative contribution of the latter two categories was reversed for MAR 2. The food categories mentioned so far were all significant estimators of the MAR values at the $p \leq 0.001$ level. Legumes and nuts, fats and sugary products had the least positive effects on both quality scores. Non-sugary beverages had a negative influence on MAR indexes, with and without nutrient supplements. This suggests that when students included tea, coffee or low-calorie drinks they may have substituted one of these beverages for a food or foods that would have resulted in a higher MAR value. In general, boys had better MAR indexes than girls.

When the stepwise regression procedure was used the results were similar for both MAR values. Food categories entered the models in the following descending order of importance: milk and milk products, vegetables, nutrient supplements, fruits, grain products, mixed protein dishes, high protein foods, legumes and nuts, and fats. However there was a reversal of the order in which the final two categories entered the model for MAR 2. Mixed protein dishes affected the MAR values less and

Table 5 Partial regression coefficients and standard errors from analysis of the effects of food categories on dietary adequacy of Kansas fifth grade students (N=1242) from 24-hour dietary recall interviews

variable	MAR 1[1]			MAR 2[2]		
	$\hat{B}_i$	std error	F	$\hat{B}_i$	std error	F
milk and milk products	4.00	0.204	383.63***	4.41	0.211	436.84***
high protein	2.27	0.318	50.80***	2.37	0.329	51.54***
mixed protein dishes	3.60	0.418	74.32***	3.75	0.432	75.24***
legumes and nuts	1.28	0.514	6.23*	1.09	0.523	4.22*
grain products	1.33	0.196	46.33***	1.48	0.202	53.42***
vegetables	1.74	0.168	108.45***	2.04	0.173	138.47***
fruits	1.71	0.239	51.33***	2.33	0.246	89.57***
sugary products	0.03	0.183	0.03	0.05	0.190	0.07
fats	0.38	0.232	2.66	0.52	0.240	4.60*
non-sugary beverages	-0.29	0.519	0.32	-0.41	0.537	0.59
supplements	3.32	0.398	69.70***			
sex (male=1; female=0)	1.19	0.538	4.87*	1.49	0.557	7.21**
df error	1229			1230		
mean square	88.40			94.61		
R^2	0.45			0.47		

[1]The mean adequacy ratio (MAR 1) was calculated by averaging the percentage RDA values for energy and nine nutrients, including supplements, with values over 100% being truncated.

[2]The mean adequacy ratio (MAR 2) was calculated by averaging the percentage RDA values for energy and nine nutrients, excluding supplements, with values over 100% being truncated.

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$

grain products exerted a greater effect in the stepwise than the partial regression analysis. The change in the order of importance was more pronounced for MAR 1 than MAR 2. Neither sugary products nor non-sugary beverages entered the model at the 0.15 significance level, which was consistent with their unimportant roles as MAR estimators in the partial regression analysis.

AuCoin et al. (14) and Haley et al. (15) found that students who had good eating patterns consumed more milk than those with poor eating patterns. They also reported that the consumption of breads and high protein foods was high for all children between the ages of 10 and 15 years, even though their intakes of some other protective foods, such as milk and fruits, decreased with age.

Effect of Consumption of Foods in Designated Groups on Mean Adequacy Ratios (MARs)

The results of the stepwise regression analysis using the 49 food groups as estimators of MAR values, as well as the order in which they entered the model, are listed in Appendix, Table 8. The analysis indicated that the food groups which had the greatest effect on MAR 1 indexes were milk and flavored-milk products, protein casseroles, ready-to-eat cereals, citrus fruits, nutrient supplements, red meats, pork and vegetables especially potatoes and starchy varieties. Citrus fruits, nutrient supplements and vegetables entered the model before protein casseroles, meats and grain-based foods.

When nutrient supplements were excluded, the relative importance of food groups, in the stepwise analysis, was not markedly altered. But the order in which food groups entered the model varied. Fruits,

vegetables, breads and ready-to-eat cereals preceded protein casseroles and meats as contributors to MAR values.

With the inclusion of nutrient supplements, a total of 35 food groups entered the model at a significance level of 0.15, whereas when nutrient supplements were excluded 34 food groups were selected for the model. Food groups which did not affect quality scores were soups, crackers, snack foods, pies and pastries, deep-yellow vegetables, gelatin desserts, sugars and sweet spreads, alcohol, carbonated beverages, cream, sauces and gravies, as well as tea and coffee. Doughnuts and sweet rolls, and the fats group were included in the model for MAR 2, but not MAR 1. Plain and flavored-milk products were the most valuable contributors to the MAR indexes and their relative importance did not change throughout the analyses.

Relationships Between Mean Adequacy Ratios (MARs), Including Nutrient Supplements, and Food Categories

To examine the relationships between different ranges of MAR 1 values and the 11 food categories least square means and standard errors were calculated by sex. When MAR 1 indexes were divided into four ranges (Table 6), average frequency of consumption of milk and milk products, high protein foods as well as legumes and nuts was usually higher for boys than girls. Fruits, fats and nutrient supplements, however were more frequently included by females than males. Average consumption of mixed protein dishes, grain products, vegetables, and sugary products was similar for both sexes. All the students ate grain products often. Subjects (34 percent girls, 43 percent boys) with MAR values between 90 and 100 included more milk and milk products and vegetables than those with MAR indexes below 66 (11 percent girls, 7 percent boys).

Table 6 Average frequency of consumption of foods in 11 categories by Kansas fifth grade girls and boys from 24-hour dietary recall interviews

group	least square means and standard errors											
	N	milk and milk products	high protein	mixed protein dishes	legumes and nuts	grain products	vegetables	fruits	sugary products	fats	non-sugary beverages	supple-ments
MAR 1[1] >90-100												
female	218	3.46 ±0.08	1.72 ±0.06	0.76 ±0.05	0.31 ±0.04	4.06 ±0.09	3.31 ±0.11	1.76 ±0.07	2.04 ±0.10	1.82 ±0.08	0.19 ±0.03	0.57 ±0.04
male	263	3.47 ±0.07	1.77 ±0.06	0.80 ±0.04	0.38 ±0.03	3.40 ±0.09	3.25 ±0.10	1.60 ±0.07	2.42 ±0.09	1.81 ±0.07	0.22 ±0.03	0.54 ±0.04
MAR 1 75-<90												
female	279	2.54 ±0.07	1.58 ±0.05	0.74 ±0.04	0.27 ±0.03	3.39 ±0.08	2.57 ±0.10	1.39 ±0.07	2.15 ±0.09	1.58 ±0.07	0.29 ±0.03	0.47 ±0.04
male	244	2.62 ±0.07	1.54 ±0.06	0.71 ±0.04	0.26 ±0.03	3.75 ±0.09	2.73 ±0.11	1.32 ±0.07	2.00 ±0.10	1.46 ±0.08	0.21 ±0.03	0.42 ±0.04
MAR 1 66-<75												
female	64	1.72 ±0.15	1.36 ±0.12	0.66 ±0.09	0.22 ±0.07	3.75 ±0.17	2.34 ±0.21	1.17 ±0.14	2.25 ±0.19	1.41 ±0.15	0.26 ±0.06	0.13 ±0.08
male	59	2.05 ±0.15	1.44 ±0.12	0.63 ±0.09	0.34 ±0.07	3.47 ±0.18	2.05 ±0.21	1.08 ±0.14	2.25 ±0.20	1.41 ±0.16	0.24 ±0.07	0.14 ±0.09
MAR 1 <66												
female	72	1.38 ±0.14	1.11 ±0.11	0.58 ±0.08	0.26 ±0.06	2.76 ±0.16	1.87 ±0.20	0.99 ±0.13	1.92 ±0.18	1.08 ±0.14	0.25 ±0.06	0.22 ±0.08
male	43	1.46 ±0.18	1.33 ±0.14	0.53 ±0.11	0.35 ±0.08	3.19 ±0.21	2.05 ±0.25	0.93 ±0.17	2.37 ±0.23	1.07 ±0.18	0.40 ±0.08	0.09 ±0.10

[1]The mean adequacy ratio (MAR 1) was calculated by averaging the percentage RDA values for energy and nine nutrients, including supplements, with values over 100% being truncated.

Trends in the eating patterns of fifth graders for the six ranges of MAR 1 resembled those of the four (Appendix, Table 9). With an increase in the number of ranges the sample size of the extreme groups decreased, while average food consumption frequency increased at the 100 level and decreased at the less than 50 range.

Relationships Between Mean Adequacy Ratios (MARs), Excluding Nutrient Supplements, and Food Categories

The MAR 2 values were divided into four ranges, according to sex, and examined in relation to the average frequency of consumption of foods in the 11 categories (Table 7). Again boys had higher MAR values than girls. All students with MAR indexes between 90 and 100 consumed milk and milk products frequently. Males tended to include legumes and nuts, sugary products and non-sugary beverages more often than their female counterparts. Average intakes of high protein foods were similar for both sexes, while grain products, vegetables and mixed protein dishes showed greater variation. In general, girls consumed more fats and fruits than boys. Students (14 percent girls, 8 percent boys) with MAR values less than 66 tended to drink non-sugary beverages more frequently than those with values between 90 and 100 (28 percent girls, 38 percent boys). This implies that boys and girls with low quality scores may have substituted non-sugary drinks for milk.

When the MAR 2 values were divided into six ranges the eating patterns did not change markedly from those of the four range system (Appendix, Table 10). The sample sizes in the extreme groups were less than 25. Results were comparable to those for MAR 1. High average frequency of consumption of milk and milk products as well as vegetables, characterized MAR 2 values in the 90 to 100 range.

Table 7 Average frequency of consumption of foods in 11 categories by Kansas fifth grade girls and boys from 24-hour dietary recall interviews

group	N	least square means and standard errors										
		milk and milk products	high protein	mixed protein dishes	legumes and nuts	grain products	vegetables	fruits	sugary products	fats	non-sugary beverages	supple-ments
MAR 2[1] >90-100												
female	182	3.54 ±0.09	1.75 ±0.07	0.79 ±0.05	0.30 ±0.04	4.09 ±0.10	3.37 ±0.12	1.76 ±0.08	1.99 ±0.11	1.92 ±0.09	0.17 ±0.04	0.46 ±0.05
male	230	3.53 ±0.08	1.79 ±0.06	0.81 ±0.05	0.39 ±0.03	3.99 ±0.09	3.35 ±0.11	1.66 ±0.07	2.47 ±0.10	1.85 ±0.08	0.25 ±0.03	0.42 ±0.04
MAR 2 75-<90												
female	283	2.70 ±0.07	1.63 ±0.05	0.72 ±0.04	0.26 ±0.03	3.51 ±0.08	2.65 ±0.10	1.49 ±0.06	2.16 ±0.09	1.64 ±0.07	0.03 ±0.03	0.48 ±0.04
male	249	2.71 ±0.07	1.57 ±0.06	0.69 ±0.04	0.27 ±0.03	3.84 ±0.09	2.77 ±0.10	1.34 ±0.07	1.98 ±0.09	1.49 ±0.07	0.20 ±0.03	0.46 ±0.04
MAR 2 66-<75												
female	78	1.86 ±0.13	1.33 ±0.10	0.71 ±0.08	0.27 ±0.06	3.59 ±0.16	2.50 ±0.19	1.18 ±0.13	2.28 ±0.17	1.26 ±0.14	0.19 ±0.06	0.31 ±0.08
male	78	2.23 ±0.13	1.37 ±0.10	0.72 ±0.08	0.32 ±0.06	3.40 ±0.16	2.10 ±0.19	1.04 ±0.13	2.29 ±0.17	1.38 ±0.14	0.19 ±0.06	0.40 ±0.08
MAR 2 <66												
female	90	1.36 ±0.12	1.12 ±0.10	0.60 ±0.07	0.29 ±0.06	2.83 ±0.15	1.82 ±0.17	0.92 ±0.12	1.93 ±0.16	1.08 ±0.13	0.30 ±0.05	0.41 ±0.07
male	52	1.48 ±0.16	1.44 ±0.13	0.54 ±0.10	0.33 ±0.07	3.25 ±0.19	2.06 ±0.23	0.94 ±0.15	2.27 ±0.21	1.04 ±0.17	0.37 ±0.07	0.27 ±0.09

[1]The mean adequacy ratio (MAR 2) was calculated by averaging the percentage RDA values for energy and nine nutrients, excluding supplements, with values over 100% being truncated.

The results of this study help to explain some of the inadequate nutrient intakes of the Kansas fifth graders, which were reported earlier by Gilbert et al. (4). Even though they found that ascorbic acid and vitamin A intakes were adequate for most students, intakes were low for about one-tenth of the boys and girls. When the eating patterns were examined non-citrus fruits were consumed by more fifth graders than citrus varieties on the day of the interview. More students included potatoes and starchy vegetables than vitamin A-rich varieties, such as dark-green and deep-yellow vegetables. Calcium intakes were low for 20 percent of the girls probably because of low consumption of milk and milk products. Iron intakes were less than two-thirds of the RDA for 37 percent of the girls and 23 percent of the boys, although they included red meats and grain products often. Guthrie and Scheer (19) stated that the high allowance for iron is difficult to meet even when a variety of foods is consumed, partly because of the variability of iron content of foods and partly because there are few rich sources of iron. Although grain product and meat consumption was high there were still over half of the students who did not meet two-thirds of the allowance for magnesium which may be attributed to the low intake of dark-green leafy vegetables. Vitamin B_6 intakes were inadequate for 28 percent of the girls and 18 percent of the boys. Rizek and Jackson (55) pointed out that the scarcity of food composition data for both magnesium and vitamin B_6 could explain, in part, the substandard mean intakes of these nutrients.

SUMMARY

Nutrition education is used widely in the United States for improving nutrition knowledge, attitudes and behavior of individuals and groups. Since school children are in the process of acquiring knowledge and lifetime habits, the school provides an ideal environment for offering this type of education. Better knowledge of the eating patterns of children would allow nutritionists to target nutrition information more effectively. To investigate the eating patterns of elementary students, 24-hour dietary recall data collected from 1,242 fifth graders during the Kansas Nutrition Education and Training Program (NETP) needs assessment project were used. Foods consumed were classified into groups and categories based on similar composition. Dietary quality was assessed by calculating mean adequacy ratios, with and without supplements (MAR 1 and MAR 2, respectively), for each student.

Grain products, primarily yeast breads and rolls, were consumed by 99 percent of the students, often three or four times daily. Almost all (97 percent) of the girls and boys included milk or milk products. High protein foods including eggs, poultry, fish and red meats were eaten by 90 percent of the subjects. Vegetables were consumed by over 90 percent of the children; potatoes and starchy vegetables, such as peas and corn, were more popular than tomatoes, dark-green and deep-yellow vegetables. Sugary products, particularly sugars and sweet spreads, were mentioned by 88 percent of the girls and boys; one-fourth consumed candy and sweetened soft drinks and one-fifth drank non-sugary beverages on the day of the interview. Fats and oils were included by 80 percent of the students, primarily table spreads and salad dressings. Four-fifths of the subjects

included fruits and juices, with non-citrus being more popular than citrus varieties. Nutrient supplements were taken by one-third of the children.

Consumption of milk and milk products was the most important estimator of MAR 1, followed by vegetables, mixed protein dishes, nutrient supplements, fruits, high protein foods and grain products. When nutrient supplements were excluded (MAR 2) fruit and grain products became more important predictors of dietary quality than for MAR 1. Non-sugary beverages adversely affected the quality of children's intakes, suggesting that those drinks were substituted for more nutritious foods. In general, boys had better diets and consumed milk or milk products and high protein foods more often than girls. Fruits, fats and nutrient supplements were included more frequently by females than males. Students with MAR indexes between 90 and 100 consumed foods from the milk and vegetable categories on more occasions than boys and girls with MAR values less than 66, who drank non-sugary beverages more often.

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APPENDIX

Table 8 Regression coefficients and standard errors from a stepwise analysis of the effects of food groups on dietary adequacy of Kansas fifth grade students (N=1242) from 24-hour dietary recall interviews

variable	MAR 1 (including supplements)[1]				MAR 2 (excluding supplements)[1,2]			
	$\hat{B}_i$	std error	F	order[3]	$\hat{B}_i$	std error	F	order[3]
cheese	1.07	0.468	5.23*	30	1.10	0.483	5.18*	27
milk desserts	2.07	0.510	16.45***	18	2.59	0.527	24.18***	12
milk, plain	5.29	0.260	413.38***	1	5.74	0.268	457.57***	1
flavored-milk products	4.32	0.410	110.96***	2	4.88	0.423	132.96***	2
eggs	2.95	0.611	23.30***	16	3.09	0.648	22.72***	17
red meats	3.07	0.466	43.54***	12	3.32	0.481	47.69***	14
liver	7.41	2.642	7.86**	26	8.17	2.728	8.97**	24
pork	3.44	0.610	31.76***	13	3.47	0.629	30.32***	16
luncheon meats	1.98	0.472	17.55***	17	2.00	0.488	16.78***	20
poultry	1.23	0.653	3.58	33	1.32	0.674	3.83	31
fish	1.97	0.802	6.02*	29	1.97	0.829	5.63*	29
shellfish	7.11	2.532	7.88**	25	7.94	2.611	9.25**	23
protein casseroles	4.15	0.415	99.91***	9	4.30	0.429	100.32***	10
soup	-	-	-		-	-	-	
legumes	1.73	0.961	3.25*	32	1.50	0.991	2.29	34
nuts and seeds	0.89	0.548	2.63	35	0.96	0.572	2.84	32
breads	1.40	0.285	24.29***	10	1.28	0.331	14.88***	9
cereals, cooked	1.46	0.800	3.32	31	2.01	0.827	5.89*	25
cereals, ready-to-eat	3.94	0.509	59.75***	11	4.81	0.531	81.99***	7
crackers	-	-	-		-	-	-	
pasta	1.91	1.032	3.43	28	2.11	1.066	3.92*	28
quick breads	2.59	0.566	20.94***	15	2.74	0.598	21.06***	18
snack foods	-	-	-		-	-	-	
cake	1.93	0.424	20.63***	14	2.03	0.439	21.48***	15
cookies	0.63	0.370	2.93	34	0.81	0.385	4.48*	30
doughnuts and sweet rolls	-	-	-		0.94	0.586	2.57	33
pies and pastries	-	-	-		-	-	-	
condiments	1.12	0.289	15.00***	19	1.49	0.302	24.46***	11
potatoes	2.21	0.348	40.34***	6	2.53	0.361	48.91***	4
deep-yellow vegetables	-	-	-		-	-	-	
dark-green vegetables and tomatoes	1.61	0.682	5.56*	23	2.09	0.703	8.83**	22
starchy vegetables	2.43	0.434	31.35***	7	2.58	0.453	32.35***	5
other vegetables	1.47	0.327	20.07***	8	1.55	0.344	20.21***	6
citrus fruits	2.62	0.344	58.26***	3	3.49	0.354	97.54***	3
non-citrus fruits	0.92	0.286	10.35**	21	1.39	0.294	22.28***	8
candy	1.23	0.412	8.86**	22	1.00	0.425	5.59*	26
gelatin desserts	-	-	-		-	-	-	
sugars and sweet spreads	-	-	-		-	-	-	
alcohol	-	-	-		-	-	-	
fruit ades	1.14	0.493	5.40*	24	1.40	0.509	7.64**	21
carbonated beverages	-	-	-		-	-	-	
fats and oils	-	-	-		0.67	0.287	5.40*	13
cream, sauces and gravies	-	-	-		-	-	-	
coffee and tea	-	-	-		-	-	-	
low-calorie beverages	5.43	1.501	13.12***	20	6.04	1.550	15.19***	19
vitamin supplements	2.92	0.416	49.08***	4				
mineral supplements	-	-	-					
vitamin-mineral supplements	8.79	1.219	51.94***	5				
protein supplements	14.81	6.135	5.83*	27				
sex (male=1, female=0)	0.79	0.496	2.55		1.02	0.511	3.98*	
df error	1205				1206			
mean squares	73.80				78.59			
R^2	0.55				0.57			

[1]Dash indicates food group not a significant predictor ($p \leq .15$).

[2]Blank indicates food group not included in model.

[3]Order in which food group entered model.

* $p \leq 0.05$. ** $p \leq 0.01$ *** $p \leq 0.001$

Table 9 Average frequency of consumption of foods in 11 categories by Kansas fifth grade girls and boys from 24-hour dietary recall interviews

group	N	least square means and standard errors										
		milk and milk products	high protein	mixed protein dishes	legumes and nuts	grain products	vegetables	fruits	sugary products	fats	non-sugary beverages	supplements
MAR 1[1] 100												
female	17	4.18 ±0.28	1.88 ±0.22	0.82 ±0.17	0.41 ±0.13	4.23 ±0.34	3.41 ±0.40	1.71 ±0.27	2.41 ±0.37	1.94 ±0.29	0.06 ±0.13	0.71 ±0.16
male	26	3.70 ±0.22	1.89 ±0.18	0.81 ±0.13	0.48 ±0.10	4.48 ±0.27	3.63 ±0.32	1.81 ±0.21	2.81 ±0.29	1.70 ±0.23	0.26 ±0.10	0.41 ±0.13
MAR 1 90-<100												
female	201	3.40 ±0.08	1.71 ±0.06	0.76 ±0.05	0.30 ±0.04	4.04 ±0.10	3.30 ±0.12	1.77 ±0.08	2.01 ±0.11	1.81 ±0.08	0.20 ±0.04	0.56 ±0.05
male	236	3.44 ±0.08	1.76 ±0.06	0.80 ±0.04	0.37 ±0.03	3.94 ±0.09	3.21 ±0.11	1.58 ±0.07	2.37 ±0.10	1.82 ±0.08	0.22 ±0.03	0.56 ±0.04
MAR 1 75-<90												
female	279	2.55 ±0.07	1.58 ±0.05	0.74 ±0.04	0.27 ±0.03	3.39 ±0.08	2.57 ±0.10	1.39 ±0.07	2.15 ±0.09	1.58 ±0.07	0.29 ±0.03	0.47 ±0.04
male	244	2.62 ±0.07	1.54 ±0.06	0.71 ±0.05	0.26 ±0.03	3.75 ±0.09	2.73 ±0.11	1.32 ±0.07	2.00 ±0.10	1.46 ±0.08	0.21 ±0.03	0.42 ±0.04
MAR 1 66-<75												
female	64	1.72 ±0.15	1.36 ±0.12	0.65 ±0.09	0.22 ±0.07	3.75 ±0.17	2.34 ±0.21	1.17 ±0.14	2.25 ±0.19	1.41 ±0.15	0.26 ±0.06	0.13 ±0.08
male	59	2.05 ±0.15	1.44 ±0.12	0.63 ±0.09	0.34 ±0.07	3.47 ±0.18	2.05 ±0.21	1.08 ±0.14	2.25 ±0.20	1.41 ±0.16	0.24 ±0.07	0.14 ±0.09
MAR 1 50-<66												
female	57	1.40 ±0.16	1.18 ±0.12	0.60 ±0.09	0.23 ±0.07	2.79 ±0.18	2.11 ±0.22	1.09 ±0.15	1.89 ±0.20	1.11 ±0.16	0.28 ±0.07	0.26 ±0.09
male	31	1.52 ±0.21	1.45 ±0.17	0.45 ±0.13	0.39 ±0.10	3.06 ±0.25	2.35 ±0.30	0.97 ±0.20	2.26 ±0.27	1.10 ±0.22	0.32 ±0.09	0.10 ±0.12
MAR 1 <50												
female	15	1.27 ±0.30	0.87 ±0.24	0.53 ±0.18	0.40 ±0.14	2.67 ±0.36	1.00 ±0.43	0.60 ±0.29	2.00 ±0.39	1.00 ±0.31	0.13 ±0.13	0.07 ±0.17
male	12	1.33 ±0.34	1.00 ±0.27	0.75 +0.20	0.25 ±0.16	3.50 ±0.40	1.25 ±0.48	0.83 ±0.32	2.67 ±0.43	1.00 ±0.35	0.58 ±0.15	0.08 ±0.19

[1]The mean adequacy ratio (MAR 1) was calculated by averaging the percentage RDA values for energy and nine nutrients, including supplements, with values over 100% being truncated.

Table 10 Average frequency of consumption of foods in 11 categories by Kansas fifth grade girls and boys from 24-hour dietary recall interviews

group	N	least square means and standard errors										
		milk and milk products	high protein	mixed protein dishes	legumes and nuts	grain products	vegetables	fruits	sugary products	fats	non-sugary beverages	supplements
MAR 2[1] 100												
female	15	4.20 ±0.30	1.93 ±0.24	0.93 ±0.18	0.27 ±0.14	3.87 ±0.36	3.47 ±0.42	1.73 ±0.28	2.47 ±0.39	1.73 ±0.31	0.00 ±0.13	0.60 ±0.17
male	25	3.72 ±0.23	1.96 ±0.19	0.80 ±0.14	0.48 ±0.11	4.40 ±0.28	3.64 ±0.33	1.80 ±0.22	2.84 ±0.30	1.68 ±0.24	0.20 ±0.10	0.32 ±0.14
MAR 2 90-<100												
female	167	3.48 ±0.09	1.73 ±0.07	0.77 ±0.05	0.31 ±0.04	4.11 ±0.11	3.37 ±0.13	1.77 ±0.08	1.95 ±0.12	1.93 ±0.09	0.19 ±0.04	0.45 ±0.05
male	205	3.50 ±0.08	1.77 ±0.06	0.81 ±0.05	0.38 ±0.04	3.94 ±0.10	3.31 ±0.11	1.65 ±0.08	2.43 ±0.11	1.87 ±0.08	0.25 ±0.04	0.43 ±0.05
MAR 2 75-<90												
female	283	2.70 ±0.07	1.63 ±0.05	0.72 ±0.04	0.26 ±0.03	3.51 ±0.08	2.65 ±0.10	1.49 ±0.06	2.16 ±0.09	1.64 ±0.07	0.30 ±0.03	0.48 ±0.04
male	249	2.71 ±0.07	1.57 ±0.06	0.70 ±0.04	0.27 ±0.03	3.84 ±0.09	2.77 ±0.10	1.34 ±0.07	1.98 ±0.09	1.49 ±0.07	0.20 ±0.03	0.46 ±0.04
MAR 2 66-<75												
female	78	1.86 ±0.13	1.33 ±0.10	0.71 ±0.08	0.27 ±0.06	3.59 ±0.16	2.50 ±0.19	1.18 ±0.13	2.28 ±0.17	1.26 ±0.14	0.19 ±0.06	0.31 ±0.08
male	78	2.23 ±0.13	1.37 ±0.10	0.72 ±0.08	0.32 ±0.06	3.40 ±0.16	2.10 ±0.19	1.04 ±0.13	2.29 ±0.17	1.38 ±0.14	0.19 ±0.06	0.40 ±0.08
MAR 2 50-<66												
female	68	1.45 ±0.14	1.20 ±0.11	0.60 ±0.08	0.29 ±0.06	2.88 ±0.17	2.07 ±0.20	1.01 ±0.13	2.01 ±0.18	1.07 ±0.15	0.34 ±0.06	0.43 ±0.08
male	38	1.55 ±0.19	1.55 ±0.15	0.50 ±0.11	0.37 ±0.09	3.21 ±0.23	2.34 ±0.27	1.03 ±0.18	2.24 ±0.24	1.05 ±0.19	0.32 ±0.08	0.29 ±0.11
MAR 2 <50												
female	22	1.04 ±0.25	0.86 ±0.20	0.59 ±0.15	0.27 ±0.11	2.68 ±0.30	1.04 ±0.35	0.64 ±0.23	1.68 ±0.32	1.09 ±0.25	0.18 ±0.11	0.36 ±0.14
male	14	1.28 ±0.31	1.14 ±0.25	0.64 ±0.19	0.21 ±0.14	3.36 ±0.37	1.28 ±0.44	0.71 ±0.29	2.36 ±0.40	1.00 ±0.32	0.50 ±0.14	0.21 ±0.18

[1]The mean adequacy ratio (MAR 2) was calculated by averaging the percentage RDA values for energy and nine nutrients, excluding supplements, with values over 100% being truncated.

EATING PATTERNS OF KANSAS FIFTH GRADE STUDENTS

by

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ABSTRACT

Nutrition education is used widely in the United States for improving nutrition knowledge, attitudes and behavior of individuals and groups. Since school children are in the process of acquiring knowledge and lifetime habits, the school provides an ideal environment for offering this type of education. Better knowledge of the eating patterns of children would allow nutritionists to target nutrition information more effectively. To investigate the eating patterns of elementary students, 24-hour dietary recall data collected from 1,242 fifth graders during the Kansas Nutrition Education and Training Program (NETP) needs assessment project were used. Foods consumed were classified into groups and categories based on similar composition. Dietary quality was assessed by calculating mean adequacy ratios, with and without supplements (MAR 1 and MAR 2, respectively), for each student.

Grain products, primarily yeast breads and rolls, were consumed by 99 percent of the students, often three or four times daily. Almost all (97 percent) of the girls and boys included milk or milk products. High protein foods including eggs, poultry, fish and red meats were eaten by 90 percent of the subjects. Vegetables were consumed by over 90 percent of the children; potatoes and starchy vegetables, such as peas and corn, were more popular than tomatoes, dark-green and deep-yellow vegetables. Sugary products, particularly sugars and sweet spreads, were mentioned by 88 percent of the girls and boys; one-fourth consumed candy and sweetened soft drinks and one-fifth drank non-sugary beverages on the day of the interview. Fats and oils were included by 80 percent of the students, primarily table spreads and salad dressings. Four-fifths of the subjects

included fruits and juices, with non-citrus being more popular than citrus varieties. Nutrient supplements were taken by one-third of the children.

Consumption of milk and milk products was the most important estimator of MAR 1, followed by vegetables, mixed protein dishes, nutrient supplements, fruits, high protein foods and grain products. When nutrient supplements were excluded (MAR 2) fruit and grain products became more important predictors of dietary quality than for MAR 1. Non-sugary beverages adversely affected the quality of children's intakes, suggesting that those drinks were substituted for more nutritious foods. In general, boys had better diets and consumed milk or milk products and high protein foods more often than girls. Fruits, fats and nutrient supplements were included more frequently by females than males. Students with MAR indexes between 90 and 100 consumed foods from the milk and vegetable categories on more occasions than boys and girls with MAR values less than 66, who drank non-sugary beverages more often.