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EFFECT OF AN INTERACTIVE COMPUTERIZED DIET ANALYSIS PROGRAM IN NUTRITION EDUCATION

BY

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ABSTRACT

EFFECT OF AN INTERACTIVE COMPUTERIZED DIET ANALYSIS PROGRAM IN NUTRITION EDUCATION

BY

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This study examined whether self-assessment of food intake via a computerized diet analysis program enhanced improvement in nutrition knowledge, dietary attitudes and intakes over that expected of students in an introductory nutrition course at MSU. One of two sections (experimental) self-evaluated individual food intake by a computerized diet analysis program; the second section (control) submitted food records without receiving feedback until the end of the study. Both sections received pre- and posttests on nutrition knowledge and attitudes. Significant improvement ($p<0.05$) in nutrition knowledge was seen in both groups from pretest to posttest for the students that participated (Control, n=177; Experimental, n=77). No significant differences were found in either attitudes or dietary intakes between the two groups. Further studies are needed to determine whether self-evaluation of intakes is consistent with students' interests, and to identify an educational approach that can improve dietary behaviors as well as increase knowledge.

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CHAPTER ONE

INTRODUCTION

An introductory nutrition course (HNF 102) at Michigan State University (MSU) attracts 800-1000 students every quarter who enroll in two live-lecture sections and a TV videotape section. When surveyed about why they registered for the course, more than 80% of the students responded that they wanted to use the nutrition information in their daily lives and for their families. This indicates that students are seeking nutrition information which can be used to promote their own health. However, because of the size of the class, there is limited interaction between instructors and students for individualized help on specific topics of concern.

In order to increase students' interest in the course and awareness of the adequacy of their diets, an assignment was given in the past for the students to record and hand-calculate their dietary intake for one day. The students were not required to hand in the assignment, nor did they receive feedback. Many students reported that the assignment would have been more meaningful to them if they had feedback on the assessment of their intake and how to make changes when needed. This suggested that although the students were exposed to the nutrition information and were expected to be increasing their knowledge, they were not successfully interpreting this knowledge and translating it into specific dietary behaviors.

Because one theory of nutrition education is that knowledge is linked to behavior, many studies have been conducted to determine whether this relationship actually exists, or to what extent it exists. In these studies dietary intake was assumed to represent behavior. Findings from some studies have supported a positive relationship between nutrition knowledge and dietary intake (Amstutz and Dixon, 1986; Brush et al., 1986; Foley et al., 1983; Rosander and Sims, 1981; Soliah et al., 1983). In other investigations little or no correlation has been found (Douglas and Douglas, 1984; Guiry and Bisogne, 1986; O'Connell et al., 1981; Ross, 1984; Shepherd and Stockley, 1987). Attitudes, rather than knowledge were indicated as better predictors of dietary intake in some studies (Carruth et al., 1977; Jalso et al., 1965; Schwartz, 1975), but again other studies have disputed these findings (Guiry and Bisogne, 1986; O'Connell et al., 1981; Shepherd and Stockley, 1987).

The most prevalent relationship found within the knowledge-attitude-behavior pathway was a positive correlation between nutrition knowledge and attitudes (Carruth et al., 1977; Foley et al., 1983; Grotkowski and Sims, 1978; Hart et al., 1990; Perron and Endres, 1985; Schwartz, 1975; Soliah et al., 1983; Werblow et al., 1978). Because of the supporting literature, this researcher hypothesized that for this study at least knowledge and attitudes would be correlated. This researcher also made the assumption that for this study knowledge or attitudes alone might not be enough to influence dietary behaviors, but if knowledge and attitudes both improved, this improvement might have a positive effect on dietary intake. It is recognized that many variables, along with knowledge and attitudes, have an effect on dietary intake. These variables include at least gender (Beerman et al., 1990; Haseba and Brown, 1968), body weight (Wakefield and Miller, 1971), length of time in college (Brown, 1967), subscription to a meal plan (Gottschalk et al., 1977; Jakobovits et al., 1977; O'Leary and Lee, 1975), patterns established prior to attending college (Stasch et al., 1970), place of residence while in college (Beerman et al., 1990, O'Leary and Lee, 1975), education (Young et al., 1956), the symbolic meaning attached to food (Pumpian-Mindlin, 1954), economic factors (Wilhelmy et al., 1950), other family members (Dickens, 1965), advertising (Holden, 1971), personal needs (Lowenburg et al., 1974), and the family life cycle (Coughenour, 1972). It is beyond the scope of this study to examine these reported variables that influence dietary intake. However,in light of the conflicting results from the studies of relationships among knowledge, attitudes and behavior, it was apparent that further research was needed to determine how and whether nutrition educators can improve people's dietary intake by increasing their nutrition knowledge and attitudes.

Though the computer has been used in nutrition education for more than a decade, there is little information available on its effectiveness in facilitating transfer of nutrition knowledge and attitudes into positive behavior changes (Ries and Granell, 1985). The research on the use of computers in education shows that in general, computer-assisted instruction (CAI) is at least as effective as traditional methods of education, and users generally have positive attitudes toward CAI as a method of education (Magidson, 1977; Mathis et al., 1970). Previous articles (Gold and Duncan, 1980; Weinberg and Scott, 1983) supported the idea that computers may serve well as motivational devices through the use of self-assessment programs, and that self-monitoring, a strong behavior change technique, is facilitated by the computer.

An interactive, user-friendly computerized diet analysis program was developed at MSU. The program was used in this study to provide the students in the introductory nutrition class the opportunity to assess their own diets. The students were encouraged to use the program as many times as desired at their own convenience for self-assessment or self-monitoring. The goal of this study was, therefore, to determine if changes in students' nutrition knowledge, attitudes and dietary behaviors occurred when they received immediate computer feedback on their dietary intakes and were encouraged to practice manipulating their diets. One group of students (experimental group) completed one-day diet records and used the computerized diet analysis program for self-assessment of their dietary intake at least twice in one quarter. Another group (control group) of students completed one-day diet records and turned them in. The researcher completed the dietary assessments and gave feedback on their diets at the end of the quarter.

The research hypothesis tested in this investigation was that students' recording of one-day dietary intakes and use of the computerized dietary analysis program for dietary assessment, as a part of a regular introductory nutrition class, would heighten the students' need for change and therefore would improve nutrition knowledge and attitudes and affect dietary behaviors.

The specific objectives of this study were:

1. To compare differences in the nutrition knowledge gained by experimental and control groups of students during a quarter in an introductory nutrition class at MSU.

2. To compare differences in the nutrition attitudes of experimental and control groups of students during a quarter in an introductory nutrition class at MSU.

3. To compare differences in the self-reported dietary intake of experimental and control groups of students during a quarter of an introductory nutrition class at MSU, and to compare differences in the dietary intake of males and females.

4. To measure nutritional adequacy and identify demographic and environmental variables that might be related to nutritional adequacy.

5. To determine if there is a relationship among nutrition knowledge, attitudes and dietary intake.

CHAPTER TWO

LITERATURE REVIEW

This chapter provides a review of the literature related to the study hypothesis and objectives. The first section reviews research regarding the relationship among nutrition knowledge, attitudes and dietary behaviors. The second section includes literature pertaining to the various methods used for dietary assessment. The third section reviews the literature related to dietary scores for assessing nutritional adequacy. The fourth section contains information on variables related to dietary intake. The last section is a review of the literature on the usefulness of computers in education.

RELATIONSHIPS AMONG KNOWLEDGE, ATTITUDES AND DIETARY BEHAVIOR

A. Positive relationships among measurements

Optimal health through dietary improvement is the ultimate goal of nutrition education programs. To justify efforts and funding for such programs, evaluation should measure whether participants made needed diet changes by using knowledge and skills gained, and whether the changes were temporary or permanent. Amstutz and Dixon (1986) conducted such an evaluation on 129 homemakers in Maryland enrolled in the Expanded Food and Nutrition Education Program (EFNEP). Homemakers were taught lessons focusing on the importance of food and the Four Food Groups, meal planning and preparation, food buying and storage, community food resources, gardening, food preservation and weight control. Lessons were given on an individual or group basis in the home. A 24-hr recall was administered to the homemakers upon enrollment, at 6-month intervals during the program, and at a period 2 to 43 months after graduation. A paired t-test showed that final diet scores (at the end of enrollment period) were significantly higher ($p<0.01$) than the initial diet score, reflecting dietary improvement during program participation. The follow-up diet scores were significantly lower ($p<0.01$) than the final diet score, indicating some regression following graduation from the program. However, the follow-up scores were higher than the initial scores, and the data indicated that the graduates retained three-fourths of their diet scores ($p<0.01$). This study supported the notion that people will improve their diet to some extent when they acquire knowledge of what constitutes a balanced diet, and other dietary guidelines, and documented that this nutrition education program was beneficial for individuals.

A survey conducted in 1979-80 assessed the nutrition knowledge, attitudes and dietary practices of Kansas elementary teachers, school food service personnel, and fifth-grade students. From the results of the survey Foley et al. (1983) reported the nutrition knowledge, attitudes, and practices of a random sample of the students ($n=103$). A test instrument was administered consisting of multiple choice knowledge questions, and items with responses on 2-point and 3-point Likert-type scales for measuring nutrition-related attitudes and practices The knowledge section included 35 questions concerning basic vocabulary and concepts, nutrition practices, food selection, and food preparation and storage procedures. The 30 items for measuring attitudes and practices were related to the areas of value of proper nutrition, food selection, eating patterns, beverage consumption, advertising claims, and school food. Analysis of variance (ANOVA) results showed that individual differences among students accounted for 97% of the variance on nutrition-related attitude and practices scores. Positive correlations were found between nutrition knowledge scores and attitude scores, nutrition knowledge scores and nutrition-related practices scores, and nutrition-related attitude scores and practices scores. The positive correlations found in this study between nutrition practices and knowledge and attitudes may be related to the fact that practices were assessed by subjects responding to statements about dietary practices. It may be easier to respond positively to a statement than to exhibit the actual behavior. If dietary practices had been assessed by some form of actual food intake record the findings may have been different. Another explanation for the correlations might be that some of the students were receiving nutrition instruction, and also may have been influenced by the teachers, who served as role models.

Soliah et al. (1983) used the same survey data to report on the nutrition knowledge, attitudes, and dietary practices of the Kansas elementary teachers (n=819). The test instrument for the teachers contained 55 multiple choice questions for assessing nutrition knowledge and 60 items which measured nutrition-related attitudes and practices and nutrition education practices. ANOVA indicated that differences in nutrition knowledge scores of the elementary teachers were attributable to grade level taught, whether teachers had completed one or more college/continuing education courses on nutrition, and whether they were teaching nutrition at that time. Results of the ANOVA for the nutrition-related attitudes and practices and nutrition education practice scores indicated that individual differences among the teachers accounted for 87 to 96% of the variance. Significant ($p<0.05$) positive correlations were found between nutrition knowledge scores and nutrition-related attitude scores, nutrition knowledge scores and nutrition-related practices scores, and nutrition-related attitude scores and practices scores. Again, the positive correlations found in this study between nutrition practices and knowledge and attitudes might be influenced by the fact that practices were assessed by subjects' response to statements about dietary practices, as explained above for the fifth grade students. The findings might also be influenced because some of the teachers (54%) were teaching nutrition in the classroom so may have been more motivated to incorporate their knowledge into food-related attitudes and practices.

Rosander and Sims (1981) reported that in the studies that demonstrated positive effects of nutrition education on dietary intakes of adult pregnant women, investigators assumed that knowledge gains were responsible for the improved diets. However the authors agreed with some social psychologists who proposed that behavior change may be dependent upon attitude change and that, possibly, attitude change must precede both knowledge acquisition and behavior change. Therefore Rosander and Sims evaluated an affective-based nutrition education program which encouraged learners to explore their feelings about food as well as to acquire nutrition knowledge. Subjects were 23 women participating in a WIC (Women, Infants, and Children) program in Central Pennsylvania. The program consisted of three lessons incorporating group activities, specific experiences and cognitive concepts. The educational objective was to improve dietary behavior of participants. The affective objective was to improve nutrition-related attitudes with emphasis on self-esteem, personal control, and decision-making ability. Results showed that the instructed group showed significant improvement ($p<0.05$) in nutrition knowledge, attitudes and behavior, whereas an uninstructed control group showed no significant change in any of the three areas. The authors concluded that among receptive participants in this study, the affective-based approach to nutrition educations was effective not only in improving knowledge and attitudes, but also in improving dietary behavior, which is the most important objective.

A similar study was conducted by Brush et al. (1986), elaborating on the design of Rosander and Sims. One hundred and twenty six subjects were recruited from the general adult population, and were divided into two groups. The treatment group (n=59) participated in a five-week (total of ten hours) nutrition education program, and the other group served as a control (n=67). The objectives were learner-centered, with measurable outcomes in the cognitive, affective, and behavioral domains. Subjects were administered pre-, post-, and retention tests on nutrition knowledge and attitudes. The knowledge test assessed cognitive gain in relation to course concepts. The attitude toward nutrition scale measured the degree of flexibility/rigidity in nutrition attitudes. Self-reported 24-hr recalls were also collected. T-tests showed that on the knowledge test, the treatment group scores rose significantly from pre-test to post-test ($p<0.001$), and dropped slightly but not significantly from post-test to retention test. The control group scores remained constant over the three tests. Dietary behavior, as measured by 24-hr recall improved in the treatment group only ($p<0.05$). Nutrition attitudes did not change in either group. The authors attributed lack of significant improvement in attitudes to high pre-test scores and insufficient time interval for demonstration of attitude change.

Hart et al. (1990) evaluated the effect of a nutrition education module on the nutrition knowledge, flexibility of attitude toward nutrition, and attitude about nutrition education of missionaries during their orientation period. The authors also attempted to determine if there was a link between nutrition knowledge, flexibility of attitude toward nutrition and attitude about nutrition education, and they explored the nature of the relationships among nutrition knowledge, flexibility of attitude, and attitude about nutrition education. Experimental ($n=22$) and control ($n=19$) groups of missionaries completed pre- and posttests consisting of a nutrition knowledge test, two scales of nutrition attitude (flexibility of attitude toward nutrition and attitude about nutrition education), and several open-ended questions about nutrition education in the mission field. The experimental group attended four nutrition classes of one hour each. Classes dealt with basic nutrition and nutrition through the life span. Results showed no significant differences between pretest and posttest knowledge scores for both control and experimental groups. However the comparison of change in knowledge scores from pretest to posttest between the experimental and control groups was significantly different ($p<0.01$). There were no significant differences between the mean scores of control and experimental groups at pretest or posttest on the flexibility of attitude toward nutrition scale. There were no significant differences between the control and experimental groups at the pretest on the attitude about nutrition education scale. At the posttest the experimental group showed significantly higher ($p<0.01$) mean scores than the control group for 13 of the 26 attitude statements. Significant ($p<0.01$) positive correlations were found at posttesting for the experimental group between nutrition knowledge and attitudes about nutrition education, between nutrition knowledge and flexibility of attitude toward nutrition, and between flexibility of attitude toward nutrition and attitudes about nutrition education. The control group showed a significant ($p<0.01$) positive correlation between flexiblilty of attitude toward nutrition and attitudes about nutrition eduaction. Regression analysis was used to investigate the extent to which knowledge and flexibility scores contriubted to the prediction of attitude scores. Posttest analysis showed that for the control group the flexibiltiy score was the only significant predictor of attitude score. In the experimental group posttest analysis showed that the knowledge score was a significant predictor of both the attitude and flexibility scores.

B. Mixed relationships among measurements

Perron and Endres (1985) conducted a study to determine whether there was a relationship between nutrition knowledge, attitudes and dietary intakes (calcium, iron, and vitamins A, C, and E) of 31 female high school athletes. A questionnaire was administered which consisted of knowledge and attitude statements related to general nutrition and nutrition for the athlete. Dietary intake was recorded by a 24-hr recall followed by a 48-hr food record. Analysis of the data revealed that knowledge was significantly correlated with attitude ($r=0.52$, $p<0.01$). However neither nutrition knowledge nor attitudes were good predictors of dietary practices. The authors reported that 81% of the subjects were unhappy with their present weight and 73% wanted to lose weight. Therefore their food choices may have been influenced by an eagerness to be thin. A study of 94 college-level female athletes found results similar to the above study (Werblow et al., 1978). Nutrition knowledge was positively correlated with attitude, and nutrition knowledge and attitudes were not correlated with food patterns. Again it was emphasized that these athletic women were most concerned about their weight and utilized food patterns they felt were desirable for a weight-control regimen. Werblow et al. concluded that food habits of female athletes may be influenced by a desire to be thin rather than by nutrition knowledge and attitudes, which was supported by the study of Perron and Endres (1985).

Schwartz (1975) investigated the relationship between previous enrollment in home economics courses and present nutrition knowledge, attitudes and practices of 313 female high school graduates from selected Ohio high schools. One hundred and seventy-one of the graduates had been enrolled in home economics courses, including food and nutrition, while 142 graduates had not had such courses. A knowledge test consisted of statements related to general knowledge of nutrition concepts, food composition, misconceptions about food, and application of basic nutrition principles. The attitude test measured attitudes toward nutrition and eating habits, meal planning, and food preparation. Dietary intake was assessed by analysis of a food frequency record of intake of foods in seventeen food groups during a three-day period as compared with the Basic 4 pattern. The author found that previous enrollment in high school home economics courses with a unit in food, nutrition, and health was not consistently associated with scores attained in tests of nutritional knowledge, attitudes, and practices. The graduates who had taken the home economics courses achieved higher mean scores in tests of nutritional attitudes and practices than did those who had not taken the courses but the differences were not significant. Significant correlations were found between nutrition knowledge and attitudes, and between attitudes and practices, but no significant correlation between knowledge and practices. This suggested that attitude may mediate both knowledge and practices. That is, it is possible that in order to gain knowledge and internalize it, one must have a positive attitude toward receiving the information. Attitudes have an effect on dietary practices, but other variables also influence practices. This may explain why no direct relationship was found between knowledge and practices. Therefore even though these young females gained nutrition knowledge, and expressed a positive attitude toward food and nutrition, they did not necessarily follow practices reflecting their knowledge and attitudes.

Grotkowski and Sims (1978), in a similar study conducted with 64 senior citizens, supported the association between nutrition knowledge and attitudes ($r=0.51$, $p<0.001$) and attitudes and dietary intake ($r=-0.31$, $p<0.05$). They also found no significant association between nutrition knowledge and dietary intake.

In a study by Jalso et al. (1965), questionnaires to test nutritional opinions and practices were completed by 340 adult subjects who were members of various community organizations in New York State. The nutritional opinion questionnaire was developed to assess areas of food and nutrition in which misconceptions are most prevalent. The questionnaire on nutritional practices was related to use of food supplements, use of special "health foods", methods of weight control, special diets, and avoidance of certain foods. A positive correlation ($r=0.63$) was found between opinions and practices, indicating that nutrition opinions were reflected in nutritional practices. Education was positively correlated with both practices ($r=0.21$) and opinions ($r=0.34$), and age was negatively correlated with scores on practices ($r=-0.42$) and opinions ($r=-0.44$). This indicated that as level of education increased, subjects had more valid nutrition opinions and practices, and as age increased (from 30 to 60 and over) valid nutrition opinions and practices decreased. A multiple regression analysis was conducted, and age was indicated as the most important variable affecting scores for both opinions and practices. Therefore authors concluded that the direct relationship between education and valid nutrition opinions and practices reflected the influence of age rather than education directly.

Carruth et al. (1977) conducted a study in the Missouri EFNEP to determine whether a significant relationship existed between nutrition knowledge, attitudes, personality traits, and nutrition-related behaviors, and which of these variables was the best predictor of nutrition-related behavior. Twenty-seven Nutrition Education Assistants (NEAs) were divided into treatment ($n=9$) and experimental ($n=18$) groups. Both groups initially completed a knowledge test related to weight modification concepts, an attitude questionnaire measuring an individual's adaptability toward changing nutritional practices, and a personality questionnaire which measured adaptability/ flexibility in personality traits. The experimental group then received five weekly training sessions on weight modification concepts suitable for teaching disadvantaged adults. After the training, both groups completed a post-test of nutrition knowledge and the attitude and personality questionnaires. Three types of nutrition-related behaviors were documented: brochure requests for free literature from both experimental and control NEAs, verbal affirmations of nutrition practices from experimental NEAs (e.g., the NEA recommending the Basic 4 food groups as a basis for menu planning), and observed nutrition-related behaviors of experimental NEAs (e.g., the NEA eating a meal that contained foods from at least three of the four food groups). A multiple regression equation was generated to predict a composite score for the three types of behavior (i.e., mail requests, verbal, and observed). Forty-seven and 32 percent, respectively, of the variance in the composite scores were attributed to age and to responses to the rigid attitude statements. Age had a negative effect, as increasing age was associated with decreasing composite scores. Also attitudes, particularly those characterized as flexible, were more prepotent predictors of nutrition-related behavior than nutritional knowledge. Therefore, authors concluded that age and attitude were the best predictors of behavior.

C. Little or no relationship among measurements

Shepherd and Stockley (1987) conducted a study to determine whether nutrition knowledge predicted either attitudes or behaviors. Participants were 210 men and women 16 to 65 years of age who returned questionnaires distributed at an International Food Exhibition in London. The questionnaire consisted of four sections. The first section contained demographic questions on age, sex, and occupation. Three nutrition knowledge questions pertained to fiber content of foods, fat content, and caloric intake. A frequency of food consumption section contained questions on meat, meat products, butter/margarine, and milk. To assess attitudes, questions based on the Fishbein and Ajzen model (1980) were formulated. Within this model, attitudes were assessed in relation to a behavior (e.g. eating a food) rather than an object (e.g. the food itself). Behavior was predicted by behavioral intention, i.e. the decision to behave in a certain way, which was predicted by the attitude toward the behavior and the subjective norm. The attitude toward the behavior was whether the subject saw the behavior as good or bad, pleasant or unpleasant, etc.. The subjective norm was the social pressure to behave in a certain way. Their results indicated that nutrition knowledge was not a good predictor of attitude or behavioral intention. Subjects with high nutrition knowledge scores did not report lower consumption of or have more negative attitudes toward the high-fat foods. Thus, greater knowledge did not necessarily result in a difference in attitudes or behavior. It was found that the person's attitude toward eating the foods proved to be a better predictor of behavioral intention. One explanation offered by the authors was that nutrition knowledge may be related to general attitudes toward nutrition, but not to more specific attitudes toward eating certain foods. That could account for the lack of relationship between knowledge and the intake of specific nutrients. A limitation of the study was that nutrition knowledge was assessed by three questions. It is possible that this was not enough information to show any kind of relationship.

A study by Guiry and Bisogne (1986) supported the assumption of Shepherd and Stockley's (1987) about the need for specificity in measurement instruments. The authors studied knowledge, attitudes and practices of caffeine consumption in 63 young women 15 to 30 years old. The knowledge instrument consisted of statements about dietary sources of caffeine, general health effects of caffeine consumption, and specific health concerns regarding caffeine use during pregnancy. The attitude instrument consisted of Likert-type items that reflected positive or negative feelings about 1) it is safe for pregnant women to consume caffeine, 2) it is hard to limit caffeine consumption, and 3) nutrition is not important. Caffeine consumption was assessed by 24-hr recall and a beverage frequency form. The strongest relationship was found between caffeine consumption and the attitude "it is hard to limit caffeine consumption" ($r=0.64$, $p<0.001$). A significant negative relationship ($r=-0.46$, $p<0.001$) was found between knowledge scores and the attitude "it is safe for pregnant women to consume caffeine". However, no association was found between caffeine knowledge and the general attitude "nutrition is not important" and the attitude "it is hard to limit coffee consumption". Also no relationship was found between caffeine knowledge and caffeine consumption. Authors concluded that the lack of specificity between the knowledge and general attitude statements may account for their observation, and that the specific attitude "it is hard to limit caffeine consumption" was an important predictor of consumption.

In a study of high school athletes (Douglas and Douglas, 1984), a weak correlation ($r=0.35$) was found between knowledge and food practices of 515 male athletes, and a weaker correlation ($r=0.15$) for 425 female athletes. The authors reported that the male athletes had higher food practice scores than the females because they ate more food than the females. Therefore the stronger correlation found between their knowledge and food practices was probably not related to nutrition knowledge but to the fact that young men eat more, and so are more likely to consume foods from the four food groups.

Ross (1984) measured change in knowledge and attitudes of nursing students after completing a nutrition course. She found that knowledge scores improved significantly ($p<0.001$) over the semester. Attitudes that assessed the role of the dietitian in the hospital, the role of the nurse in nutrition education, nutrition education in nursing, and general nutrition were not significantly altered. The nursing students indicated positive attitudes towards these parameters on the pretest, therefore there was little room for improvement in attitudes at the posttest, which may account for the small change seen.

Byrd-Bredbenner et al. (1988) determined the effect of nutrition instruction on the nutrition knowledge, food/nutrition attitudes, and dietary behaviors of home economics students in grades 10, 11, and 12. Students were grouped into four groups: one experimental group was pretested, taught nutrition and posttested; a second experimental group was not pretested, taught nutrition and posttested; a control group was pretested and posttested, and the other control group was only posttested. The control groups received nutrition instruction after the study was complete. The nutrition knowledge test consisted of multiple-choice items related to the instructional objectives. The Likert-type attitude instrument assessed students' attitudes about the constructs titled 'Caring about Nutrition', 'Eating New Foods', 'Nutrition Affects Health', and 'Learning about Nutrition'. A two-part food behavior assessment form was used to assess dietary behavior. The first part was a food frequency form with a 5-point scale ranging from 'hardly ever' to 'three or more times per day' to indicate frequency of food consumption. The second part focused on food choices. Students chose one of the following responses for 20 foods: a) a food I have never eaten or heard of; b) a food I like and eat; c) a food I like but try not to eat too often; d) a food I do not like but will eat; or e) a food I refuse to eat. The 20 foods were grouped into five food categories and scores were computed for the scales 'acceptance' (student has eaten and will continue to eat the food), 'exposure' (student has eaten the food), 'low risk taking' (student has never eaten the food), and 'selective avoidance' (student will avoid the food). Results indicated that pretesting did not affect posttest scores for both control and experimental groups. The experimental groups achieved a significantly higher ($p<0.0001$) mean knowledge posttest score than the control groups. The mean attitude postscore of the experimental groups on the attitude construct 'Nutrition Affects Health' differed significantly ($p<0.0001$) from that of the control groups, however there was no difference between groups on the other three attitude constructs. There were also no significant differences in dietary intake between groups. Therefore the outcome of the study showed improvement in nutrition knowledge but little change in attitude and dietary intake. The authors suggested that many factors work against rapid, major changes in adolescents' diets. The factors may include time demands, peer pressure, and the fact that they do not have complete control over their diets and the food available to them. Also because enhancement of knowledge is a primary goal of school-based education, teaching strategies are geared toward cognitive goals. In the case of nutrition, such strategies are not likely to be the most effective ones for changing attitudes and dietary behavior.

In summary of this section, the results from research on the relationships between nutrition knowledge, attitudes, and behaviors vary widely. Much of the conflict in the literature may be due to the use of different methods for measuring knowledge, attitudes, and dietary intake. Nutrition knowledge has been measured by multiple choice tests, true-false tests, Likert-type scales, and self-evaluation. Nutrition attitudes have been assessed by open-ended questionnaires, Likert-type scales, personality factor questionnaires, and still other methods. Dietary intake is measured by a number of methods, including 24-hour recalls, food frequency forms, one- or more-day food records, questionnaires, and food intake patterns.

Another major problem is attitude assessment. Attitudes are difficult to measure, and there is no one single definition of attitudes accepted by those who do research on attitude and attitude change. Therefore there have been many different interpretations of attitude. Terms such as values, opinions, beliefs, motivations, and intentions, have been used synonymously with attitude.

A third problem is that researchers test for different aspects of nutrition knowledge and attitudes. For example, different studies have evaluated knowledge of nutrition for the athlete, fat content of foods, food preparation and storage, basic nutrition concepts, and many other areas. Nutrition attitudes have been assessed by evaluating concern or interest in nutrition, flexibility or rigidity in personality factors, attitude toward teaching nutrition, personal control over eating habits, foods' effect on health and feelings, as well as many other aspects of nutrition attitudes. This lack of consistency makes it difficult to compare across studies. Related to this is the wide variety of population groups included in different studies. It is difficult to generalize or compare results from studies on athletes, adolescents, college students, middle-aged adults, or senior citizens.

Another consideration is the validity and reliability of the measurement instruments used to obtain the data. Some studies report procedures used to determine the validity and/or reliability of the test instruments used while others don't report this information, or report that the instrument was tested and used in a previous study. It should not be assumed that because a test is valid and reliable for one group, it will be equally valid and reliable for another group. In order to adequately interpret results and determine the worth of a study it is important to know that the test instruments used were tested for the specific purposes of the study and found to be valid and reliable.

An overall problem in looking for a relationship between dietary intake and knowledge and attitudes is that so many other factors influence dietary intake besides nutrition knowledge and attitudes. Other factors that need to be considered are social, cultural, environmental and emotional factors, and others.

It is accepted by this researcher that there are many problems to be solved in this type of research. Yet the need for further well-defined research on the relationships between nutrition knowledge, attitudes and dietary intakes was clear.

DIETARY ASSESSMENT METHODS

The scientific nutrition literature reports many ways to assess food intake for individuals and population groups. The usefulness of the different dietary intake measurements varies depending on the research purpose and population groups studied. It is therefore crucial to clearly define the research objectives before choosing a specific method. In order to identify the most efficient and accurate method for use in this study, three of the most frequently referenced dietary intake methods were reviewed: the 24-hr recall, food intake records, and food frequency forms.

24-Hour Recall

The 24-hour recall is a retrospective account of a subject's food intake during the previous 24 hours. This method imposes light respondent burden, and collection, calculation and analysis of data can be easier than other methods (Pao et al., 1985). The personnel time is reduced because the method requires only one interview. The 24-hr recall has been reported to provide reliable information on mean intakes of large groups (Gersovitz et al., 1978; Karvetti and Knuts, 1985; Linusson et al., 1974; Morgan et al., 1978; Young et al., 1952). The 24-hr recall has been criticized because the accuracy relies on one's memory. This method also may not capture information that is representative of an individual's usual intake (Pao et al., 1985).

Pao et al. (1985) examined the three-day food intake data from the Spring 1977 Nationwide Food Consumption Survey (NFCS). One of the research objectives using three-day diets was to determine whether the three-day method, which combined one-day recall and two-day food records, yielded different information for sex-age groups from that obtained for the first day by recall. Results indicated that mean daily intakes of calories, fat, protein and carbohydrate for all individuals based on three-day diets were nearly the same as those from one-day recall (coefficient of variation within 2%). This was true for the majority of the sex-age groups. Three-day and one-day diets yielded similar mean intakes of four minerals (within 3%), and five vitamins (less than 5%) for most sex-age groups. Vitamin C intakes of 15-18 year-old boys and 19-22 year-old women differed more than 5%, and vitamin A value differed 6-15% for 10 of the 22 sex-age groups. Authors concluded that one-day intakes provide nearly as reliable a base as three-day intakes for computing mean intakes of most nutrients except vitamins A and C for large groups.

Fanelli and Stevenhagen (1986) assessed the consistency of the mean nutrient and energy intakes for 2,667 non-institutionalized persons, 65 years or older, using either 24-hr recalls or one-day food records. The two methods gave similar estimates for the group of older adults in this study, indicating that both methods appeared to be equally effective for collecting group dietary intake information.

A study conducted by Madden et al. (1976), using a similar group of 76 elderly subjects supported the validity of the 24-hr recall when compared to observed actual intake. Tests of the validity of the 24-hr. recall were done by comparing actual with recalled intakes for eight nutrients and the MAR (mean adequacy ratio). Validity was tested by using paired t-tests and regression analysis. In the paired t-test, no significant difference was found between the mean recalled and the mean actual intake of nutrients, with the exception of calories. Using regression analysis, results indicated that for calories, protein, and vitamin A, small intakes tended to be over-reported and large intakes under-reported. Therefore for these three nutrients the recall seemed to be statistically conservative for group comparisons. The conclusion was that although the regressions for the other five nutrients seemed to support the validity of the 24-hr. recall, further replications of this validity study are required.

Karvetti and Knuts (1985) also tested the validity of the 24-hr recall as compared to observed food intake of 140 men and women 15-57 years old. The observation was carried out during one day by recording the amounts of foods selected by the subjects at four meals. The following day, 24-hr. recalls were obtained. The difference between mean recalled and observed nutrient intake was between -6% and 11%, except for sucrose (-20%) and vitamin C (-16%). The correlation coefficient between observed and recalled nutrient intake was in the range of 0.58 to 0.74. It was concluded that validity was unsatisfactory at the individual level and satisfactory at the group level.

Gersovitz et al. (1978) tested the internal validity of the 24-hr. recall and the seven-day record among a group of 65 non-institutionalized elderly participating in a congregate meals program for lunch. Internal validity was assessed by comparing reported intakes with actual intakes, obtained by weighing the foods served. Paired t-test results for both the 24-hr. recall and the seven-day record suggested that both methods provided about equally accurate estimates of the mean intake. This study supported the findings of Madden et al., suggesting that mean recalled intake did not significantly differ from mean actual intake for the elderly groups studied.

Greger and Etnyre (1978) studied the validity of 24-hr recalls of adolescent females. The actual food intake of the subjects was known because all foods consumed were pre-weighed. The nutrient composition of the actual meals and snacks and the reported meals and snacks, as determined by the diet recalls, was calculated by computerized diet analysis and by laboratory analyses. The authors found that recalls were valid for estimating energy, protein, calcium and zinc. However, for this group, the 24-hr recall method was not accurate for estimating intakes of vitamins A, C, thiamin, riboflavin, niacin, and iron.

Linusson et al. (1974) evaluated the validity of the 24-hr recall method for 86 lactating women in a Medical Center. Validity was tested by comparing the quantity of food consumed (by weighing) with food recalled during an interview (24-hr. recall). Significant differences were found between the recalled and actual amounts of foods eaten for eight of the 14 food groups. The overall tendency to underestimate was found to be much greater than the tendency to overestimate. The authors concluded that much caution should be exercised in using the 24-hr. recall method for estimating quantitative food intake of groups. Authors noted that what is crucial prior to determining the choice of a dietary method is a clear definition of study objectives. If quantitative dietary information is the need, then the appropriate method should be direct weighing of food. However, if the purpose is to gather trends in dietary patterns from sizeable population groups, then the choice of the 24-hr. recall method is a valid one.

Young et al. (1952) conducted a study to compare a dietary history, a seven-day record, and 24-hr recall, when estimating nutrient intakes of individuals and mean group nutrient intakes. The methods were compared within and between three population groups: pregnant women, seventh and eighth grade pupils, and high school and college students. For individuals, it was found that 24-hr recall and seven-day records did not give the same estimates of nutrient intake. Also the 24-hr recall and the diet history did not give the same estimate of intake for an individual. For the groups it was found that the estimate of mean intake obtained by diet histories was not the same as that obtained by 24-hr recalls. However, there were no detectable differences between estimates for the groups obtained by the 24-hr recall and by the seven-day record. The authors concluded that for estimates of mean dietary intake of population groups under certain circumstances, the shorter, more expedient 24-hr recall can be used as a substitute for the seven-day record.

Morgan et al. (1978) assessed three methods of estimating group and individual dietary consumption in a case-control study of diet and breast cancer. The methods studied were a 24-hr recall, a detailed diet history, and a four-day diet diary. Authors found a relatively low individual correlation between the three methods, suggesting that the 24-hr recall did not adequately predict the diet for an individual, as compared to the four-day record. Also the 24-hr recall and four-day record did not predict the diet as estimated by diet histories. The authors concluded that each of the three methods were satisfactory for estimating group values. However for estimates of usual intake of these individuals the diet history was more reliable than either the 24-hr recall or four-day diary.

Food Intake Record

A food record is a diary of intake recorded immediately after consumption. Food records have been promoted because of this direct record, and because portion sizes can be measured. But the respondents' burden is increased, and subjects asked to keep a record may subconsciously eat a better diet than usual, so the intake information may be biased (Todd et al, 1983). Also, as more days are included in the food record, subject compliance and accuracy decrease. When a 7-day record was used, accuracy was reported to decline by the fifth, sixth and seventh day (Gersovitz et al., 1978).

A study by Chalmers et al. (1952) attempted to determine how many days a dietary record should include when dietary intakes of groups and individuals are estimated, and which days should be included. They also looked at how many subjects should be included for a group study. Data were collected from regional studies of various population groups in the northeastern United States. Included were junior high, senior high and college students, pregnant women, and male industrial workers. By the use of ANOVA, it was found that for all nutrients and populations, a dietary record of one day characterized the dietary intake of the group. It should be noted that this answer is based on relative importance of days as compared to number of subjects. To obtain an estimate of the mean intake for a group with greater precision, it was more efficient to take more subjects, not more days. For an individual, the number of days to be included in the dietary record depends on the precision required. The authors suggested use of confidence intervals, and a logarithmic graph, and gave a specific example of how to estimate number of days required for a given precision.

The problem of which days to use is particularly important when dietary records are taken for one day. If a day effect should exist, it would become necessary to select a day representative of all seven. For the group, there were no significant differences beyond chance occurrence between days for any of the nutrients or any of the population types except one. The exception was the college students, who had a distinct decrease in food intake on weekends. In contrast to this St. Jeor et al. (1983) found no specific day-of-the-week effect in their study of college students, faculty and their spouses. Chalmers et al. (1952) contended that it is immaterial which day or days one selects for a record, provided no distinct tendency for a specified population has been found. In the case of which day(s) are most representative for an individual, the authors found no answer.

To determine the number of subjects needed in a group for a specified precision, Chalmers and co-authors (1952) suggested the same technique as that for determining number of days to include in an individual dietary record. That is, a confidence interval should be determined for the group mean, and then a logarithmic graph used to determine the number of subjects necessary.

Stuff et al. (1983) evaluated the ability of dietary intake collection methods to estimate nutrient intakes adequately. The collection methods included 1-day, 3-day, and 7-day diet records and a food frequency form. Intakes of forty lactating women were measured by the food frequency form and seven-day diet records. Then one day was randomly selected from the seven-day record to provide data for the one-day record. The 3-day record contained two weekdays and one weekend day randomly selected from the 7-day record. Estimates of mean nutrient intakes determined by one-day record, three-day record and seven-day record did not differ significantly. The one-day record showed intermediate agreement (intraclass correlation coefficients 0.42-0.63) with the seven-day record, and the three-day record showed good to strong agreement (r=0.74-0.91) with the seven-day record. The food frequency form showed poor agreement (r=0.00-0.24) with the seven-day record. Authors concluded that the three-day record appeared to be a reasonable approach for obtaining qualitative nutrient intake data for population groups.

Todd et al. (1983) assessed the sources of variance in dietary intake records. Eighteen graduate students recorded self-selected food intakes for 30 days. The 30-day study was divided into six periods of five days each, in which subjects alternately weighed food intake and recorded it by tape recorder or kept a written record of estimated food intake. Two 24-hr recalls were also obtained and compared to the written estimates of intake. Only energy and protein intakes were analyzed. Results showed that there was no significant difference in the mean energy and protein intake by recording method, i.e., taped intake records or written diary records.

Comparing the 24-hr recall and a one-day diary with an individual's 30-day record showed that one-day records did not accurately represent the overall "usual" intake. Analysis of variance using energy intake for all subjects for 30 days by day of the week suggested that for this group the mean energy intake did not differ during the week, especially when comparing weekday to weekend intake. Protein intake was different, being lower on Saturday and Sunday than on some weekdays. Given the small sample size of this study, the day of the week effect should be interpreted cautiously here. If people eat differently on weekends than they do on weekdays and if an accurate assessment of intake is required, the authors suggested that the survey should include the days of the week that are different. The major sources of variance identified in this study were between subject and within subject variance. This is in agreement with a study by Beaton et al. (1979). For this study sample, a one-day sample mean for energy was found to come within 15% of the 30-day mean energy intake of the group 95% of the time. Increasing the number of replicate measures to five days of record keeping increased the group mean to come within 10% of the usual intake with 95% confidence. For an individual the one-day record gave a very poor estimate of protein and energy intake.

Food Frequency Form

The food frequency form is another method that is used to estimate dietary intake. This method lists representative foods by groups and requires subjects to record their average intake (usually by week). The food frequencies are adequate when information on usual intakes of representative foods or food groups is desired. However for specific nutrient assessment, food frequency is not detailed enough. Some research on food frequency forms was discussed under the headings of 24-hr recall and food intake record.

Concerns With Dietary Assessment Methods

A dietary intake pattern that has been indicated in many of these studies (Gersovitz et al., 1978; Karvetti and Knuts, 1985; Madden et al., 1976; Young et al., 1952) should be noted here. The "flat-slope syndrome" is a tendency to over-report small intakes and under-report large intakes. When this occurs in a study, the figures will be statistically conservative for group comparisons. The syndrome would seldom, if ever, indicate a difference in intake where none exists. But it could yield an indication of no significant difference when in fact a difference does exist. Therefore the data must be examined carefully.

A study by Guthrie and Crocetti (1985) analyzed the extent to which nutrient intake of individuals varied over a three-day period. It was based on a nutrient analysis of the food intake data collected in the 1977-78 NFCS. For the three-day period a 24-hr recall of food intake was provided by respondents, and then for the next two days a written food intake record was kept. The authors assessed variation within +/-15% and +/-25% for 11 different nutrients for participants in all four seasons. The results of the analysis indicated that there was considerable variation in the intake of nutrients from day to day. The fact that as many as 85% of the population had intakes of a specific nutrient on any one day that varied by more than 25% from the average for the three-day period confirmed that intake on any one day cannot be considered a sensitive indicator of the usual intake of that nutrient for an individual. Guthrie and Crocetti found the one-day records to be the least sensitive for vitamins A and C, which was supported by Pao et al. (1985). The authors contended that a one-day record for representation of usual intake of an individual was inadequate and inappropriate. The one-day record may represent the usual intake of a group, but for nutrients such as vitamins A and C it is necessary to have a large group.

Basiotis et al. (1987) stated that when assessing the dietary status of an individual and groups of individuals, the day-to-day variability in food energy and nutrient intake would affect the statistical precision or accuracy of estimates of intakes. The level of variability that can be tolerated (i.e. the level of accuracy desired) depends on the intended use of the data. The level of precision needed may also differ by the nutrients studied. Therefore, the authors used 29 food intake records for 365 consecutive days from a study conducted by the USDA's Beltsville Human Nutrition Research Center, to determine the number of days of food intake records needed to estimate "true" average nutrient intakes for individuals and groups with a given degree of statistical confidence or precision. For their study, authors defined a "precise" estimate as an X-day average intake being within 10% of the "true average" intake for the individual or the group 95% of the time. The true intake was the 365-day average for individuals or groups. Two formulas were derived to calculate the number of days of food intake records necessary to estimate true intake for an individual or group, respectively.

Twenty-nine subjects participated in the study-13 males, age 21-49 and 16 females, age 20-53. Daily intakes of 19 nutrients were calculated, but only food energy, iron and vitamin A were discussed. For an individual, to estimate their food energy intake with a 95% degree of accuracy, a range of 14 to 84 days was needed. For iron, the number of days ranged from 18 to 142 days. To estimate vitamin A, a range of 115 to 1724 days was needed. To estimate the days required for a group, the males and females were examined as separate groups. To estimate true average food energy intake "accurately" for both groups, an intake of 3 days was needed. For iron, the males required 7 days, and the females required 6 days. The average number of days for vitamin A was 39 for males and 44 for females. To achieve a defined level of statistical precision for groups, one can either increase the number of days of food intake records for a set number of individuals, or increase the number of individuals with a set number of food intake records. Chalmers et al. (1952) suggested that to obtain an estimate of the mean intake for a group with greater precision, it was more efficient to take more subjects, not more days.

A study done by Beaton et al. (1979) examined sources of variance and error in 24-hr recalls in the National Heart, Lung and Blood Institute (NHLBI) nutrition data system. Three 24-hr dietary recalls were collected at different points in time from sixty subjects 25 to 44 years of age. The authors analyzed the nature and magnitude of components of variance observed in the NHLBI nutrition data system with regard to sex differences, subject differences (true interindividual variation), day of the week effect, and day to day variation in individual subjects, as well as others not relative here.

When data for males and females were analyzed separately, results showed that there were characteristic differences between males and females in the amounts of foods consumed without characteristic differences in the pattern of foods consumed. In the analyses for the combined sexes, sex was a major contributor to total variance of absolute intakes. However, when nutrient intakes were expressed in proportion to energy intake the contribution of sex to total variance was small. The analyses suggested that absolute nutrient intakes should be examined separately by sex whereas nutrient concentrations might be considered with data pooled from both sexes.

There was a significant and consistent day of the week effect on absolute nutrient intakes among females. This was not present among males. The data showed that the women in this study ate more food on Sunday than on weekdays. This is in contrast to findings of Chalmers et al. (1952) and St. Jeor et al. (1983), who found no significant day of the week effect. Because nutrient concentrations were similar for all days, it might be assumed that the patterns of food intake did not differ greatly with day of the week. The data suggested that the mean intakes of groups, especially females, would be significantly affected by differences in the proportion in which weekends and weekdays are represented. But if the prime interest is in nutrient concentrations, data might be pooled across days without major concern.

The major components of variance identified were interindividual variation (true between subjects variation in usual intake) and intraindividual variation that included any methodologic error as well as the true inter-day variation in intake within subjects and the day of the week effect seen in females.

The observation of a high intraindividual variance component implies that the precision of the estimate of an individual's usual intake, obtained from a single one-day observation, is relatively low. This was supported by Guthrie and Crocetti (1985) and St. Jeor et al. (1983). The reliability of the estimate can be improved if there is opportunity to obtain several dietary recalls for the same individual. To decide the required number of days of observation, one would have to know the required precision of the estimate of the individual's usual intake. If the focus is an individual, a fairly reliable estimate of usual intake may be wanted. If the focus is the mean intake of a group, a reliable estimate of individual intake may be less important. The authors provided equations for individuals and groups for calculating mean intakes with 95% confidence limits. When the objective of a survey or study is to detect differences between groups of individuals with confidence, the choice is between increasing sample size or increasing the number of replicate observations for individuals. This suggestion was also given by Basiotis et al. (1987). Beaton et al. (1979) noted that when considering cost, it is more preferable to increase sample size rather than repeating dietary interviews. Chalmers et al. (1952) also suggested that it is more efficient to take more subjects rather than more days. Beaton et al. (1979) supported the belief that when group size is reasonable, good estimates of group average intakes can be obtained with one-day data.

Another concern was brought up by Guthrie in 1984. Her study determined the amount of food that young adults select as a usual portion size and assessed their ability to describe the food in quantifiable terms. Students and university employees between the ages of 18 and 30 participated in the study. Each participant was invited individually to a buffet table, offered food items comprising either a breakfast or lunch meal, and asked to select the amount of food he/she considered an average serving size of each meal item. The subjects were allowed to eat the meal, and after the meal they were taken to another room where they were asked to describe in writing the kind and amount of food they had selected. Neither food models or measuring aids were provided.

Results showed that the amounts selected as an average portion size deviated by more than 25% from a generally accepted serving size in 50% to 80% of the responses for breakfast food items and in 28% to 67% for lunch items. Deviations of this magnitude have important implications for the interpretation of food consumption data. For example, for the people who overestimated a typical portion size the actual intake of nutrients would be higher than that calculated for an average portion. Actual energy intake would be underestimated. For many items male participants chose portions that were from 10% to 35% larger than those selected by women. The use of the same standard portion size for men and women would lead to errors of different magnitude for the two groups.

The analysis of the relationship between the amount of food selected and the the amount reported showed large discrepancies. The overall tendency was to overestimate rather than underestimate food quantities. For seven of the twelve food items, over 25% of the people overestimated their actual serving size by more than 51%. For nine of the twelve items over 25% of people overestimated the actual serving size by 25%. Failure to report a selected food item presented an additional source of error. These data reinforce the recommendations that we need to develop and continue to evaluate techniques to assist respondents in remembering and describing food portions more accurately when using recalls and written food records to assess intake. It is obvious that the concern over the validity of reported food intake is warranted, especially when respondents are given written instructions. An important factor in the present study may be the students' ability to remember and accurately describe amounts of foods.

METHODS FOR ASSESSING DIET QUALITY

In order to compare the quality of diets between individuals or groups of people a method indicating the nutritional adequacy of the total diet needs to be established. Several methods have been used in previous research, each with its inherent strengths and weaknesses. This section provides a review of methods for assessing dietary quality in order to identify an approach appropriate to meet the objectives in this study.

Nutrients/1,000 kilocalories

The ratio of the amount of a nutrient/1,000 kcals is useful for examining the diet quality of an individual or group. When examining diets in terms of nutrients, it is difficult to compare persons or groups of people because caloric intake varies widely. In general as one increases caloric intake it is easier to meet the RDAs for individual nutrients. Therefore one could make poor food choices and still meet the RDAs for most nutrients by consuming a large amount of calories. As one consumes fewer calories, choices must be of higher nutrient density to meet the RDAs. The term 'nutrient density' refers to choosing foods that contribute large amounts of needed nutrients relative to the number of calories in the food. Foods that are high in nutrients but relatively low in calories are said to have high nutrient density, while those high in calories but with few nutrients are said to have low nutrient density. Expressing the nutrient composition of the diet in terms of the amount of a nutrient/1,000 kcals allows a direct comparison of individual nutrients between diets, thus giving an idea of nutritional quality. This method is suitable when the objective is to examine and compare individual nutrients and assess the quality of food choices. The amount of a nutrient/1,000 kcals can also be used when looking at the quality of the total diet, with focus on more than one nutrient.

The amount of several nutrients/1,000 kcals can be obtained and then divided by the number of nutrients, to obtain a value indicating the quality of the diet.

Index of Nutritional Quality (INQ)

The INQ concept provides a quantitative analysis of the diet using nutrient standards, and also provides a profile of nutritional quality based on a ratio of nutritive to caloric needs. The INQ was developed from the nutrient density concept to compare the nutritive content of a food or diet with its energy content relative to the recommended nutritive to caloric ratio:

$$INQ = \frac{\text{amount of nutrient in diet per day / USRDA for that nutrient}}{\text{kcal in diet per day / energy requirement}}$$

(From Sorenson et al., 1976)

The standards commonly used to calculate the INQ are the U.S. Recommended Daily Allowances (USRDAs) for nutritional labeling. However other values, such as the RDAs may be used to describe more accurately the nutritional needs of an individual or group. An INQ value of one or greater for a given nutrient in a food or combination of foods indicates that the food choice provides a sufficient amount of the nutrient relative to caloric content. Values less than one indicate that a food or combination of foods contains excess calories relative to nutrient content. A computer program has been developed for calculation and printing of INQs in a tabular and graphic form (Sorenson et al.,1976) In graphic form, the INQ profile yields both qualitative and quantitative information. It can be determined at a glance whether the RDAs or USRDAs were met by observing whether the individual foods eaten additively gave an INQ of one or greater for each nutrient. Sorenson et al. (1976) suggested some useful applications of the INQ, such as menu and recipe analysis, dietary evaluation, planning clinical menus to fit a patient's special nutritional requirements, and providing a basis for public nutrition education.

Nutrient Adequacy Ratio (NAR) and Mean Adequacy Ratio (MAR)

The NAR is a percentage of the RDA for a single nutrient, and is obtained by dividing a subject's daily intake of a nutrient (with intakes greater than 100% of the RDA truncated at 100) by the RDA for that nutrient and multiplying by 100 (Krebs-Smith and Clark, 1989). Then the MAR can be calculated by summing the NARs for individual nutrients of interest and dividing by the number of nutrients used. Thus MAR can be used as a measure of dietary quality.

Newell et al. (1985) collected 24-hr dietary recalls from 1,242 Kansas elementary school children to investigate their eating patterns. Foods consumed were classified into categories on the basis of similar composition, and the effect of consumption of foods in various groups on dietary quality was determined. Regression analysis was used to determine which food categories were significant estimators of dietary quality, as represented by MAR values. The MAR was calculated based on NARs for energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, vitamin B-6, calcium, magnesium, and iron. Results of regression analysis indicated that the categories of milk products, vegetables, mixed protein dishes and fruits were the best estimators of MAR values. To further examine the relationships between dietary quality and food consumption, frequency of foods consumed from the food categories was determined for boys and girls according to level of MAR values, divided into four ranges. The authors thus showed the usefulness of the MAR method for judging dietary quality.

Krebs-Smith and Clark (1989) used MAR as a method of validating a simplified dietary scoring system based on a food grouping scheme. The purpose of the study was to determine the validity of the scoring system for measuring nutrient adequacy that could be used by maternal and child nutrition programs. Data for the study were obtained from the basic survey portion of USDA's 1977-78 Nationwide Food Consumption Survey (NFCS). Two MARs were calculated: one assessed overall nutrient adequacy and another represented only problem nutrients. The nutrients included in the overall nutrient adequacy were iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, vitamin B-6, vitamin B-12, and vitamin C. The authors offered no justification for selection of those nine nutrients. Problem nutrients were those with an average NAR below 80 for pregnant and lactating women in a subset of 274 women who participated in the USDA's NFCS. The problem nutrients were calcium, magnesium, and vitamins A and C. Correlation/ regression analysis was used to assess the relationships between the overall MAR and the simplified food frequency dietary score and between the problem nutrient MAR and the dietary score. Thus the MAR was the "gold standard" used as a measure of diet quality to validate a simplified food frequency diet score.

Worthington-Roberts et al. (1989), studying dietary cravings and aversions of pregnant, lactating and non-lactating women, used NAR for computation of an "Index of Dietary Quality" (IDQ). The authors obtained dietary information from four-day food records kept by subjects and analyzed the records to obtain average daily intakes of energy, protein, and 14 micronutrients. Two summary indexes were calculated. First, mean percent RDA was computed for energy, protein, vitamin A, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, calcium, iron, magnesium, zinc, and folate. Then an IDQ was computed by counting the number of nutrients for which the percent RDA consumed was at least 66.7%. As 16 dietary components were considered, the maximum possible IDQ was 16. Results showed that the IDQ ranged from 8.25 to 10.09 for the first year postpartum, indicating diets of less than ideal quality. This use of the NAR as an indicator of diet quality is practical and sound if it is accepted that an intake greater than 2/3 of the RDA is adequate, and anything less is inadequate. Assigning a score of "one" for nutrients for which intake was greater than 66.7% of the RDA reduces the effect of intakes greater than this cutoff point pulling the mean adequacy ratio up toward 100.

The studies cited above indicate the major strengths of the MAR and NAR. They are easy to calculate and manipulate statistically, and can be used for validating other diet scoring methods. However, much of the research does not offer statistical support or justification for selection of nutrients used in calculating NARs and MARs. If statistical procedures are not used for selecting indicator nutrients, the chances are good that nutrients that are highly interrelated will be used, giving a weighted score not truly representative of diet quality. Also the MAR does not account for nutrient density.

Correlations among nutrients have been reported in a limited number of studies. On the basis of a correlation analysis of the nutrient composition of 202 foods, Pennington (1976) selected seven nutrients - vitamin B-6, magnesium, pantothenic acid, vitamin A, folacin, iron, and calcium, as the best combination of index nutrients for judging dietary adequacy. Pennington claimed that if a diet met the recommended intakes for these seven index nutrients, and if a few simple dietary guidelines were followed, there was a high probability that all 45 essential nutrients included in her data base would be present in the diet in adequate amounts.

Jenkins and Guthrie (1984) criticized Pennington's conclusions because they were based on nutrient data composition of equal portions of 202 foods without considering the relative amounts used in a typical diet, and furthermore data on only three of Guthrie's seven nutrients were available and complete. Jenkins and Guthrie went on to identify a set of index nutrients that could be used for dietary assessment. The authors analyzed 3,318 three-day food intake records collected from the adult population surveyed in the 1977-78 NFCS. The records were analyzed using a data base providing information for 15 nutrients - carbohydrate, protein, calcium, phosphorus, vitamin A, thiamin, riboflavin, niacin, vitamins B-6, B-12 and C, folacin, iron, magnesium, and zinc. A correlation matrix of the 15 nutrients was generated and then a factor analysis with an orthogonal varimax rotation was performed. Four factors were identified and then index nutrients for each factor were determined. The four index nutrients identified by Jenkins and Guthrie as reflecting adequate intakes of the other 11 nutrients were vitamin B-6, iron, calcium, and vitamin A. These nutrients need to be tested under other circumstances and populations to see if they hold as adequate index nutrients.

Food Groups Methods

Food groups are sometimes used as a scoring method for assessing dietary adequacy. Numerical scores have been generated to reflect intake from the four food groups, or other food grouping schemes. Examples are EFNEP's Twenty-four Hour Diet Score and a simplification of EFNEP's system by Guthrie and Scheer (1981). Because the nutritional intakes in the present study were analyzed by nutrient content rather than food groups, the food groups method was not considered appropriate for assessing dietary adequacy in this study.

To conclude, there are many approaches that can be taken in assessing nutritional adequacy, and none of these methods are ideal. Because the computerized diet analysis used in the present study was based on nutrient intake and the percent of the RDA consumed, the MAR seems to be the method best suited to analysis of the data gathered in this study.

VARIABLES RELATED TO DIETARY INTAKE

It is well known that dietary habits are difficult to change because eating is related to many factors. Researchers have identified some of these factors, such as gender (Haseba and Brown, 1968; Beerman et al., 1990), body weight (Wakefield and Miller, 1971), length of time in college (Brown, 1967), subscription to a meal plan (O'Leary and Lee, 1975; Gottschalk et al., 1977; Jakobovits et al., 1977), patterns established prior to attending college (Stasch et al., 1970), place of residence while in college (Beerman et al., 1990; O'Leary and Lee, 1975), education (Young et al., 1956), the symbolic meaning attached to food (Pumpian-Mindlin, 1954), economic factors (Wilhelmy et al., 1950), other family members (Dickens, 1965), advertising (Holden, 1971) personal needs (Lowenburg et al., 1974), and the family life cycle (Coughenour, 1972).

Of the above mentioned factors, gender and place of residence were two of the available factors in this study that were evaluated for their ability to predict diet quality. O'Leary and Lee (1975) compared the nutrient intakes of female students living in university residence (n=75) to the intakes of female students living at home (n=32). Seven-day food records were used for the collection of dietary information. Results showed that mean daily intakes of calcium, riboflavin, and thiamin were significantly higher ($p<0.01$) for students living in residence halls than for students living at home. Mean daily vitamin A intake of students in residence halls was also significantly higher ($p<0.05$). However it was found that for both groups of students mean daily intakes of all nutrients were similar to or in excess of the Canadian Dietary Standards.

Beerman et al. (1990) identified differences in food choices among students at Washington State University living in on-campus (n=65), off-campus (n=62), and Greek housing (n=25). The authors also identified gender differences in food choices. The students completed a food frequency for evaluation of food choices. The authors found that students living on campus ate more fresh fruits and vegetables, drank less beer, and consumed more cookies and fish than students living elsewhere. On-campus students were less likely to select white bread and unsweetened cereals. Significant differences were found between men and women for some of the food selections. More women drank sugar-free soft drinks ($p<0.05$). Men were significantly more likely to consume beer ($p<0.01$) and had greater meat consumption (including chicken, beef, pork, and fish: $p<0.05$). The men consumed more white bread ($p<0.05$) compared with women, who preferred whole grain breads. Though it was not an objective of this study to examine the factors that influence dietary intake, the available demographic and environmental factors (age, gender, place of residence, class level, and body mass index) were evaluated for their ability to predict dietary quality.

COMPUTERS IN EDUCATION

Computers have been used to assist in education for many years. The initial efforts incorporated the first generation of computer hardware, which was large, expensive and relatively unreliable by today's standards. But since their introduction, computers have decreased greatly in size and price, and have increased in capability and reliability. With the relatively inexpensive and popular microcomputers available now, computer-based education is affordable to most educational and training institutions. There has been much research on effectiveness and uses of computers in education. Some of the research is summarized in this section, to provide rationale for the decision to use a computerized program in this research study.

Kulik et al. (1980) conducted a meta-analysis to integrate findings from 59 independent evaluations of computer-based college teaching between 1967-1978. The studies used in the meta-analysis described four major types of applications of the computer to instruction, in varying degrees of use: tutoring, computer-managed teaching, simulation, and problem-solving. The meta-analysis gave equal weight to each independent study, regardless of number of students, classes, or comparisons described. The overall conclusion was that the computer has made a small but significant contribution to the effectiveness of college teaching. In a typical implementation, computer-based instruction (CBI) raised examination scores by about three percentage points, or about one-quarter standard deviation. Computer-based teaching produced small positive effects on attitudes of college students toward instruction and toward the subject matter taught.

Dence (1980) also reviewed research on computer-assisted instruction (CAI) between the 1960's and 1970's. The studies she summarized identified effectiveness of CAI under certain conditions. Two areas in which CAI programs were consistently proven effective were foreign languages and the sciences (Koch, 1973; Allen, 1972; Suppes and Morningstar, 1969; Magidson, 1978; Bitzer and Alpert, 1970). Also, two separate studies (Lewellen, 1971; Vinsonhaler and Bass, 1972) found that CAI students performed better on standardized tests than students being provided traditional instruction. Another advantage of CAI was that it allowed students to progress at their own rates (Okey and Mayer, 1976), and it permitted repeated review of material (Grimm, 1978; Magidson, 1977). Prompt feedback also helped to make CAI effective. One study cited (Kulhavy, 1976) found that students remembered more from a lesson when they were given immediate feedback, and this was supported by other studies (Grimm, 1978; Tait et al., 1974). In one survey of CAI studies (Magidson, 1978), the author found CAI to be at least as effective as traditional instruction in 55% of studies, and more effective in 45%. Some studies (Lewellen, 1971; Allen, 1972; Molnar, 1972; Bitzer and Alpert, 1970) found that CAI students took less time to learn as much or more material than students under traditional instruction. The author concluded that much more research is needed to clarify the role of CAI in instruction, and CAI can then be used in those situations where it will enhance learning for individuals or groups.

A study of CAI in nursing education was conducted by Conklin (1983). The author sought to determine if CAI as a teaching technique would improve the achievement scores and attitude toward CAI in a third year nursing course, and if the improvement would be greater than that shown by students assigned reference-reading only, and students given no instruction. The CAI package used was developed specifically for the 'Nursing of Adults' course. The specific purpose was to augment surgical nursing knowledge gained through traditional instruction. The students were divided into three groups: 1)"CAI" group- a group taking the course, and participating in a six-week surgical nursing practicum and exposed to the CAI component; 2)"Traditional group"- students in the course and also doing the six-week surgical practicum, but assigned reference readings; and 3)" Control group"- from a different section of the class who did not have surgical nursing instruction or practicum. Students were given pre- and post-tests, consisting of a multiple-choice achievement test, and a semantic differential questionnaire to assess attitudes toward CAI. Results revealed that the CAI group improved significantly ($p<0.001$) on achievement scores, and the improvement was significantly greater than that for traditional and control groups ($p<0.001$). Mean scores of the attitude test improved from pre-to post-test in all three groups, so no difference was found between the CAI group and the other two groups in change of attitude toward CAI. Results from this study, combined with literature cited by the author from other areas of the health profession promoted the general consensus that CAI can be used effectively in such settings as nursing education, continuing education, inservice education, community health, hospital orientations, and nursing refresher courses.

Schroeder and Kent (1982) carried out a study to determine whether a computer-based instructional system for teaching renal diet therapy could teach as well as, or better than traditional instruction, and to compare students' attitudes toward the computer teaching method and traditional method. A CBI program was designed specifically for this purpose, and provided tutorial and drill-and-practice sessions. Junior and senior dietetics students were divided into two groups, one group to be self-instructed by computer, the other to be taught by a traditional lecture/laboratory mode. Multiple-choice pre-and post-tests for knowledge were administered, and following the post-test a Likert-type instrument measured attitude toward the respective teaching method for each group. Analysis of pre-test and post-test scores showed no significant difference in achievement between the two instructional groups. The students who learned by computer had more favorable attitudes than the conventionally taught students. Therefore the study supported the use of a CBI system as a primary means of teaching renal diet therapy to dietetics students.

Deardorff (1986) compared a computerized format to written and face-to-face formats for presentation of medical information to undergraduate students in introductory psychology courses. Participants were randomly divided into four groups and received information by written presentation, a computerized presentation, a face-to-face presentation, or a control group who received no information. Subjects in the control group completed a general information sheet and then were given magazines to peruse while the other groups were receiving their respective presentations. The information presented to the groups was on sexually transmitted diseases. At the end of the presentations, participants were administered four evaluations. These consisted of an assessment of state or situational anxiety, a semantic differential questionnaire assessing the information delivery format, a free recall task which asked participants to write all the information they could remember from the presentation, and a cued recall task consisting of a 20-item multiple-choice test. Results for the state of anxiety scores revealed no significant difference between delivery formats. The semantic differential responses indicated that generally the computer and face-to-face formats were equal, and both were rated higher than the written format. The free recall and cued recall (multiple-choice test) both showed that computerized and written formats did not differ in proportion recalled, and both of these were superior to the face-to-face format. The results supported the conclusion that a computerized health education format is just as effective as a written format. Also, the computerized format was rated positively, as was the face-to-face method.

Ries and Granell (1985) developed a college-level CAI lesson on vegetarianism, and compared its effectiveness with the lecture/ discussion method. Forty-four students enrolled in an introductory-level foods and nutrition course comprised three study groups: CAI, lecture/discussion, and a control group. All three groups completed a pre-test, and one week later the CAI and lecture/ discussion groups received their respective lessons. The control group received a lesson on another topic. Three weeks after the lesson, a post-test was completed. Results showed no significant effects on learning with either CAI or lecture/discussion method. Authors noted that due to the small sample size and specificity of subject matter, the results should be interpreted cautiously. However, the findings did support previous research in suggesting that CAI is a feasible alternative to the lecture/discussion method in the college nutrition classroom. These findings were also supported by Wade and Thiele (1973), who compared a CAI group to a non-CAI group in a college-level Food Science and Nutrition course, and found CAI to be as effective as a non-computer assisted program.

Carew et al. (1984) developed a CAI program to serve as a study guide in a college-level introductory nutrition course. Students used the program on a volunteer basis to review or clarify lecture notes, to review difficult concepts, or to help prepare for exams. Students using the CAI program were given a questionnaire at the end of the semester. This was not a controlled study, but preliminary data provided some indications about the use of CAI. Most students (51%) thought the CAI approach was useful, and 52% felt it should be required rather than optional. The most important question asked was whether the students thought using CAI improved their grades. Before grades were distributed, 83% of students thought using the CAI definitely had improved their grades. After analyzing grades, it was found that the mean course grade for users was 81.3, while that of non-users was 76.2. This difference in grades may be because the CAI users were more motivated or better students to begin with, not that using the computer improved their scores significantly. Regardless of this, the students enjoyed using the program, and the feasibility of CAI as an alternative in classroom education was again supported.

A study designed to compare the effectiveness of CAI and lecture method of instruction (LMI) for teaching sanitation to hospital foodservice personnel was carried out by Waddell et al. (1985). Two independent variables, gain in sanitation knowledge, and amount of time required to complete the training experience were compared between CAI and LMI groups and a control group. The effects of employees' age and education level were also investigated. A sanitation knowledge test, in a pre-test and post-test format, was used to measure gain in knowledge, along with an attitude assessment questionnaire to assess attitudes toward sanitation training and CAI. The control group was administered the pre-and post-tests and received no training. 230 foodservice employees participated in the training. The CAI training consisted of three diskettes, used at individually scheduled times. The LMI group attended one lecture session. The CAI and LMI group attained significantly higher scores ($p<0.001$) than the control group. The CAI group obtained higher gain scores than the LMI group, but the difference was not significant. The age and levels of education did not affect the gain scores. In regard to time required to complete the training, the LMI group required one-third the time of the CAI group, contrary to the researchers' expectations. Possible explanations offered for this were that the participants were not limited to the time they could spend on the computer, and because of the novelty of the situation, workers might have intentionally repeated parts of the lesson to spend less time at work. Data from the attitude assessment questionnaire showed significant differences ($p<0.001$) in scores from pre-test to post-test in the CAI group, indicating that attitudes toward CAI improved as a result of participation. To conclude, the CAI was as effective as the LMI in increasing knowledge, but the authors emphasized that further research is needed to determine whether CAI is a cost-effective method for training hospital foodservice personnel.

In discussing computers and health education, Gold and Duncan (1980) stated that one of the most basic ways that computers may serve as motivational devices is through the use of self-assessment programs. One such approach is computerized dietary analysis programs. These programs allow students to input information on what they eat, and receive immediate output about how well they met their dietary standards. Authors stated that such programs can provide an excellent introduction to the study of nutrition by developing and focusing student interest.

Weinberg and Scott (1983) also discussed the use of the computer in nutrition education. They focused on using advances in technology to efficiently translate knowledge of nutrition to the public. Patient education is one place where technology can be taken advantage of. Computerized programs allow for the patient's active participation in the education process. Computers are also advantageous in that they are available 24 hours a day. When used for nutrient analysis, computers provide personalized advice and are a valuable adjunct to one-to-one counseling. Self-monitoring, which is a strong behavioral change technique, is facilitated by the computer. The authors concluded that the potential for computers in health promotion is great, as the computer can handle multiple inputs and provide multiple outputs, and cater to an individual's specific needs and demands. But further research must demonstrate effectiveness and cost-effectiveness of computer applications.

CHAPTER THREE

METHODS

Subjects

Prior to collecting data, an approval for the study was obtained from the University Committee on Research Involving Human Subjects (Appendix A). A consent form was developed for the students who agreed to have their data used for research purposes (Appendix B). Students in the college-level introductory nutrition course (two live lecture sections) at Michigan State University comprised the control and experimental groups. The course enrollment for the fall 1988 quarter in the two sections was 711 students. Two sections of the course were offered consecutively, by the same instructor in the late morning, three days a week. This helped minimize student bias between the two sections.

Of the students in the course, approximately 47% were freshmen, 36% were sophomores, 11% were juniors, and 5% were seniors. Students from all majors enrolled in the class in part because the course fulfills a Natural Science general education requirement at MSU. There were no differences in the students' demographic backgrounds (class level, college major) between the two sections.

Instruments

The test instruments included a multiple-choice nutrition knowledge test and a Likert-type nutrition-related attitude questionnaire (Appendix C). To estimate students' dietary behavior, food intake data were collected from one-day dietary records (Appendix D).

Nutrition Knowledge Test

The 22-question knowledge test was formulated from test questions used in examinations during previous terms of the class. Difficulty and discrimination indices from five previous examinations were used in selecting appropriate questions. Difficulty scores (percentage of students marking the wrong answer) of the knowledge test questions ranged from 8 (easy) to 49 (difficult). In order to cover the depth of information presented in the class, questions were selected to range from easy to difficult and to cover general as well as detailed information. Discrimination scores (difference between top 27% and bottom 27% of students marking the correct answer) ranged from 0.33 to 0.68. These are commonly accepted cutoff points for discrimination scores (Crocker and Algina, 1986). The formulated questions were tested for face validity by faculty associated with the course and by graduate students in the Department of Food Science and Human Nutrition during the 1988 winter quarter.

Nutrition Attitudes Test

Copies of attitude instruments were obtained after the literature was reviewed, relevant studies were identified, and authors were contacted. The attitude instrument for this study was compiled based on research from two previous publications (Boren et al., 1983; Christopher et al., 1980). The two instruments selected had been formulated specifically for college students enrolled in introductory nutrition courses. These instruments included two constructs related to this study; flexibility or rigidity in attitudes toward nutrition and concern about nutrition.

Previous literature (Carruth et al., 1977; Jalso et al., 1965) has suggested that flexibility or rigidity in attitudes and personality is an important factor in determining a person's willingness to change. The attitude instrument from Boren et al. (1983) measured the construct of flexibility/rigidity in attitudes toward nutrition.

Attitude statements were written in a Likert format with a five-category continuum from "strongly agree " to "strongly disagree". Negatively worded items were reversed for scoring. Thus, the higher the total score was, the less flexible the attitude toward nutrition was considered to be. Content validity was established by the authors on the basis of information provided by experts in nutrition, education or instrument development. Reliability was determined by split-half reliability (Spearman Brown Prophecy Formula) and Cronbach's Alpha reliability. Split-half reliability was reported as 0.86 for the Boren et al. study, and Cronbach's Alpha was reported as 0.84.

The attitude instrument used by Christopher et al. (1980) was a compilation of items selected from various other instruments and these items also were written in a five-point Likert-scale format. Using factor analysis, the authors had identified five factors within their attitude instrument: 'Concern about Nutrition', 'Breast Feeding is Important', 'Nutrition is Important in Pregnancy', 'World Food issues', and 'Attitude about Televised Instruction'. Because it has been suggested that a person's concern about nutrition will affect his/her motivation to change (Eppright et al., 1970; Grotkowski and Sims, 1978), the 'Concern about Nutrition' factor was selected for use in the present study. Christopher et al. (1980) reported the reliability coefficient (Cronbach's Alpha) for this factor as 0.91 and 0.88 from testing at two different campus branches.

Although the attitude measurement instruments had been tested by the original authors (Boren et al., 1983; Christopher et al., 1980), they were tested again by this researcher in the spring quarter (1988) to confirm the reliability for the HNF 102 class at MSU. The attitude instruments were pilot tested at one time point, rather than a test/retest, with this HNF 102 class, therefore changes in attitude were not tested. In testing the construct of flexibility/rigidity (Boren et al.,1983) the Likert scale was reversed, reading from "strongly disagree" to "strongly agree" so that a high score would indicate a more flexible attitude toward nutrition. Negatively worded items were reversed for scoring. Thus the higher the total score, the more flexible the attitude toward nutrition was considered to be. Using the Statistical Package for Social Sciences (SPSSX) (SPSS Inc., 1988), a reliability analysis was computed. By examining the correlation matrix, five of the items were determined to have low correlations (r=0.0-0.3) with the other items. Coefficient Alpha, which measures how well the items are working together as a scale, was increased by excluding these five items. The final nine-item scale reliability (Coefficient Alpha) was 0.81.

The 'Concern about Nutrition' scale of Christopher et al. (1980) also was tested with the MSU HNF 102 students. Again using SPSSX, a reliability analysis was computed. Three items were deleted because they had low correlations (r=0.0-0.3) with other items in the correlation matrix, and Coefficient Alpha was increased by excluding them. The final fourteen-item scale reliability (Coefficient Alpha) was 0.92. Both constructs ('flexibility/rigidity of attitudes toward nutrition' and 'concern about nutrition') were combined to make a 23-item attitude instrument for use in this study, as they were both considered important.

Dietary Intake

Dietary intake information was collected using a one-day dietary intake form (Appendix D). The one-day diet record was chosen because recording and analyzing the data can be easier than other methods or using more days (Pao et al., 1985), and it was assumed students would more readily participate. Also previous literature has supported the ability of one-day dietary intake records to represent group mean dietary intakes. All students were instructed to record their complete intake for one weekday, including all foods and beverages, condiments, method of preparation, serving sizes, etc. Students in the control group turned in their food records and also recorded gender, age, height, weight, and activity level information so that the computerized diet analysis program could be run by the researcher. Students in the experimental group were given complete instructions on how to run the computerized diet analysis program and were instructed to turn in the printout of their diet analysis.

The diet analysis program used, 'MSU NutriGuide' was developed in the nutrition department at Michigan State University (Department of Food Science and Human Nutrition, MSU, East Lansing, MI). It was initially developed specifically for use by the students in HNF 102 and contains a unique educational component designed to reinforce the information learned in the class. The program was designed to assess dietary intake over a 24-hour period and analyze these foods for 27 nutrients. The nutrient intake was then compared to the 1980 RDAs and other dietary guidelines. In addition, the program calculated daily caloric needs based on age, sex, body size and activity level. The database consisted of 730 foods, including foods selected from the MSU Nutrient Database and food items from the MSU residence hall food service. Recipe analysis information for residence hall items was obtained from MSU Food Service and added to the MSU NutriGuide Database. The educational component includes information on the 27 nutrients assessed within the program and information on current nutrition issues, some of which are covered in the course.

Procedures

Both sections of the nutrition course covered the same lecture material and were taught by the same instructor. The teaching method was consistent for both sections, and the same examinations were administered on the same days.

Data Collection

The control and experimental groups were administered pre- and post-tests on nutrition-related knowledge and attitudes. The pre- and post-tests were not required as part of the course. Because the research study was independent of the course, the instructor and researcher agreed that the pretest and posttest be completed on a voluntary basis, rather than as a course requirement. The pretest was given the first week of class, and the posttest given the last week of the 10-week quarter. In addition to knowledge and attitude questions on the posttest, students in the experimental group were asked questions related to the computerized diet analysis assignments. Students recorded responses on computer-readable scoring sheets. The scoring sheets were sent to the computer center scoring office and item analysis run on the knowledge test questions. Data analyzed by the scoring office are recorded on magnetic tapes. The knowledge and attitude responses were transferred to floppy diskettes to be available for statistical analysis. Data for each student were identified by student number only.

To assess dietary intake, both sections of the nutrition course received the same diet record assignments. During the first week of the quarter and the second to last week of the quarter, the control and experimental groups completed one-day diet intake records. The control group handed in the records and received no feedback until the end of the quarter. The experimental group used MSU NutriGuide to analyze their diet records and to receive immediate feedback both times. The experimental group was encouraged to assess their diets by using the program as frequently as desired during the term. The diet records from the control group were analyzed with the same computerized program by the researcher so that the dietary intake data could be compared between the two groups. The students received four points (on a 100 point scale) for completing the two diet record assignments.

All dietary intake data were automatically stored on floppy diskettes, and after each assignment was turned in, data were downloaded onto a master diskette. The dietary intake information was also identified by student number. At the end of the quarter, the knowledge and attitude responses were merged with the dietary intake information by matching student numbers. Data for students who completed both the knowledge and attitude pre- and posttests and the pre and post diet record assignments were retained for research purposes.

Statistical Procedures

For data analysis the Statistical Package for the Social Sciences (SPSS-X) program was used.

Means and standard errors were obtained for the scores of the knowledge test, attitude questionnaire, and the nutrient intake data estimated by the dietary analysis program.

ANOVA procedures were used to determine whether there was a significant treatment effect (experimental vs. control group), time effect (pretest vs. posttest), or an interaction effect (treatment by time) for knowledge, attitude and dietary data. For this study, MANOVA (multiple analysis of variance) was not chosen as a method of statistical analysis for the dietary data. MANOVA is classically used when there are multiple dependent variables, as with the 27 nutrients included in the dietary analysis. However, in order to adequately interpret the output generated by MANOVA a hierarchy of dependent variables needs to be established. Because our knowledge of nutrients at this point is inadequate to identify nutrients from most to least important, it was decided that the MANOVA procedure was inappropriate.

Where significant differences were determined by ANOVA, t-tests were used to compare the two groups and two time points in this study. When a significant treatment (group) effect was found, the independent samples t-test was used to evaluate whether the difference between the groups was at the pretest and/or posttest, for knowledge, attitude and dietary data. When a significant time effect was detected by ANOVA, the paired samples t-test was used to determine whether the difference was within the control and/or experimental group for knowledge, attitude and dietary data. Dietary data were evaluated for the entire study population and also for females and males separately.

Measurement of Dietary Quality

Nutrients included in the calculation of the Mean Adequacy Ratio (MAR) score were protein, vitamins A, D, E, B-1, B-2, B-6, B-12 and C, niacin, folacin, iron, calcium, phosphorus, magnesium, and zinc. These nutrients were selected because they have established RDAs, and were included in the dietary assessment program. However, the database contains incomplete data for zinc. Because of the incomplete data for zinc, the MAR scores also were calculated without zinc. There were no differences in the MAR scores with or without zinc, so zinc was left in the calculations. For the other fifteen nutrients the database is approximately 90% complete. To calculate the MAR, first the Nutrient Adequacy Ratio (NAR) is determined for each nutrient. The NAR is each persons' percentage of intake of the RDA for each nutrient. All NARs with a value greater than 100 were truncated to 100 to prevent high intakes of some nutrients from pulling the mean score up. Then all NARs were summed and divided by the total number of nutrients included to obtain the MAR.

Variables Related to Nutritional Adequacy

Multiple regression analysis was used to examine the associations between available demographic and environmental variables (independent variables) and nutritional adequacy (dependent variable). Independent variables included age, gender, place of residence, class level, and body mass index (BMI). These variables were selected because of data availability. The dependent variable was nutritional adequacy as indicated by MAR. In this study the backwards method of regression analysis was used. In this method first all the independent variables were entered into the regression equation. A t-value was determined for each variable, and the significance of the t was determined. The variable with the least significant t-value (greater than 0.05) was deleted from the equation and the equation was recalculated, with new t-values determined for each variable. The process was repeated with variables deleted one by one until only variables with significant t-values ($p<0.05$) were remaining. Because the regression coefficients were each determined by a different scale (each variable as it related to MAR) the coefficients could not be compared to determine their relative importance in the equation. In order to compare the coefficients they were transformed to the standardized z-scale, and are termed beta-weights. Thus the beta-weights can be compared to determine the relative importance of each variable in the equation. When the prediction of the dependent variable is based on two or more independent variables an adjusted multiple correlation coefficient (R) is computed. The adjusted value is the correction for bias resulting from procedures used in determining the multiple regression equation. The squared value of the adjusted multiple correlation coefficient (R^2) describes the proportion of variance in the dependent variable predicted by the regression equation. In the actual computation process, dummy variables were substituted for class levels (i.e., 1 representing freshmen, 2 representing sophomores, 3 representing juniors, 4 representing seniors, and 5 representing any other level), gender (i.e., 1 for female and 2 for male), and place of residence (i.e., 1 being residence hall, 2 being off-campus housing, 3 being fraternity/sorority, 4 being at home with parents, and 5 being any other living situation). For age and BMI, actual values were used.

Finally, Pearson product-moment correlation coefficients were computed to determine the relationship between nutrition knowledge and attitudes, nutrition knowledge and MAR, and nutrition attitudes and MAR. Because there were no significant differences between the control and experimental groups in terms of knowledge, attitudes, and dietary data, group data were combined for this statistical procedure.

CHAPTER FOUR

RESULTS AND DISCUSSION

SUBJECTS

The subjects included in the data analysis were 254 students who completed both knowledge and attitude pre-and posttests and pre and post diet record assignments. The study sample comprised 36% of the total class population: 49 percent of the students in the control section (n=177) and 22 percent of the students in the experimental section (n=77). This author suggests that the difference in participation rates was due to the difference in the workload for the diet record assignments. The control group recorded one-day intakes and turned them in. The researacher analyzed the diet records and gave feedback to the students at the end of the term. The experimental group recorded one-day intakes and self-evaluated their diets using the computerized diet analysis program and then turned in their printouts. The diet analysis program generally took twenty to thirty minutes to run. The assignment was given twice during the quarter, and therefore involved more work for the students in the experimental group.

Another possible explanation for the seemingly low participation rates for the experimental group lies in the method of data collection for the computerized diet analysis program. After the students entered their dietary intake data the nutritional assessment was printed. Data storage was carried out after the printout function. From information obtained from the computer lab monitors it is possible that many of the students simply did not have their dietary data stored because they stopped at the printout step. There is no way of determining how many students did not save their dietary data.

The response rate for the pretest in the control group was 82%, and 83% for the experimental group. Sixty-eight percent of the students in the control group completed the posttest with 64% in the experimental group. Eighty-three percent of the students in the control group completed the first diet record assignment, while 92% in the experimental group completed the assignment. For the post diet record assignment 68% of the students in the control group returned it while 66% of the students in the experimental group completed theirs. Therefore, the response rates for each individual piece were fairly good. However all four pieces were necessary for data analysis, and many students were likely missing only one piece.

It was determined that the study group was a representative sample of the class population based on the class level and place of residence (Tables 1 and 2).

Table 1. Class level of students

	Total class n=711 %	Study sample n=254 %
Freshman	47	36
Sophomore	37	39
Junior	11	16
Senior	5	7
Other		2

Table 2. Place of residence of students

	Total class n=711 %	Study sample n=254 %
Residence hall	73	70
Off-campus housing	21	22
Fraternity/Sorority	2	2
Home with parents	2	4
Other	2	2

The majority of students that enrolled in the introductory nutrition course were freshmen and sophomores (Table 1). Because most of the students were underclassmen, the majority lived in the residence halls (Table 2). Place of residence would likely affect their dietary intakes, due to residence hall food service (Beerman et al., 1990; Gottschalk et al., 1977; Jakobovits et al., 1977; O'Leary and Lee, 1975).

Data are not available for the gender of the students in the entire class. For the study population information on males and females is presented in Table 3.

Table 3. Percent of males and females in the study group

	Females %	Males %
Control (n=177)	80	20
Experimental (n=77)	78	22
Study population (n=254)	79	21

NUTRITION KNOWLEDGE

The knowledge test score (± standard error) increased from 7.9 ± 0.2 in the pretest to 12.8 ± 0.3 in the posttest (maximum possible score of 22) in the control group. In the experimental group, the average pretest score of 7.4 ± 0.3 increased to 14.9 ± 1.6 in the posttest (Table 4).

Table 4. Knowledge test scores

Group		Pretest*		Posttest*	
		$\bar{X}$	SE	$\bar{X}$	SE
Control	(n=177)	7.9	0.2	12.8	0.3
Experimental	(n=77)	7.4	0.3	14.9	1.6

* Maximum possible score=22

Table 5. ANOVA for knowledge test means*

Effect	F	Significance of F
Time	119.24	<0.001
Group by time	5.35	<0.05

*n=254

Results from ANOVA indicated significant time and interaction effects (Table 5). The increase in scores from pretest to posttest (time effect) was significant (p<0.001) for both control and experimental groups, as determined by paired t-tests. This was an anticipated outcome of the course because enhancement of knowledge is a primary goal of education. The increase in nutrition knowledge resulting from the course has been supported by other studies where a pretest-posttest design was used (Brush et al., 1986; Byrd-Bredbenner et al., 1988; Carruth et al., 1977; Rosander and Sims, 1981; Ross, 1984). However, there was no significant difference between the knowledge scores of the groups at the posttest (beta=0.01). Therefore, as far as the first objective of the study, it must be concluded that use of the computerized diet analysis program as used in this course, did not significantly enhance nutrition knowledge beyond the improvement resulting from the course.

NUTRITION ATTITUDES

The attitude pre- and posttest score means (± SE) of the control group were 23 ± 0.7 and 22 ± 0.9, respectively (maximum possible score = 46). The attitude pre- and posttest score means of the experimental group were 22 ± 1.4 and 23 ± 1.1 respectively (Table 6). Results of ANOVA showed no significant group, time, or interaction effect.

Table 6. Attitude test scores

Group		Pretest*		Posttest*	
		$\bar{X}$	SE	$\bar{X}$	SE
Control	(n=177)	23	0.7	22	0.9
Experimental	(n=77)	22	1.4	23	1.1

*Maximum possible score=46

In other studies where changes in nutrition attitudes were measured by pretest and posttest, results have varied (Brush et al., 1986; Byrd-Bredbenner et al., 1988; Ross, 1984). In the study by Brush et al. (1986), no differences were found in nutrition attitudes of adults 19 to 65 years old from pretest to posttest. One explanation offered by the authors for the lack of change was the possibility of a "ceiling effect". At the pretest both the treatment and control groups scored over 82% of the maximum possible score for the nutrition attitudes scale. Therefore the attitudes of their study participants may have reached their "ceiling". However, this was not the case in the present study. Both control and treatment groups scored around 50% of the maximum possible score on the attitude scale at the pretest, therefore the ceiling effect cannot be considered as an explanation for the lack of change in attitudes.

Byrd-Bredbenner et al. (1988) also found little detectable change in attitude scores from pretest to posttest in their high school home economics students. The authors suggested that because school-based education is geared toward cognitive goals, the curricula and teaching strategies are likely not the most effective ones for changing nutrition attitudes. General nutrition curricula, such as the one used in their study, helped students comprehend basic nutrition principles rather than change specific dietary attitudes and behaviors. This is also a plausible explanation for the results found in the present study, because of the general nature of the basic nutrition course.

In the study by Ross (1984), nutrition attitudes of college-level nursing students did not change from pretest to posttest. Ross found a decrease in score (less positive attitude) for two attitude statements at the posttest. She suggested that means of pre- and posttest series may regress to the mean when completed over short periods, and this may account for the small amount of change seen in her study.

The finding from this study of no changes in attitudes could be attributed to several reasons. Attitude change was not a specific goal of the curriculum, however it was likely an intended goal along with knowledge change. If some attitude change was stimulated, the 9-week interval between pre- and posttest may have been insufficient to demonstrate any attitude change. It is also possible that the attitude instrument was not sensitive enough to pick up changes in attitudes if there were any. It is possible there may have been changes in attitudes other than those assessed in the nutrition attitude questionnaire. Perhaps if "satisfaction with the course" or "ability to apply the information taught", or some other attitude constructs were assessed, a difference could be determined between the group that used the computerized diet analysis program and the control group. Determining which specific attitudes will be addressed in an educational program is difficult because the effect of the program on attitudes may vary from person to person. The actual attitude changes, if any, may be intended or unintended. Also, attitudes may be relatively resistant to change (Swanson, 1972). Finding a valid and specific measure of intended attitude change is difficult.

Another problem with attitude measurement occurs when the subjects know that they are part of a research project. When subjects are aware that their data are being analyzed, they are likely to modify responses because of wanting to please the researcher, wanting to give a good impression, giving responses that they believe are socially "acceptable", etc. (Fishbein and Ajzen, 1972). However, because the response rate for completing all four pieces of data was so low, this is not a probable factor in this study. The results indicated that use of the computerized diet analysis program, as used in this course, did not positively or negatively affect the students' attitudes toward nutrition.

DIETARY INTAKE

Average one-day nutrient intakes of the control and experimental groups are summarized in Table 7. Results of ANOVAs indicated a significant time effect (i.e., intake of these nutrients differ between the pretest and posttest) across both groups ($p<0.05$) for folacin, alcohol, vitamin A, and magnesium intakes (Table 8).

Table 8. Results of ANOVA for folacin, alcohol, vitamin A, and magnesium intake from pretest to posttest

Nutrient	F	Signif of F
Folacin*	6.76	<0.01
Alcohol*	9.02	<0.01
Vitamin A*	5.79	<0.05
Magnesium*	5.61	<0.05

* time effect

TABLE 7. Mean daily nutrient intake

Variable	Pretest				Posttest			
	Control		Experimenta		Control		Experimental	
	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE
Calories	2277	78	2301	129	2184	103	2255	170
Protein (g)	90	4	87	5	95	13	85	6
Carbohydrate (g)	272	20	281	18	258	10	275	21
Total fat (g)	91	4	91	7	87	4	92	8
Polyunsat fat (g)	14	1	15	3	14	1	12	1
Saturated fat (g)	33	2	30	4	32	2	32	4
Cholesterol (g)	287	19	304	42	262	36	245	25
Alcohol (g)	3 *	1	4 *	2	1 *	0.3	1 *	0.5
Vitamin A (IU)	9541 **	845	10595	1841	6730 **	576	8928	1490
Vitamin D (IU)	176	14	151	21	186	13	151	18
Vitamin E (mg)	6	0.5	6	0.8	7	0.5	6	0.8
Thiamin (mg)	1.6	0.06	1.5	0.1	1.5	0.07	1.4	0.1
Riboflavin (mg)	2.2	0.09	2	0.1	2.1	0.1	1.9	0.1
Niacin (mg)	23	1	23	2	27	5	21	2
Vitamin B-6 (mg)	1729	89	2575	127	1814	246	1421	98
Vitamin B-12 (mcg)	4.6	0.3	3.7	0.3	4.4	0.4	3.8	0.3
Folacin (mcg)	339 *	19	301	27	296 *	15	252	22
Vitamin C (mg)	135	15	147	33	108	11	121	14
Phosphorus (mg)	1529	59	1471	96	1533	108	1433	95
Potassium (mg)	2804	106	2918	221	2677	142	2698	165
Magnesium (mg)	299	14	300	25	272	16	253	16
Iron (mg)	14	0.5	14	1	13	0.6	14	1
Calcium (mg)	1211	57	1086	89	1170	58	1123	94
Sodium (mg)	3672	162	3930	288	3738	146	3945	323
Zinc (mg)	9.8	0.4	9.6	0.7	9.7	0.6	9.7	0.8
Dietary fiber (g)	7	0.5	9	1	8	0.5	8	1
Caffeine (mg)	94	10	125	26	106	12	110	25

Control group (n=177); Experimental group (n=77)
* significantly different ($p<0.05$) between pretest and posttest within group
**significantly different ($p<0.001$) between pretest and posttest within group

To further investigate in which group changes took place from pretest to posttest, paired t-tests were conducted. In the control group, intake of alcohol, folacin and vitamin A had significantly decreased ($p<0.05$). In the experimental group there was also a significant decrease in intake of alcohol ($p<0.05$) (Table 7). The apparent decrease in alcohol intake for both groups was a positive change. However, because there was no control group outside of the nutrition course, it was not possible to measure whether this decrease in intake was a result of the students taking the nutrition course or not. Also because of the 10-week (one quarter) duration of the study, it was not possible to measure whether alcohol intake has seasonal variability, with warm or cold weather having more of an effect on alcohol intake. There also may be a day of the week effect for alcohol intake, with higher intakes existing in the middle or end of the week. If the pretest and posttest diet records were kept for different days of the week that might help explain the difference in intake. There is no way of determining which days of the week were recorded by students. This researcher also admits that recording of one-day intakes is likely not an accurate representation of alcohol consumption. Other research that has evaluated alcohol use among college students has reported alcohol consumption in terms of prevalence rate (percentage using alcohol), frequency of use and quantity of use (Berkowitz and Perkins, 1986; Berkowitz and Perkins, 1987; Davis.and Reynolds, 1990; Sarvela et al., 1988; Valois, 1986). Different survey formats were used to gather the alcohol consumption information in each of those studies. Comparisons cannot be made between the reported one-day alcohol intakes in the present study and the frequency and quantity of consumption information from other studies.

The vitamin A intake of the control group (as well as the experimental group) was more than twice the RDA at the pretest, so the decrease in intake at the posttest brought the value closer to, but still higher than the RDA. However the accuracy of mean vitamin A intake is questionable. One-day intakes have been shown to be the least accurate for vitamin A and C intake when evaluating individual and also group data (Guthrie and Crocetti, 1985; Pao et al., 1985; St.

Jeor et al., 1983; Basiotis et al., 1987). This was one of the concerns of one-day dietary intakes as stated in the literature review section on 'Concerns with dietary assessment methods'. It is believed that the apparent difference in mean intake is actually a reflection of the wide variation in day-to-day intake of vitamin A, as shown by Guthrie and Crocetti (1985) and Basiotis et al. (1987).

The folacin intake of the control group was 85% of the RDA at the pretest, and decreased to 75% of the RDA at the posttest. The decrease in folacin intake might be due to the seasonality of food sources of folacin. Green vegetables, which are more readily available and affordable in the summer and early fall are a good source of folacin. Although there was a significant difference in magnesium intake across both groups, as indicated by ANOVA procedures, paired t-tests for the control and experimental groups individually showed no significant changes from pretest to posttest.

It has been observed in previous studies (Basiotis et al., 1987; Beaton et al., 1979) that there are significant differences in dietary intakes between males and females. In light of this, the dietary intake data of the males and females in this study were compared by t-tests to determine whether there were significant differences in intake. Once the nutrients for which significant differences in intakes between the sexes were identified, comparisons of those nutrients were made within each of the sexes using ANOVA procedures. However the data for the males and females needs to interpreted with caution. Using Kraemer and Thiemann's (1988) power analysis equation for the two-sample t-test, it was determined that, for nutrients for which no significant difference in intake was found, there were not enough females to have confidence in the results at the 80% power level. For all nutrients for which no significant difference in intake was found for the males, the n-size was too small to have confidence in the results (using the 80% power level). At the onset of the study, this researcher assumed that using the students enrolled in HNF 102 would provide a large enough sample size to obtain reliable results. However the sample size was not as large as expected and in retrospect the data for males and females were questionable taking into account the small sample sizes. Therefore the power analysis was done post hoc in order to have confidence in the results. The equation used and a sample calculation are shown in Appendix G.

The average one-day nutrient intakes of the females at the pre- and posttests are presented in Table 9. The ANOVAs indicated a significant time effect (i.e., intake of these nutrients differ between the pretest and posttest) for carbohydrate and magnesium intake, and a significant group effect (i.e., intake of this nutrient differs between the control and experimental groups) for saturated fat intake (Table 10). Results of the t-tests indicated that the saturated fat intake of the control group at the pretest was significantly greater ($p<0.05$) than that of the experimental group, therefore this apparent difference in saturated fat intake is accounted for by the pretest data (Table 9).

Table 10. Results of ANOVA for carbohydrate, magnesium and saturated fat intake of the females (n=201)

Nutrient	F	Signif of F
Carbohydrate**	5.67	<0.05
Magnesium**	4.52	<0.05
Saturated fat*	4.13	<0.05

* group effect
** time effect

Results of the paired sample t-tests showed that for the control group of females, a significantly higher intake ($p<0.05$) of carbohydrates was found in the pretest as compared to the posttest (Table 9). For the females in the experimental group, intake of magnesium proved to be significantly higher ($p<0.05$) at the pretest than at the posttest (Table 9). The magnesium intake was 87%of the RDA at the pretest and decreased to 71% of the RDA at the posttest.

Table 9. Mean daily nutrient intake of females

Variable	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	$\overline{X}$	SE	$\overline{X}$	SE	$\overline{X}$	SE	$\overline{X}$	SE
Calories	2084	78	1936	122	1957	111	1765	115
Protein (g)	82		72	5	87	16	70	5
Carbohydrate (g)	249**	9	242	16	229**	9	218	15
Total fat (g)	84	4	75	6	78	4	70	6
Saturated fat (g)	31	2	24	3	28	2	23	2
Cholesterol (g)	260	19	240	40	241	44	187	21
Vitamin D (IU)	154	14	146	24	154	12	145	19
Thiamin (mg)	1.4	0.07	1.3	0.1	1.3	0.07	1.2	0.1
Riboflavin (mg)	1.9	0.9	1.8	0.1	1.8	0.09	1.6	0.1
Niacin (mg)	22	1	18	2	26	7	17	1
Vitamin B-6 (mg)	1596	96	1362	129	1710	304	1285	103
Vitamin B-12 (mcg)	3.8	0.2	3.3	0.3	3.4	0.26	3.6	0.3
Vitamin C (mg)	137	18	96	11	108	13	99	12
Iron (mg)	13	0.6	12	0.9	12	0.7	11	1
Calcium (mg)	1081	58	993	100	985	46	958	90
Phosphorus (mg)	1395	58	1310	107	1377	126	1176	76
Sodium (mg)	3377	184	3346	264	3343	130	3054	228
Potassium (mg)	2600	113	2500	182	2420	160	2293	136
Magnesium (mg)	273	12	261**	23	252	18	214**	13
Zinc (mg)	9	0.4	8.1	0.6	9	0.6	7.9	0.6
Dietary fiber (g)	8	0.6	7	0.9	8	0.6	7	0.7

Control group (n=141); Experimental group (n=60)
* significantly different ($p<0.05$) between groups (group effect)
** significantly different ($p<0.05$) within groups (time effect)

Changes in carbohydrate and magnesium intakes are unexplainable at this time. This researcher believes that although there was a statistically significant difference, the change in intake was not likely to have any real biological significance.

The dietary intake of the females was less than 80% of the RDA at both pretest and posttest for vitamin D, vitamin E, folacin, iron and zinc. Data for vitamin D is incomplete however, because the data base does not include milk fortified with vitamin D. Other researchers also have found diets of college females to be below the RDA for iron (Hernon et al., 1986; Hoffman, 1989; Khan and Lipke, 1982; Ostrom and Labuza, 1977). Hoffman (1989) also found that 67% of the women in her study consumed less than 75% of the RDA for folacin. It was noted previously that the database contains incomplete data for zinc, which might explain the seemingly low zinc intake.

The mean one-day nutrient intakes of the males at pretest and posttest are presented in Table 11. ANOVAs indicated a significant group effect (i.e., intake of these nutrients differs between the control and experimental groups) for intake of calories, total fat, vitamin D, vitamin C, and sodium. A significant time effect (i.e., intake of this nutrient differs between the pretest and posttest) was found for calcium intake (Table 12).

Table 11. Mean daily nutrient intake of males

Variable	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	$\overline{X}$	SE	$\overline{X}$	SE	$\overline{X}$	SE	$\overline{X}$	SE
Calories	3033	187	3590	174	3076	196	3986	457
Protein (gm)	123	7	140	9	126	7	141	13
Carbohydrate (g)	365	26	417	44	375	27	474	61
Total fat (g)	117	8	146	13	119	9	173	24
Saturated fat (g)	41	4	54	11	47	5	61	12
Cholesterol (g)	395	56	529	113	344	38	449	66
Vitamin D (IU)	261	40	169	38	312*	39	173*	45
Thiamin (mg)	2.1	0.2	2.3	0.3	2.2	0.2	2.3	0.3
Riboflavin (mg)	3.2	0.2	2.9	0.3	3.3	0.3	3.1	0.4
Niacin (mg)	31	2	38	3	31	2	33	4
Vitamin B-6 (mg)	2249	203	2324	296	2224	212	1896	222
Vitamin B-12 (mcg)	7.7	0.9	5.3	0.7	8.6	2	4.9	0.8
Vitamin C (mg)	126	14	326	138	108	14	198	46
Iron (mg)	18	1	21	1	19	1	21	2
Calcium (mg)	1717	140	1412	174	1895	172	1703	243
Phosphorus (mg)	2057	147	2042	147	2144	163	2340	234
Sodium (mg)	4829	267	5992	733	5288*	423	7090*	882
Potassium (mg)	3606	238	4392	668	3685	252	4125	425
Magnesium (mg)	401	43	438	73	352	29	393	44
Zinc (mg)	13	1	15	2	14	1	16	2
Dietary fiber (g)	6	1	13	4	8	1	9	3

Control group (n=36); Experimental group (n=17)
* significantly different ($p<0.05$) between groups

Table 12. Results of ANOVA for calories, total fat, vitamin D, vitamin C, sodium, and calcium intake of the males (n=53)

Nutrient	F	Signif of F
Calories*	5.42	<0.05
Total fat*	6.90	<0.05
Vitamin D*	4.00	<0.05
Vitamin C*	6.77	<0.05
Sodium*	5.50	<0.05
Calcium**	4.32	<0.05

* group effect
** time effect

Results of the t-tests showed that the sodium intake of the experimental group at the posttest was significantly greater ($p<0.05$) than that of the control group (Table 11). The sodium intake of the control and experimental groups was much greater than the Estimated Safe and Adequate Daily Dietary Intake (ESADDI) recommendation. The vitamin D intake of the control group was significantly greater at the posttest ($p<0.05$) than that of the experimental group (Table 11). The other nutrients (calories, total fat, vitamin C, and calcium) were not significantly different between groups or from pretest to posttest using t-tests.

The dietary intake of the males was less than 80% of the RDA at both pretest and posttest for vitamin E. Evaluation of vitamin E intake was not included in other studies on dietary intake of college students which were reviewed by this researcher. Hoffman (1989) found that intake of calcium and folacin was less than 75% of the RDA for some of the males in her study. The present study is in agreement with other studies (Hernon et al., 1986; Khan and Lipke, 1982; Ostrom and Labuza, 1977) that found that mean intakes for almost all nutrients met or exceeded the RDAs for college males.

From examination of the dietary intake data it was concluded that use of the computerized diet analysis program, as used in this course, had no more effect than the traditional lecture course. There are several possible explanations for this, and these are some of the limitations of this study. One explanation offered is that the information given in this introductory nutrition course is of such a general nature that to expect specific changes in dietary intakes was unwarranted. Byrd-Bredbenner et al. (1988) noted that general nutrition curricula help students comprehend and apply basic nutrition principles rather than change specific dietary behaviors. If changing dietary behaviors is the primary aim of school-based nutrition education, then curricula need to target specific dietary behaviors and employ change strategies specific to those behaviors. Also, only two interventions using the computerized diet analysis program were assigned by the instructor. This was likely not enough intervention to cause a change in eating patterns of students. Because of the study design, the researcher and instructor agreed that no further attempts would be made by the instructor to integrate into the course the information obtained from the dietary analysis or how to use this type of information. The objective of the study was to evaluate whether or not recording of one-day intakes and assessing those intakes by computerized diet analysis would affect nutrition knowledge, attitudes or dietary intakes. If additional information was given, it was theorized that the addition of information could affect the outcome of the study.

Informal reports from students indicated that many completed the dietary analyses mainly for the credit rather than for self-assessment of their intake. Another probable explanation for lack of change is that the nine-week period from the first diet record assignment to the second is not enough time to make significant changes in one's diet. Brush et al. (1986) noted that 'any change in usual intake is difficult because changes are not made or maintained easily'. The knowledge gain from the course was the immediate outcome, and changes in attitude and dietary behavior were possibly more distant and not readily apparent. Also it is well recognized that it is difficult to change dietary habits because eating is not only a physiological function but also a social, emotional, environmental, cultural and habitual function. This is true for the general population, and this researcher believes it is especially true for these college students. Of the students in the study population 70% lived in the residence halls. Therefore they ate meals from the cafeterias with peers and may have had a more difficult time making changes in their diets. They were subject to the cycle menu system and students might have felt as though they had little control over their food choices. Other researchers (Beerman et al., 1990; Gottschalk et al., 1977; Jakobovits et al., 1977; O'Leary and Lee, 1975) have found that living in residence halls and subscribing to meal plans does affect college students' dietary intake. College students are also subject to much peer pressure in this situation and time in their lives.

NUTRITIONAL ADEQUACY

The Mean Adequacy Ratio (MAR) values for both control and experimental groups at pretest and posttest are presented in Table 13. Because there were no significant differences between the MARs' of the control and experimental groups at pretest and posttest the groups were combined and an overall MAR was determined for the pretest and posttest. The combined group mean MAR at the pretest was 79 with a standard error of 1.1. At the posttest the mean MAR was 77 with a standard error of 1.1. This indicator of diet quality supports the previously drawn conclusion that there was no change in dietary intakes from pretest to posttest.

Table 13. Pretest and posttest MAR of control and experimental groups

	Pretest		Posttest	
	Control	Experimental	Control	Experimental
Mean	80	76	78	75
SE	1.2	1.8	1.1	2.0
range*	28-100	34-99	40-100	24-100

* MAR is the average of NARs truncated at 100, and ranges from 0 to 100

Table 14. Pretest and posttest MAR for females* and males**

	Pretest		Posttest	
	Females	Males	Females	Males
Mean	78	87	77	86
SE	1.1	1.2	1.1	1.7
range	29-100	59-99	25-100	42-100

* n=201

** n=53

MAR scores also were determined for females and males at pretest and posttest (Table 14). From the MAR scores, it appears that the males had better diets than the females. This is generally true because of the greater calorie consumption of the males. When examining the range of scores it looks as though the females had much lower scores than the males. However when the histograms for the females were examined, there were two low MAR scores in the 20's at both pretest and posttest, and the normal range started at 49 and 42 for the pretest and posttest respectively, making the range of scores much closer to the males.

VARIABLES RELATED TO MAR

The regression equation formulated to show associations between the dependent variable (MAR) and independent variables (age, gender, place of residence, class level, and body mass index) was as follows:

MAR=b1(age) + b2(gender) + b3(residence) + b4(level) + b5(BMI) + c

Results of the backwards method of regression analysis for the pretest indicated that two of the independent variables, gender and age were significant ($p<0.05$) predictors of nutritional adequacy (Table 15).

Table 15. Results of the regression analysis for the variables gender and age to predict pretest MAR

Variable	b*	Beta**	t	Signif of t
Gender	11.064	284	4.590	<0.001
Age	.944	85	2.422	<0.05
Constant	51.950		7.127	<0.001

* b=regression coefficient
** Beta=standardized regression coefficient

The regression equation can thus be shown as follows:

MAR = 11.064(gender) + 0.944(age) + 51.950

In this equation the independent variable gender contributed more to the prediction than age, based on the Beta values. The adjusted multiple correlation coefficient (R) for this equation was 0.285. The adjusted R-squared value was 0.081. Therefore the variables gender and age accounted for 8 percent of the variance in pretest nutritional adequacy. BMI, class level, and place of residence did not account for a significant amount of the variability in nutritional adequacy.

The ages of students in the study group are presented in Table 16. From examination of the data for MAR scores by age, it appears that the younger students, ages 17-21 had better diets than the students over 21, explaining why age was a significant factor in predicting nutritional adequacy. Students 21 and under had the highest frequency of MAR scores in the 90's. Students over 21 generally had MAR scores in the 80's.

Table 16. Percentage of the total study population by age groups

	17-20 (%)	21 and over (%)
Pretest	84	16
Posttest	84	16

Table 17 shows the results of the regression analysis for posttest data. The adjusted multiple correlation coefficient (R) for this equation was 0.294 and the adjusted R-squared value was 0.087. Therefore the variable gender accounted for 9 percent of the variability in nutritional adequacy. Age was close to significance for the posttest data ($p=0.069$), showing some consistency with the pretest equation. However, BMI, class level, age and place of residence did not account for a significant amount of variance in posttest nutritional adequacy.

Table 17. Results of the regression analysis for the variable gender to predict posttest MAR

Variable	b*	Beta**	t	Signif of t
Gender	11.326	.292	4.784	<0.001
Constant	54.774		7.986	<0.001

* b=regression coefficient

** Beta=standardized regression coefficient

The regression equation is as follows:

Mar =11.326(gender) + 54.774

The results from both pretest and posttest suggest that gender is the strongest of the available predictors of diet quality. This is supported by previous studies (Basiotis et al., 1987; Beaton et al., 1979) that found a difference between the dietary intakes of males and females. Beerman et al. (1990) and Haseba and Brown (1968) also found that gender was one of the factors related to dietary intake. In the present study the males had better MAR scores than the females. The results indicated that most of the variance in nutritional adequacy was not predicted by variables included in this study. Other researchers have identified factors that influence dietary intake of college students. These included body weight (Wakefield and Miller, 1971), length of time in college (Brown, 1967), subscription to a meal plan (Gottschalk et al., 1977; Jakobovits et al., 1977; O'Leary and Lee, 1975), patterns established prior to attending college (Stasch et al., 1970), and place of residence while in college (Beerman et al., 1990; O'Leary and Lee, 1975).

RELATIONSHIP AMONG NUTRITION KNOWLEDGE, ATTITUDES AND DIETARY INTAKE

To determine whether there was a relationship between nutrition knowledge, attitudes, and dietary intake, correlations were determined at pre-and post-tests (Table 18). Results showed no significant correlations between any of the three variables at the pretest and posttest, with the exception of a significant ($p<0.01$) correlation between knowledge and dietary intake at the pretest (Table 18). The negative correlation between knowledge and attitudes and knowledge and dietary intake at the posttest is a result of the nutrition knowledge scores increasing from pretest to posttest and the attitude scores and dietary intake remaining the same.

Table 18. Correlations between nutrition knowledge, attitudes, and dietary intake

Variable	Pretest	Posttest
Knowledge-Attitudes	.09 p=.078	-.06 p=.158
Knowledge-Dietary intake	.16 p=.006 *	-.02 p=.351
Attitudes-Dietary intake	.09 p=.073	.06 p=.179

* $p<0.01$

Reviewing the literature relevant to this study, Brush et al. (1986) found a significant correlation between nutrition attitudes and dietary behaviors for adults aged 19 to 65 years. This was in contrast to the findings in this study. Although the mean age (42.6 yrs.) was somewhat higher than the mean age of college students (19.8 yrs.) in the present study, participants in the Brush et al. study were from the general adult population rather than a more specific target group, and the study design consisted of a pretest, intervention and posttest, similar to the present study.

Also in contrast to this study, Werblow et al.(1978) demonstrated a significant positive correlation between nutrition knowledge and attitudes of female collegiate athletes. Schwartz (1975) supported the relationship of nutrition knowledge and attitudes, and also nutrition attitudes and practices in female high school graduates four years after high school. Because there was no direct relationship between nutritional knowledge and practices, Schwartz proposed that attitudes mediate both knowledge and dietary practices.

Knowledge and dietary intake were significantly correlated in few studies (Douglas and Douglas, 1984; Foley et al., 1983; Soliah et al., 1983). Douglas and Douglas (1984) found a positive correlation ($r=.35$) between knowledge and dietary practices of their male high school athletes, and a weak positive correlation ($r=.15$) between knowledge and dietary practices for their female high school athletes. Foley et al. (1983) found positive correlations between knowledge and nutrition practices of fifth grade students. Soliah et al. (1983), studying elementary school teachers, also found a positive correlation between knowledge and nutrition practices. However both Foley et al. (1983) and Soliah et al. (1983) assessed dietary practices by responses to statements about dietary practices rather than actual diet records.

Based on the most prevalent relationship found in the literature cited, this researcher made the assumption that nutrition knowledge and attitudes would be correlated. However the data do not support this assumption. This is perhaps due to the scores for the attitude assessment. The students achieved a mean score around 50% of the maximum possible score on the attitude scale at both pretest and posttest. It was also assumed that knowledge or attitudes alone was likely not enough to influence dietary behaviors. However, if knowledge and attitudes both improved, this improvement might have a positive effect on dietary intake. This researcher theorized that if knowledge and attitudes improved and changes in dietary intake were found, a correlation between knowledge or attitudes and dietary intake at the posttest would be more likely. However there was no significant improvement in nutrition attitudes and no major significant changes in dietary intake, and no significant correlations found among knowledge, attitudes or dietary intake at the posttest.

Ajzen and Fishbein (1980) have emphasized that when trying to understand or predict behaviors, the specificity of the variables must be carefully considered. The less specifically the variables relate to the behavior, the less likely they are to exlain the behavior. Guiry and Bisogne (1986), studying knowledge of caffeine, attitudes and practices in young women 15-30 years old stated that the lack of specificity between caffeine knowledge and the general attitude statements in their study probably accounted for the lack of association found. It may be true that for the present study the lack of specificity between the nutrition knowledge questions and the general attitude statements accounts for the lack of a relationship between nutrition knowledge and attitudes. Shepherd and Stockley (1987) noted that nutrition education will not be effective in modifying the intake of specific nutrients in the population if nutrition knowledge relates to general attitudes toward nutrition and general nutrition practices but not to the eating of specific foods.

The basic nutrition course utilized in this study was designed to cover a variety of topics and was therefore somewhat general in nature. The nutrition knowledge test administered was intended to follow the design of the course, including questions on most of the topics covered. Therefore questions were specific, but covering many topics it could be considered general in nature. The attitude items assessed general attitudes related to 'concern about nutrition' and 'flexibility/rigidity' in attitudes toward nutrition, rather than relating to the nutrition knowledge questions. If the nutrition knowledge and attitude assessments were of a specific nature, and were related to each other, then a correlation would more likely have been found. Also the course and the nutrition knowledge and attitude assessments were not geared toward or related to any *specific* dietary behaviors, therefore helping to explain the lack of relationship between dietary intake and knowledge or attitudes.

Assumptions

Before beginning the data collection phase of this study several assumptions were made by this researcher, based on findings from other studies and ideas about this project. The assumptions were as follows:

1) That students in both sections of HNF 102 had similar backgrounds and characteristics.

2) There is a relationship among nutrition knowledge, attitudes and dietary intake. Based on the literature reviewed, this researcher assumed that for this study at least knowledge and attitudes would be correlated.

3) That students honestly answered the nutrition knowledge and attitudes pretest and posttest.

4) That the students in the experimental and control groups honestly recorded all food and beverage items consumed, without fear of evaluation. It was stressed that the students would not be graded or evaluated on the adequacy of their diet, and that the assignment would be more meaningful and informative for them if they were honest.

5) That the students accurately estimated portion sizes. Guthrie (1984) reported, however, that students and university employees ages 18 to 30 had difficulty estimating portion sizes, with errors greater than 50% for both under-and overreporting of many food items. For this study it was assumed that errors in estimating portion sizes were consistent from pretest to posttest and from group to group, therefore, minimizing error in making comparisons.

6) That appropriate substitutions were made when consumed food items were not in the database of the diet analysis program.

7) That minimal errors were made when entering foods into the diet analysis program because foods did not have to be entered by code numbers.

8) That the students were interested in self-evaluation of their diets in order to improve their dietary habits.

9) That the students used the diet analysis software as the researcher intended.

LIMITATIONS

This study has limitations which should be addressed and considered when designing further studies to evaluate nutrition knowledge, attitudes and behaviors.

1) The basic study design intended that recording dietary intakes and assessing the intakes via a computerized diet analysis program, along with the information gained in HNF 102, would heighten students' awareness of the need for change, and that nutrition knowledge, attitudes and dietary intakes would be affected positively. The course and assignment were designed to increase nutrition knowledge. However, there is no evidence that the course or assignment of recording intakes and evaluating them via computer was designed specifically to change the nutrition attitudes measured. Therefore to expect changes in attitudes when that was not a focus of the course or assignment was improbable. It was not a course objective to change dietary intake, but this was an objective of the diet analysis assignment. However to expect a significant change in intake after completing one dietary assessment was questionable.

2) The participation rate was low for completing the four parts necessary for this study (nutrition knowledge and attitudes pretest and posttest and pre and post one-day diet records). The pretest and posttest were not required as part of the course, therefore some students did not complete one or both of the tests, and this contributed to incomplete data for many students. Dietary data might not have been saved by a number of students, contributing to incomplete diet records. The diet record assignment and nutrition knowledge and attitude posttest given near the end of the term might have had a low priority for students, because of other commitments for completing courses. This is evidenced by the lower participation rates at the posttest compared to the pretest

(Eighty-two and 83% of students in the control and experimental groups respectively completed pretest; 68 and 64% of students in the control and experimental groups respectively completed posttest; 83 and 92% of students in control and experimental groups respectively completed the first diet record assignment; 68 and 66% of students in control and experimental groups respectively completed the second diet record assignment).

3) There was a lack of specificity between the nutrition knowledge, nutrition attitudes and dietary intake measured. The general nutrition knowledge questions were unrelated to the nutrition attitudes items. Also, the knowledge and attitudes measured might have related to the diet in general, but not to intake of specific foods.

4) It is questionable whether significant changes in attitudes or dietary intake are to be reasonably expected in an eight to nine-week period. The steps related to the change process might or might not occur within the time of the intervention and assessment. The course and diet analysis assignment act as stimulants, and attitude and dietary changes may be ongoing after the course. Therefore the posttest scores and second diet record results might underestimate positive changes.

5) The recording and analyzing of one-day food records depends on honesty of self-reported food consumption, ability to correctly record amounts consumed, and ability to correctly identify foods or adequate substitutions from the dietary analysis program database. Also, as far as evaluation purposes for this study, one-day intakes have been shown to adequately represent mean group intake for large groups. The one-day intake was used because it was assumed that the response rate would be better than when using a lengthier method. However, the purpose of the assignment was to have students use their dietary assessments as a basis for making appropriate changes in their diets. Previous research has shown that one-day intakes are not an accurate representation of individual

diet intake. A three-day record would have been more appropriate for individual intake.

SUMMARY

1) Nutrition knowledge: Scores of both groups (Control, n=177; Experimental, n=77) increased significantly ($p<0.001$) from pretest to posttest (Pretest: 7.9, 7.4; Posttest: 12.8,14.9, respectively). However there were no differences in nutrition knowledge between the groups at the posttest.

2) Nutrition attitudes: There were no changes in nutrition attitudes from pretest to posttest for either group, and no significant differences between the groups at the posttest.

3) Dietary intake: There were no significant differences as measured by one-day diet records, between the dietary intakes of the groups at both the pretest and posttest. However within the groups from the pretest to the posttest significant differences were found. The control group significantly decreased their intake of alcohol, folacin, and vitamin A ($p<0.05$). The experimental group significantly decreased their intake of alcohol ($p<0.05$). However, it is doubtful that one-day intakes give an accurate representation of alcohol intake. Decreases in folacin intake might be due to the seasonal availability of good sources of folacin. Also one-day intakes have been shown to be inaccurate for evaluating vitamin A intake.

4) Dietary intake of males and females : When the dietary data were examined for males and females separately, some significant differences were found. However results must be interpreted cautiously due to the small sample sizes (Females, n=201; Males, n=53).

5) Predictors of diet quality: At the pretest gender and age were shown to be the best of the available predictors of diet quality, accounting for 8% of the variance. Class level, place of residence, and BMI were insignificant predictors of diet quality. At the

posttest gender was the only variable that predicted diet quality, accounting for 9% of the variance. The males had better MAR scores than the females at both pretest and posttest.

6) Correlations among nutrition knowledge, attitudes, and dietary intakes: No correlations were found among the three variables, with the exception of a significant correlation ($p<0.01$) between nutrition knowledge and dietary intake at the pretest.

CONCLUSIONS

The hypothesis of this study was that students' recording of one-day dietary intakes and use of the computerized dietary analysis program for dietary assessment would heighten the students'need for change and therefore would improve nutrition knowledge and attitudes and affect dietary behaviors. However, self-recording of intakes and self-evaluation using the computerized dietary analysis program had no more effect on general nutrition knowledge and attitudes and dietary intake than the traditional course. Therefore the hypothesis of this study can be rejected. It is possible that the assumption that students are interested in self-evaluation of their diets in order to make positive changes is wrong. The students' main concern might be cognitive gains and earning a good GPA.

Gender was the only available demographic variable that significantly predicted MAR. Gender accounted for only 9% of the variability in dietary quality at the posttest, leaving most of the variability unexplained. The males had better MAR scores than the females. The other available demographic and environmental factors (i.e., age, class level, place of residence, and body mass index) were insignificant predictors of MAR.

There was no relationship found among nutrition knowledge, attitudes and dietary intake, with the exception of a significant correlation ($p<0.01$) between nutrition knowledge and dietary intake at the pretest. The lack of relationship may be due to the general nature of the nutrition knowledge test, the attitude questionnaire, the fact that neither the knowledge test or attitude questionnaire were related to any specific dietary behavior, or other factors.

RECOMMENDATIONS

Based on the results of this research, this author has several recommendations to make regarding nutrition education, further research on the relationship between knowledge, attitudes, and behavior, use of the computerized dietary assessment, and research on factors that influence dietary intake.

Effective education requires assessment of the nutrition knowledge, dietary practices, and concerns of a population. Gillespie (1987) indicated that "the more narrowly targeted a nutrition message, the more effective it will be."

Recommendation 1: A survey, questionnaire or pretest could be given each term to students taking the introductory nutrition course to determine their nutrition knowledge, dietary practices and concerns. This information could be used to determine whether the goals and objectives of the course are consistent with students' needs. Updates in goals and objectives could continually be made as needed, to better meet the needs and concerns of students.

Frequently nutrition classes are taught under the assumption that the better informed people are, the more likely they are to make better choices in the selection of their food. From this research and previous studies it is clear that knowledge is a necessary but not necessarily sufficient factor in behavior change. Obviously increased knowledge is a major objective of nutrition education. The question is whether behavior change is a legitimate objective, especially in short-term education programs such as the 10-week basic nutrition course.

Recommendation 2: Because significant changes in dietary intake are not likely to occur during the 10-week nutrition course, behavior change, as an objective of the introductory nutrition course, should not focus on statistically significant changes. The evaluation of dietary intakes could look for changes or trends in intake that have been determined to be important (e.g. decreases in fat intake, decreases in sodium intake, increases in iron intake, etc.). The computerized dietary assessment could be utilized as a tool to focus attention on the desired behavior changes.

It was suggested by the results of this study that behavior change is not an immediate outcome of a basic nutrition course, but rather more distant.

Recommendation 3: Research on dietary intake should be on a longer term basis than 10 weeks. Students that consented to participate, after completing the introductory nutrition course, could complete food records and computerized dietary assessments over a specified period of time, such as six months.

Nutrition education programs and courses need to define specifically the goals and objectives of the program or course and which areas of knowledge and attitudes will be addressed.

Recommendation 4: Given the course goals and objectives, the relationship between nutrition knowledge, attitudes, and dietary intake needs to be further examined by using instruments which measure variables specifically related to course goals. The knowledge and attitude measurement instruments should be very specific, and should relate specifically to the nutrition information taught.

Recommendation 5: Further evaluation is needed to determine whether the assignment of recording dietary intakes and self-evaluating intakes is consistent with students' concerns. The students main concern might be attainment of a good grade for the course rather than changes in dietary intake.

Recommendation 6: Further studies are needed to determine how or whether the computerized dietary assessment program can be better integrated into the class lecture and activities to affect students' dietary intake. Variables such as interpretation and application of information from dietary assessments, more frequent self-assessments, and instruction on estimating portion sizes and how to complete a food intake record should be evaluated to determine the usefulness of the assignment on improving students' diets..

Recommendation 7: The students need to be accountable for their dietary assessments. Points should be given that could significantly affect their course grade for completion of an assignment evaluating their personal information. Students need to make a judgment about the adequacy of their diets and assess where they could make improvements.

Recommendation 8: In light of the limitations of one-day food records for individual assessment, in order for the students to adequately evaluate their diets a three-day diet record would be more desirable.

Recommendation 9: Data from this study and others on college students needs to be further examined to determine the role of various factors on dietary intake. If factors that influence dietary intake can be more well defined, those factors could help determine the goals and objectives of nutrition education. For example, place of residence has been identified as one factor that influences food intake of college students (Beerman et al., 1990; O'Leary and Lee, 1975). If students on meal plans eat better quality diets than off-campus students, then nutrition education programs should target the off-campus students. This author believes that place of residence, body image, emotional reaction to food, socioeconomic status, level of physical activity, and advertising are some important variables that should be studied in the future.

APPENDICES

APPENDIX A

Appendix A

MICHIGAN STATE UNIVERSITY

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN SUBJECTS (UCRIHS)
206 BERKEY HALL
(517) 353-9738

EAST LANSING • MICHIGAN • 48824-1111

September 30, 1988

IRB# 88-361

Sherry Nied
Room 208 Food Science Bldg.

Dear Ms. Nied:

Subject: "EFFECT OF AN INTERACTIVE COMPUTERIZED DIET ANALYSIS PROGRAM IN NUTRITION EDUCATION IRB# 88-361"

The above project is exempt from full UCRIHS review. I have reviewed the proposed research protocol and find that the rights and welfare of human subjects appear to be protected. You have approval to conduct the research.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval one month prior to September 26, 1989.

Any changes in procedures involving human subjects must be reviewed by the UCRIHS prior to initiation of the change. UCRIHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to our attention. If we can be of any future help, please do not hesitate to let us know.

Sincerely,

John K. Hudzik, Ph.D.
Chair, UCRIHS

JKH/sar

cc: W. Song

APPENDIX B

FSHN Food Science and Human Nutrition
Michigan State University East Lansing, Michigan 48824-1224

Consent Form For HNF 102 Students (Sec. 3)

As a course requirement for HNF 102, I will record a one-day dietary intake at the beginning and end of the quarter and run a computerized diet analysis program, for assessment of my intake. The computer analysis is expected to take approximately thirty minutes. I will also complete pre- and post-term questionnaires related to nutrition knowledge and attitudes. I understand that I will receive a small credit for completing the assignment, as indicated in the course syllabus.

I understand that, with my consent, information obtained from my pre- and post-term questionnaires and dietary assessment will be used for research purposes, and in an attempt to improve this course. I understand that my responses will be kept confidential and anonymous. My name will not be used in any part of the study. The results of the project will be available to me at my request upon completion of the study.

I understand that I am free to decide not to have my data used in this project, without penalty. This will in no way affect my grade for the course. I also understand that I can change my decision at any time.

I understand that Sherry Nied, a graduate student (353-9736) and Dr. Won Song (353-9604), in the Department of Food Science and Human Nutrition are conducting this study independent of the instructor. I will be able to ask the researchers questions related to the project anytime during the term.

I have read the above statements and agree to have my data used for research purposes.

Signed ______________________________________

Print Name ______________________________________

Date ______________________

Thank you very much.
Sherry Nied 353-9736
Dr. Won Song 353-9604
Dept. of Food Science and Human Nutrition
Rm. 208 Food Science Bldg.

APPENDIX C

Appendix C

HNF 102
Sec. 2, 3
Bond (F 88)

HNF 102 PRETEST

Fill in your name, student number and section number on the answer sheet.
Read the following questions and choose the best answer for the multiple choice questions. For questions 23-45, select the answer that reflects your degree of agreement with each statement. **THIS PRE-TEST WILL IN NO WAY AFFECT YOUR GRADE FOR THE COURSE.**

1. The correct match to the name of the B vitamin is
   a. B1-thiamin
   b. B2-pyridoxine
   c. B6-niacin
   d. B12-riboflavin
   e. B6-cobalamin

2. Which of the following is produced by bacteria in the intestinal tract?
   a. vitamin A
   b. vitamin K
   c. ascorbic acid
   d. vitamin E

3. A deficiency of iodine may be seen as
   a. anemia
   b. spoon-shaped finger nails
   c. goiter
   d. skin rashes

4. Absorption rate of iron
   a. is increased when the body's need for iron is increased
   b. is approximately 50%
   c. in the heme form is lower than in iron from plant sources
   d. in the normal diet is so high that it reduces absorption of copper

5. The stored form of carbohydrates in the body is called
   a. glycogen
   b. insulin
   c. fat
   d. muscle

6. Proteins are essential in the diet
   a. as the major source of energy
   b. to provide nitrogen for growth and tissue development
   c. to furnish the only source of hydrogen
   d. to provide essential fatty acids

7. Elevated concentrations of this lipoprotein are associated with a decreased risk of cardiovascular disease
   a. low density lipoprotein
   b. high density lipoprotein
   c. lecithin
   d. linoleic acid

8. The major form of fat in the diet is
   a. cholesterol
   b. lecithin
   c. triglyceride
   d. polyunsaturated fat

9. Of the following, which is the best source of polyunsaturated fat?
   a. soybean oil
   b. animal fat
   c. margarine
   d. shortening
   e. coconut oil

10. The correct function of the organ in the digestive tract is
    a. the mouth is the major site of carbohydrate digestion
    b. the small intestine is chiefly a storage reservoir
    c. the stomach is the site where most digestion occurs
    d. the pancreas secretes amylase and lipase into the small intestine

11. The specific dynamic action reflects the increase in energy expenditure
    a. caused by respiration
    b. caused by circulation
    c. caused by glandular activity
    d. following ingestion of food

12. Normally the most energy is expended for
    a. Basal Metabolic Rate (BMR)
    b. physical activity
    c. thermogenesis
    d. digestion of food

13. Pica is
    a. a vitamin deficiency
    b. craving for non-foods such as clay, laundry starch, sand and newspaper
    c. most commonly seen in men and adolescent boys
    d. a recommended mineral supplement at the level of the RDA

14. Which of the following is considered a nutrient?
    a. carbohydrate
    b. lipids
    c. water
    d. all of the above

15. Your breakfast included a fried egg, whole wheat toast, and orange juice. Which Basic Four Food Group was not represented?
   a. meat group
   b. dairy group
   c. grain group
   d. fruit and vegetable group

16. During pregnancy
   a. the increased need for energy exceeds the increased need for protein and minerals
   b. two extra servings of iron-enriched bread are sufficient to meet the increased iron needs
   c. the mother needs to double the amount of food she eats by the sixth month to meet the baby's needs
   d. it is recommended that the average mother gain approximately 25-30 pounds

17. The requirements for water based on 1000 kcals expended is the greatest for
   a. infants
   b. adults
   c. teenagers
   d. elderly

18. The Recommended Dietary Allowances for fat and carbohydrate
   a. have not been established
   b. are the same for both
   c. depend on ideal body weight
   d. are based on basal metabolic rate

19. Which food group has the highest percent of complex carbohydrate?
   a. milk group
   b. meat and alternates group
   c. fruit and vegetables group
   d. cereal and grains group
   e. limited extra

20. The general guidelines in nutrition recommend what percent of your caloric intake should be from fat?
   a. 15%
   b. 20%
   c. 30%
   d. 40%
   e. 55%

21. The adult recommendation from the Basic Four Food Plan is
   a. 4 servings each day from the dairy group
   b. 2 servings each day from the cereal group
   c. 2 servings each day from the fruit and vegetable group
   d. 2 servings each day from the meat group

22. If you consumed 100 grams of fat and your total caloric intake was 1800 kcals, what percent of your energy intake was from fat?
    a. 5%
    b. 20%
    c. 22%
    d. 50%

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
23. I believe that diet is a major controlling factor when it comes to maintaining health and controlling disease.					
24. I feel the foods I eat now will affect my future health.					
25. I am concerned about eating nutritious foods throughout the day.					
26. Nutrition is extremely important during pregnancy.					
27. I feel that I need to learn more about good nutrition.					
28. If a person is not eating well his/her health will surely suffer.					
29. I feel that as long as I am maintaining my weight, I don't have to worry much about nutrition.					
30. As long as the doctor doesn't say much to me about nutrition, I don't think I need to worry about it.					
31. I feel that all college students need to take at least one course in nutrition.					
32. I feel that if I drink milk I don't have to worry about nutrition.					
33. Nutrition is important and one should not be careless about it.					
34. Even if I take vitamins, I feel that I should be concerned about the foods I eat.					
35. I would fix more nutritious meals if I knew what to prepare.					

	STR DIS-AGREE	Dis agree	No opinion	agree	Str agree
36. For better health, I would be willing to try a food I hadn't eaten before or several foods over a period of time.					
37. Exploring several methods of food preparation is desirable.					
38. I think that food habits should be flexible enough to vary with a new situation.					
39. I like for my family to stick to the old favorite meals, rather than mess them up with new and different kinds of foods.					
40. Unfamiliar foods interest me.					
41. If I am satisfied with foods I eat, I see no reason for me to change.					
42. I believe that the person who gets the most satisfaction out of eating is the one who sticks to the foods that are familiar.					
43. Trying new and different foods appeals to me.					
44. I would be willing to spend time in making nutritious foods available for myself and/or family instead of eating convenience foods of low nutritional quality.					
45. I would be willing to try an unfamiliar food at least once.					

46. Where do you currently reside?
   a. Residence Hall
   b. Off-campus apartment or house
   c. Fraternity/Sorority
   d. Home with parents
   e. Other

47. What class level are you?
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Graduate student or other

48. Have you previously enrolled in any other nutrition or health-related courses?
   a. Yes
   b. No
   If yes, please list:

HNF 102
Sec. 2
Bond (F 88)

HNF 102 POSTTEST

Fill in your name, student number and section number on the answer sheet. Read the following questions and choose the best answer for the multiple choice questions. For questions 23-45, select the answer that reflects your degree of agreement with each statement. **THIS POSTTEST WILL IN NO WAY AFFECT YOUR GRADE FOR THE COURSE.**

1. The correct match to the name of the B vitamin is
   a. B1-thiamin
   b. B2-pyridoxine
   c. B6-niacin
   d. B12-riboflavin
   e. B6-cobalamin

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   c. ascorbic acid
   d. vitamin E

3. A deficiency of iodine may be seen as
   a. anemia
   b. spoon-shaped finger nails
   c. goiter
   d. skin rashes

4. Absorption rate of iron
   a. is increased when the body's need for iron is increased
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   c. fat
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6. Proteins are essential in the diet
   a. as the major source of energy
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7. Elevated concentrations of this lipoprotein are associated with a decreased risk of cardiovascular disease
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8. The major form of fat in the diet is
   a. cholesterol
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    a. the mouth is the major site of carbohydrate digestion
    b. the small intestine is chiefly a storage reservoir
    c. the stomach is the site where most digestion occurs
    d. the pancreas secretes amylase and lipase into the small intestine

11. The specific dynamic action reflects the increase in energy expenditure
    a. caused by respiration
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    a. Basal Metabolic Rate (BMR)
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    d. 2 servings each day from the meat group

22. If you consumed 100 grams of fat and your total caloric intake was 1800 kcals,what percent of your energy intake was from fat?
  a. 5%
  b. 20%
  c. 22%
  d. 50%

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
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24. I feel the foods I eat now will affect my future health.					
25. I am concerned about eating nutritious foods throughout the day.					
26. Nutrition is extremely important during pregnancy.					
27. I feel that I need to learn more about good nutrition.					
28. If a person is not eating well his/her health will surely suffer.					
29. I feel that as long as I am maintaining my weight, I don't have to worry much about nutrition.					
30. As long as the doctor doesn't say much to me about nutrition, I don't think I need to worry about it.					
31. I feel that all college students need to take at least one course in nutrition.					
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33. Nutrition is important and one should not be careless about it.					
34. Even if I take vitamins, I feel that I should be concerned about the foods I eat.					
35. I would fix more nutritious meals if I knew what to prepare.					

	Str Dis-agree	Dis-agree	No Comment	Agree	Str Agree
36. For better health, I would be willing to try a food I hadn't eaten before or several foods over a period of time.					
37. Exploring several methods of food preparation is desirable.					
38. I think that food habits should be flexible enough to vary with a new situation.					
39. I like for my family to stick to the old favorite meals, rather than mess them up with new and different kinds of foods.					
40. Unfamiliar foods interest me.					
41. If I am satisfied with foods I eat, I see no reason for me to change.					
42. I believe that the person who gets the most satisfaction out of eating is the one who sticks to the foods that are familiar.					
43. Trying new and different foods appeals to me.					
44. I would be willing to spend time in making nutritious foods available for myself and/or family instead of eating convenience foods of low nutritional quality.					
45. I would be willing to try an unfamiliar food at least once.					

46. Have you had computer experience previous to the computerized diet analysis assignment?
    a. yes
    b. no

47. Did you have any problems getting to a computer to do the diet analysis assignment?
    a. yes (explain in # 57)
    b. no

48. Did you have any problems running the diet analysis program?
    a. yes (explain in # 57)
    b. no

49. Did you review any information in the 'Main Nutrient Menu/Current Nutrition Issues' section?
    a. yes
    b. no

50. Were you able to understand the computer printout of your diet analysis?
    a. yes
    b. no (explain in # 57)

51. How would you rate this assignment in terms of helping you apply the concepts taught in HNF 102?
    a. very useful
    b. somewhat useful
    c. neutral
    d. not very useful
    e. not useful at all

52. Do you feel this exercise wll be helpful to others in learning nutrition?
    a. yes
    b. no

53. Did you use the program other than the two assigned times?
    a. yes
    b. no

54. If yes to # 53, how many times?
    a. 1 - 2
    b. 3 - 4
    c. 5 - 6
    d. 7 - 8
    e. 9 or more

55. What is your overall G.P.A.?
    a. 1.5 - 1.9
    b. 2.0 - 2.4
    c. 2.5 - 2.9
    d. 3.0 - 3.4
    e. 3.5 - 4.0

56. Would you like to see the program available on campus for your use in the future?
    a. yes
    b. no

57. Comments/suggestions:

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HNF 102 POSTTEST

Fill in your name, student number and section number on the answer sheet.
Read the following questions and choose the best answer for the multiple choice questions. For questions 23-45, select the answer that reflects your degree of agreement with each statement. **THIS POSTTEST WILL IN NO WAY AFFECT YOUR GRADE FOR THE COURSE.**

1. The correct match to the name of the B vitamin is
   a. B1-thiamin
   b. B2-pyridoxine
   c. B6-niacin
   d. B12-riboflavin
   e. B6-cobalamin

2. Which of the following is produced by bacteria in the intestinal tract?
   a. vitamin A
   b. vitamin K
   c. ascorbic acid
   d. vitamin E

3. A deficiency of iodine may be seen as
   a. anemia
   b. spoon-shaped finger nails
   c. goiter
   d. skin rashes

4. Absorption rate of iron
   a. is increased when the body's need for iron is increased
   b. is approximately 50%
   c. in the heme form is lower than in iron from plant sources
   d. in the normal diet is so high that it reduces absorption of copper

5. The stored form of carbohydrates in the body is called
   a. glycogen
   b. insulin
   c. fat
   d. muscle

6. Proteins are essential in the diet
   a. as the major source of energy
   b. to provide nitrogen for growth and tissue development
   c. to furnish the only source of hydrogen
   d. to provide essential fatty acids

7. Elevated concentrations of this lipoprotein are associated with a decreased risk of cardiovascular disease
   a. low density lipoprotein
   b. high density lipoprotein
   c. lecithin
   d. linoleic acid

8. The major form of fat in the diet is
   a. cholesterol
   b. lecithin
   c. triglyceride
   d. polyunsaturated fat

9. Of the following, which is the best source of polyunsaturated fat?
   a. soybean oil
   b. animal fat
   c. margarine
   d. shortening
   e. coconut oil

10. The correct function of the organ in the digestive tract is
    a. the mouth is the major site of carbohydrate digestion
    b. the small intestine is chiefly a storage reservoir
    c. the stomach is the site where most digestion occurs
    d. the pancreas secretes amylase and lipase into the small intestine

11. The specific dynamic action reflects the increase in energy expenditure
    a. caused by respiration
    b. caused by circulation
    c. caused by glandular activity
    d. following ingestion of food

12. Normally the most energy is expended for
    a. Basal Metabolic Rate (BMR)
    b. physical activity
    c. thermogenesis
    d. digestion of food

13. Pica is
    a. a vitamin deficiency
    b. craving for non-foods such as clay, laundry starch, sand and newspaper
    c. most commonly seen in men and adolescent boys
    d. a recommended mineral supplement at the level of the RDA

14. Which of the following is considered a nutrient?
    a. carbohydrate
    b. lipids
    c. water
    d. all of the above

15. Your breakfast included a fried egg, whole wheat toast, and orange juice. Which Basic Four Food Group was not represented?

a. meat group
b. dairy group
c. grain group
d. fruit and vegetable group

16. During pregnancy

a. the increased need for energy exceeds the increased need for protein and minerals
b. two extra servings of iron-enriched bread are sufficient to meet the increased iron needs
c. the mother needs to double the amount of food she eats by the sixth month to meet the baby's needs
d. it is recommended that the average mother gain approximately 25-30 pounds

17. The requirements for water based on 1000 kcals expended is the greatest for

a. infants
b. adults
c. teenagers
d. elderly

18. The Recommended Dietary Allowances for fat and carbohydrate

a. have not been established
b. are the same for both
c. depend on ideal body weight
d. are based on basal metabolic rate

19. Which food group has the highest percent of complex carbohydrate?

a. milk group
b. meat and alternates group
c. fruit and vegetables group
d. cereal and grains group
e. limited extras

20. The general guidelines in nutrition recommend what percent of your caloric intake should be from fat?

a. 15%
b. 20%
c. 30%
d. 40%
e. 55%

21. The adult recommendation from the Basic Four Food Plan is

a. 4 servings each day from the dairy group
b. 2 servings each day from the cereal group
c. 2 servings each day from the fruit and vegetable group
d. 2 servings each day from the meat group

22. If you consumed 100 grams of fat and your total caloric intake was 1800 kcals, what percent of your energy intake was from fat?
   a. 5%
   b. 20%
   c. 22%
   d. 50%

	Strongly Dis-agree	Dis-agree	No opinion	agree	Strongly agree
23. I believe that diet is a major controlling factor when it comes to maintaining health and controlling disease.					
24. I feel the foods I eat now will affect my future health.					
25. I am concerned about eating nutritious foods throughout the day.					
26. Nutrition is extremely important during pregnancy.					
27. I feel that I need to learn more about good nutrition.					
28. If a person is not eating well his/her health will surely suffer.					
29. I feel that as long as I am maintaining my weight, I don't have to worry much about nutrition.					
30. As long as the doctor doesn't say much to me about nutrition, I don't think I need to worry about it.					
31. I feel that all college students need to take at least one course in nutrition.					
32. I feel that if I drink milk I don't have to worry about nutrition.					
33. Nutrition is important and one should not be careless about it.					
34. Even if I take vitamins, I feel that I should be concerned about the foods I eat.					
35. I would fix more nutritious meals if I knew what to prepare.					
36. For better health, I would be willing to try a food I hadn't eaten before or several foods over a period of time.					
37. Exploring several methods of food preparation is desirable.					

	Strongly Disagree	Dis-agree	No opinion	agree	Strongly agree
38. I think that food habits should be flexible enough to vary with a new situation.					
39. I like for my family to stick to the old favorite meals, rather than mess them up with new and different kinds of foods.					
40. Unfamiliar foods interest me.					
41. If I am satisfied with foods I eat, I see no reason for me to change.					
42. I believe that the person who gets the most satisfaction out of eating is the one who sticks to the foods that are familiar.					
43. Trying new and different foods appeals to me.					
44. I would be willing to spend time in making nutritious foods available for myself and/or family instead of eating convenience foods of low nutritional quality.					
45. I would be willing to try an unfamiliar food at least once.					

APPENDIX D

Appendix D

HNF 102
Sec. 2
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ONE-DAY DIET RECORD
ASSIGNMENT (Part I)

2 pts. for Part I. Part II, also 2 pts will be assigned later in the quarter. You must complete both parts to recieve 4 pts. for ths assignment.

This assignment is intended to increase your awareness of the adequacy of your diet. Take this sheet home with you. Select a WEEKDAY (not Saturday or Sunday) and record all the food and drink you consume for that day. List foods as completely and accurately as possible. You will NOT be graded on the adequacy of your diet.

Be sure to include:

a) beverages: water, milk, soft drinks, juice, tea, coffee, alcoholic beverages, etc.
b) condiments: butter, margarine, mayonnaise, catsup, mustard, pickle relish, cream, sugar, jelly, sauces, etc.
c) method of preparation: fried, baked, boiled, broiled, etc.
d) anything added during preparation: oil, milk, wine, etc.
e) for combination foods, list all ingredients as accurately as possible

Be sure to note estimated quantity of food. Describe portion sizes by ounces, cups, tablespoons, etc. For example, rather than "1 glass of milk", estimate ounces as close as possible.

1 cup = 8 ounces (fluid)
1 tablespoon = 3 teaspoons
1/4 pound = 4 ounces (weight)

Turn in your diet record sheet and accompanying demographic and activity data sheet to the instructor or teaching assistants before or after class to recieve credit for the assignment.

Graduate assistants will use a computerized diet analysis program to assess your diet. The computer printout of your diet analysis will be available for you later inthe quarter (date will be announced).

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Please fill this sheet out completely and turn it in with your one-day diet record. This information is necessary to calculate your diet analysis.

DATE:

STUDENT NUMBER:

SEX:

AGE:

HEIGHT: FT. IN.

WEIGHT: LB.

HAVE YOU BEEN TAKING ANY VITAMIN OR MINERAL SUPPLEMENTS?
(YES OR NO)

ARE YOU PREGNANT OR LACTATING? (YES OR NO)

RECORD THE AMOUNT OF TIME (IN HOURS) THAT IS SPENT IN EACH OF THE ACTIVITIES LISTED BELOW: (IT IS EASIEST TO RECORD HOURS SLEEPING AND THEN WORK UP FROM THE LAST CATEGORY)

SLEEPING... hr.

LIGHT ACTIVITY
(EX. STUDYING, TYPING, COOKING, DRIVING, SITTING, WATCHING T.V.).. hr.

MODERATE ACTIVITY
(EX. WALKING, BICYCLING, DANCING, TENNIS, SWIMMING)................. hr.

HEAVY ACTIVITY
(EX. BASKETBALL, AEROBICS, RUNNING, CROSS-COUNTRY SKIING, ROWING) hr.

TOTAL:
(24 hrs)

ONE-DAY DIET RECORD

NAME: ______________________ I.D. # __________
##

ITEM AND DESCRIPTION	PORTION
Meal 1	
Snack(s)	
Meal 2	
Snack(s)	
Meal 3	
Snack(s)	

Vitamin/Mineral Supplement(s) ______________________

Is this a complete one-day intake? _____ Yes _____ No

Was this a TYPICAL day? _____ Yes _____ No

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Sec. 3
Bond (F 88)

ONE-DAY DIET RECORD
ASSIGNMENT (PART I)

2 pts. for Part I. Part II, also 2 pts. will be assigned later in the quarter. You must complete both parts to receive 4 pts. for the assignment.

This assignment is intended to increase your awareness of the adequacy of your diet. Take this sheet home with you. Select a WEEKDAY (not Saturday or Sunday) and record all the food and drink you consume for that day. List foods as completely and accurately as possible. You will NOT be graded on the adequacy of your diet.

Be sure to include:

a) beverages: water, milk, soft drinks, juice, tea, coffee, alcoholic beverages, etc.
b) condiments: butter, margarine, mayonnaise, catsup, mustard, pickle relish, cream, sugar, jelly, sauces, etc.
c) method of preparation: fried, baked, boiled, broiled, etc.
d) anything added during preparation: oil, milk, wine, etc.
e) for combination foods, list all ingredients as accurately as possible

Be sure to note estimated quantity of food. Describe portion sizes by ounces, cups, tablespoons, etc. For example, rather than "1 glass of milk", estimate ounces as close as possible.

1 cup = 8 ounces (fluid)
1 tablespoon = 3 teaspoons
1/4 pound = 4 ounces (weight)

After you have completed your diet record, you will run a computerized diet analysis program for assessment of your diet. Bring your diet record sheet with you to one of the computer labs listed below. Hours will be reserved for HNF 102 students at the times listed, and open hours are also available. The computerized diet analysis program 'MSU NutriGuide', will be available from the assistants in the Human Ecology lab and the Student Union lab. Bessey Hall computer labs will have the program on the mainframe, but you will need to get a bootdisk and NutriGuide A disk from the monitor in Rm. 210. Follow the attached instructions for the lab you are attending and proceed through the program. The computer will automatically print 2 copies of your analysis. Turn one copy in to the instructor or teaching assistants before or after class, and keep the second copy for your own use.

NOTE: YOU ARE FREE TO USE NUTRIGUIDE AT ANY TIME DURING THE QUARTER!
The program will be available for checkout, and you are encouraged to practice using the program for assessment of your diet.

ONE-DAY DIET RECORD

NAME:______________________________ I.D. # ______________
##

ITEM AND DESCRIPTION	PORTION
Meal 1	
Snack(s)	
Meal 2	
Snack(s)	
Meal 3	
Snack(s)	

Vitamin/Mineral Supplement(s) ______________________________

Is this a complete one-day intake? _____ Yes _____ No

Was this a TYPICAL day? _____ Yes _____ No

APPENDIX E

Appendix E

Table 19. Summary of knowledge-attitude-behavior relationships: A review of literature cited

AUTHOR	TARGET GROUP	ASSESSMENT MEASURES	RESULTS
Amstutz and Dixon (1986)	EFNEP participants (homemakers)	24-hour recall (b)	Positive dietary change
Brush et al. (1986)	General adult population	Nutrition knowledge (k) Degree of flexibility/rigidity in nutrition attitudes (a) 24-hour recall (b)	Positive correlation between attitudes and behavior
Byrd-Bredbenner et al.(1988)	Senior high home economics students	Nutrition knowledge (k) Caring about nutrition (a) Eating new foods (a) Nutrition affects health (a) Learning about nutrition (a) Food frequency (b) Food choices (b)	Improvement in knowledge No change in attitudes No change in dietary scores (correlations not examined)
Carruth et al. (1977)	Nutrition education assistants in EFNEP	Knowledge about weight modification (k) Adaptability toward changing nutritional practices (a) Requests for literature (b) Verbal nutrition practices (b) Observed nutrition practices (b)	Knowledge and attitudes significantly correlated with requests for literature (b)

k=nutrition knowledge
a=nutrition attitudes
b=dietary behaviors

AUTHOR	TARGET GROUP	ASSESSMENT MEASURES	RESULTS
Douglas and Douglas (1984)	High school athletes	Food frequency of four food groups (b) Nutrients (k) Misconceptions about food and nutrition (k)	Positive correlation (r=0.35)between knowledge and behaviors for males Positive weak correlation (r=.15) between knowledge and behaviors for females
Foley et al. (1983)	Fifth grade students	Basic vocabulary/concepts (k) Nutrition practices (k) Food selection (k) Food prep and storage (k) Value of proper nutrition (a) Food selection (a&b) Eating patterns (&b) Beverage consumption (a&b) Advertising claims (a&b) School food (a&b)	Positive correlation between knowledge and attitudes Positive correlation between knowledge and behaviors Positive correlation between attitudes and behaviors
Grotkowski and Sims (1978)	Senior citizens	Nutrition knowledge (k) Nutrition is important (a) Misconceptions about weight-reducing diets (a) Using food and supplements as medicine (a) Necessity of vitamin/mineral supplements(a) 3-day food records (b)	Significant correlation between knowledge and attitudes Significant correlation between attitudes and behaviors

AUTHOR	TARGET GROUP	ASSESSMENT MEASURES	RESULTS
Guiry and Bisogne (1987)	Young women (15-30 yrs)	Dietary sources of caffeine (k) General health effects of caffeine consumption (k) Caffeine use during pregnancy (k) Caffeine consumption during pregnancy (a) Limiting caffeine consumption (a) 24-hour beverage recall (b) Beverage frequency (b)	Significant correlation between caffeine consump. (b) and attitude about limiting caffeine consump. Significant correlation between caffeine consump. (b) and attitude about caffeine use during pregnancy
Hart et al. (1990)	Missionaries	General nutrition knowledge (k) Flexibility of attitude toward nutrition (FATN) (a) Attitude about nutrition education (AANE) (a)	Significant correlation between k & FATN Significant correlation between FATN & AANE Significant correlation between k & AANE
Jalso et al. (1965)	General adult population	Nutritional opinions (a) Use of food supplements (b) Use of special health foods (b) Methods of weight control (b) Special diets (b) Avoidance of certain foods (b)	Significant correlation between opinion scores and practices scores

AUTHOR	TARGET GROUP	ASSESSMENT MEASURES	RESULTS
Perron and Endres (1985)	Female high school athletes	General nutrition knowledge and attitudes (k&a) Nutrition for the athlete (k&a) 24-hour recall (b) 2-day food record (b)	Significant correlation between knowledge and attitudes
Rosander and Sims (1981)	Pregnant women	Nutrition knowledge (k) Nutrition attitudes (a) Food frequency of 7 food groups (b)	Improvement in knowledge, attitudes, and behaviors (correlations not examined)
Ross (1984(	College nursing students	Nutrition principles (k) Role of nurse in nutrition education (a) Role of dietitian in the hospital (a) Nutrition education in nursing (a) General nutrition (a)	Improvement in knowledge No change in attitudes (correlations not examined)
Schwartz (1975)	Female high school graduates previously enrolled in home economics courses	General nutrition knowledge (k) Food composition (k) Misconceptions about food (k) Basic nutrition principles (k) Attitude toward nutrition & eating habits (a) Meal planning & food prep (a) 3-day food frequency (b)	Significant correlation between knowledge and attitudes Significant correlation between attitudes and behaviors

AUTHOR	TARGET GROUP	ASSESSMENT MEASURES	RESULTS
Shepherd and Stockley (1987)	General adult population (United Kingdom residents)	Fiber and fat content of foods (k) Caloric intake (k) Attitude toward eating food from 4 food types (a) Food frequency of 4 food types (b)	Attitude correlated with behaviors Knowledge not correlated with attitudes or behaviors
Soliah et al. (1983)	Elementary school teachers	Basic vocabulary (k) Nutrition practices (k) Food selection (k) Food prep & storage (k) Advertising claims (k) Value of proper nutrition (a&b) Food selection (a&b) Eating patterns (a&b) Beverage consumption (a&b) Advertising claims (a&b) School food (a&b)	Positive correlation between knowledge and attitudes, knowledge and behaviors, and attitudes and behaviors
Werblow et al. (1978)	Female collegiate athletes	General nutrition knowledge and attitudes (k&a) Nutrition for the athlete (k&a) Food pattern assessment (b)	Significant correlation between knowledge and attitudes

APPENDIX F

Appendix F

TABLE 20. Mean daily nutrient intake: means and standard deviations

Variable	Pretest				Posttest			
	Control		Experimenta		Control		Experimenta	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Calories	2277	1037	2301	1129	2184	1369	2255	1489
Protein (g)	90	49	87	46	95	169	85	50
Carbohydrate (g)	272	129	281	157	258	134	275	188
Total fat (g)	91	53	91	78	87	54	92	74
Polyunsat fat (g)	14	11	15	23	14	13	12	9
Saturated fat (g)	33	28	30	31	32	24	32	33
Cholesterol (g)	287	254	304	366	262	483	245	221
Alcohol (g)	3 *	12	4 *	14	1 *	4	1 *	4
Vitamin A (IU)	9541 **	11237	10595	16151	6730 **	7659	8928	13073
Vitamin D (IU)	176	191	151	182	186	179	151	157
Vitamin E (mg)	6	6	6	7	7	7	6	7
Thiamin (mg)	1.6	0.9	1.5	1	1.5	0.9	1.4	1
Riboflavin (mg)	2.2	1.2	2	1.2	2.1	1.4	1.9	1.2
Niacin (mg)	23	17	23	15	27	73	21	13
Vitamin B-6 (mg)	1729	1182	2575	1117	1814	3273	1421	857
Vitamin B-12 (mcg)	4.6	3.8	3.7	2.6	4.4	6	3.8	2.8
Folacin (mcg)	339 *	257	301	239	296 *	198	252	191
Vitamin C (mg)	135	196	147	290	108	147	121	125
Phosphorus (mg)	1529	780	1471	843	1533	1442	1433	838
Potassium (mg)	2804	1415	2918	1942	2677	1891	2698	1449
Magnesium (mg)	299	181	300	221	272	210	253	142
Iron (mg)	14	7	14	9	13	9	14	9
Calcium (mg)	1211	763	1086	779	1170	767	1123	829
Sodium (mg)	3672	2158	3930	2526	3738	1945	3945	2837
Zinc (mg)	9.8	5.4	9.6	6.2	9.7	7.6	9.7	6.7
Dietary fiber (g)	7	6	9	10	8	6	8	7
Caffeine (mg)	94	131	125	231	106	163	110	217

Control group (n=177); Experimental group (n=77)

* significantly different ($p<0.05$) between pretest and posttest within group

**significantly different ($p<0.001$) between pretest and posttest within group

Table 21. Mean daily nutrient intake of females: means and standard deviations

Variable	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	X	SD	X	SD	X	SD	X	SD
Calories	2084	923	1936	943	1957	1323	1765	888
Protein (g)	82	47	72	38	87	188	70	36
Carbohydrate (g)	249**	110	242	126	229 **	107	218	118
Total fat (g)	84	52	75	48	78	50	70	44
Saturated fat (g)	31	29	24	21	28	21	23	19
Cholesterol (g)	260	221	240	307	241	528	187	167
Vitamin D (IU)	154	171	146	189	154	148	145	150
Thiamin (mg)	1.4	0.8	1.3	0.8	1.3	0.8	1.2	0.7
Riboflavin (mg)	1.9	1	1.8	1	1.8	1.1	1.6	0.9
Niacin (mg)	22	17	18	12	26	82	17	10
Vitamin B-6 (mg)	1596	1140	1362	998	1710	3606	1285	797
Vitamin B-12 (mcg)	3.8	2.9	3.3	2.3	3.4	3.1	3.6	2.6
Vitamin C (mg)	137	215	96	89	108	159	99	90
Iron (mg)	13	7	12	7	12	8	11	8
Calcium (mg)	1081	687	993	776	985	549	958	699
Phosphorus (mg)	1395	694	1310	833	1377	1501	1176	590
Sodium (mg)	3377	2187	3346	2041	3343	1540	3054	1768
Potassium (mg)	2600	1342	2500	1411	2420	1896	2293	1057
Magnesium (mg)	273	144	261 **	175	252	214	214**	99
Zinc (mg)	9	5.1	8.1	4.8	9	7.5	7.9	5
Dietary fiber (g)	8	6.6	7	7	8	6.7	7	6

Control group (n=141); Experimental group (n=60)
* significantly different ($p<0.05$) between groups (group effect)
** significantly different ($p<0.05$) within groups (time effect)

Table 22. Mean daily nutrient intake of males: means and standard deviations

Variable	Pretest				Posttest			
	Control		Experimental		Control		Experimental	
	X	SD	X	SD	X	SD	X	SD
Calories	3033	1125	3590	718	3076	1178	3986	1884
Protein (gm)	123	41	140	35	126	45	141	54
Carbohydrate (g)	365	154	417	183	375	163	474	250
Total fat (g)	117	50	146	55	119	56	173	100
Saturated fat (g)	41	21	54	47	47	31	61	50
Cholesterol (g)	395	338	529	467	344	226	449	272
Vitamin D (IU)	261	241	169	158	312	233	173*	184
Thiamin (mg)	2.1	0.9	2.3	1.1	2.2	1.1	2.3	1.3
Riboflavin (mg)	3.2	1.3	2.9	1.2	3.3	1.8	3.1	1.7
Niacin (mg)	31	13	38	13	31	13	33	15
Vitamin B-6 (mg)	2249	1216	2324	1219	2224	1271	1896	915
Vitamin B-12 (mcg)	7.7	5.3	5.3	3	8.6	10.9	4.9	3.3
Vitamin C (mg)	126	87	326	570	108	87	198	191
Iron (mg)	18	7	21	10	19	8	21	10
Calcium (mg)	1717	843	1412	719	1895	1034	1703	1002
Phosphorus (mg)	2057	883	2042	607	2144	979	2340	964
Sodium (mg)	4829	1600	5992	3023	5288*	2538	7090*	3635
Potassium (mg)	3606	1429	4392	2756	3685	1512	4125	1752
Magnesium (mg)	401	260	438	303	352	174	393	180
Zinc (mg)	13	6	15	7.7	14	6	16	8.4
Dietary fiber (g)	6	4	13	18	8	6	9	11

Control group (n=36); Experimental group (n=17)
* significantly different ($p<0.05$) between groups

APPENDIX G

Appendix G

Kraemer and Thiemann Power Analysis: (p.42)

Equation for the two-sample t-test

$$\delta = \frac{\text{difference in means you consider important}}{\sigma}$$

$$\Delta = \frac{\delta}{(\delta^2 + \frac{1}{pq})^{1/2}}$$, where Δ = critical effect size

n=v+2

where p+q=1: proportion p of the total n subjects from one group and proportion q of the total n subjects from a second group.
For my study p=.70, q=.30
$(\frac{177}{254} = 70, \frac{77}{254} = 30)$

Sample equation: Iron intake for females

Significant difference in means = 6mg (1/3 of the RDA: I arbitrarily chose this)

σ = 7.5 (from my data)

$$\delta = \frac{6}{7.5} = 0.8$$

$$\Delta = \frac{0.8}{\sqrt{.8^2 + \frac{1}{(.7)(3)}}} = \frac{.8}{\sqrt{(.8^2 + 4.76)}}$$

$$\Delta = \frac{.8}{2.32}$$

$$\Delta = .34$$

Using the tables at the back of the book, look up Δ=.34, 5% level, two-tailed test, 80% power (p.110):

v = 64, n = 64+2 = <u>66</u> subjects

I assume that my sample size is large enough to be confident in my results because I have 201 subjects.

APPENDIX H

Appendix H

SPSS-X Data Program

```
TITLE 'THESIS DATA ANALYSIS'
FILE HANDLE SHERRY/NAME='SHERRY DATA1 A'
DATA LIST FILE=SHERRY FIXED RECORDS=34 NOTABLES
1/IDNUMBER 1-7 LAST NAME 9-18 (A) PRESCORE 19-21 KNOWB1 TO
   KNOWB23 22-43 ATTB1 TO ATTB23 44-66 RESIDE 67 LEVEL 68
  ENROLL 69
2/POSTSCOR 19-21 KNOWA1 TO KNOWA23 22-43 ATTA1 TO
   ATTA23 44-66 COMPUTE1 TO COMPUTE10 67-77
3/GENDER 29(A) AGE 31-32 HEIGHT 34-38 WEIGHT 40-44 ENEEDS 46-
   50 VITAMIN 52 PREG 54 SLEEP 56-59 LIGHT 61-64 MOD 66-69
   HEAVY 71-74
4/CALORIE 9-14 CRDA 15-20 CSNACK 21-25
   PROTEIN 27-32 PRDA 33-38 PSNACK 39-43
   CARBO 45-50 CARDA 51-56 CASNACK 57-61
   FAT 63-68 FRDA 69-74 FSNACK 75-79
5/POLYFAT 9-14 PFRDA 15-20 PFSNACK 21-25
   SATFAT 27-32 SFRDA 33-38 SFSNACK 39-43
   CHOL 45-50 CHRDA 51-56 CHSNACK 57-61
   ALCOHOL 63-68 ALRDA 69-74 ALSNACK 75-79
6/VITA 9-14 ARDA 15-20 ASNACK 21-25
   VITD 27-32 DRDA 33-38 DSNACK 39-43
   VITE 45-50 ERDA 51-56 ESNACK 57-61
   B1 63-68 B1RDA 69-74 B1SNACK 75-79
7/B2 9-14 B2RDA 15-20 B2SNACK 21-25
   NIACIN 27-32 NIARDA 33-38 NIASNACK 39-43
   B6 45-50 B6RDA 51-56 B6SNACK 57-61
   B12 63-68 B12RDA 69-74 B12 SNACK 75-79
8/FOLACIN 9-14 FOLRDA 15-20 FOLSNACK 21-25
   VITC 27-32 VCRDA 33-38 VCSNACK 39-43
   IRON 45-50 FERDA 51-56 FESNACK 57-61
   CALCIUM 63-68 CALRDA 69-74 CALSNACK 75-79
9/PHOSPHOR 9-14 PHOSRDA 15-20 PHOSNACK 21-25
   SODIUM 27-32 NARDA 33-38 NASNCAK 39-43
   POTASS 45-50 POTRDA 51-56 POTSNACK 57-61
   MAGNES 63-68 MAGRDA 69-74 MAGSNACK 75-79
10/ZINC 9-14 ZNRDA 15-20 ZNSNACK 21-25
   DFIBER 27-32 DFRDA 33-38 DFSNACK 39-43
   CAFFEINE 45-50 CAFRDA 51-56 CAFSNACK 57-61
11/FOOD1 9-14 MEAL1 16 SVG1 18-20
```

FOOD2 21-26 MEAL2 28 SVG2 30-32
FOOD3 33-38 MEAL3 40 SVG3 42-44
FOOD4 45-50 MEAL4 52 SVG4 54-56
FOOD5 57-62 MEAL5 64 SVG5 66-68
FOOD6 69-74 MEAL6 76 SVG6 78-80
12/FOOD7 9-14 MEAL7 16 SVG7 18-20
FOOD8 21-26 MEAL8 28 SVG8 30-32
FOOD9 33-38 MEAL9 40 SVG9 42-44
FOOD10 45-50 MEAL10 52 SVG10 54-56
FOOD11 57-62 MEAL11 64 SVG11 66-68
FOOD12 69-74 MEAL12 76 SVG12 78-80
13/FOOD13 9-14 MEAL13 16 SVG13 18-20
FOOD14 21-26 MEAL14 28 SVG14 30-32
FOOD15 33-38 MEAL15 40 SVG15 42-44
FOOD16 45-50 MEAL16 52 SVG16 54-56
FOOD17 57-62 MEAL17 64 SVG17 66-68
FOOD18 69-74 MEAL18 76 SVG18 78-80
14/FOOD19 9-14 MEAL19 16 SVG19 18-20
FOOD20 21-26 MEAL20 28 SVG20 30-32
FOOD21 33-38 MEAL21 40 SVG21 42-44
FOOD22 45-50 MEAL22 52 SVG22 54-56
FOOD23 57-62 MEAL23 64 SVG23 66-68
FOOD24 69-74 MEAL24 76 SVG24 78-80
15/FOOD25 9-14 MEAL25 16 SVG25 18-20
FOOD26 21-26 MEAL26 28 SVG26 30-32
FOOD27 33-38 MEAL27 40 SVG27 42-44
FOOD28 45-50 MEAL28 52 SVG28 54-56
FOOD29 57-62 MEAL29 64 SVG29 66-68
FOOD30 69-74 MEAL30 76 SVG30 78-80
16/FOOD31 9-14 MEAL31 16 SVG31 18-20
FOOD32 21-26 MEAL32 28 SVG32 30-32
FOOD33 33-38 MEAL33 40 SVG33 42-44
FOOD34 45-50 MEAL34 52 SVG34 54-56
FOOD35 57-62 MEAL35 64 SVG35 66-68
FOOD36 69-74 MEAL36 76 SVG36 78-80
17/FOOD37 9-14 MEAL37 16 SVG37 18-20
FOOD38 21-26 MEAL38 28 SVG38 30-32
FOOD39 33-38 MEAL39 40 SVG39 42-44
FOOD40 45-50 MEAL40 52 SVG40 54-56
FOOD41 57-62 MEAL41 64 SVG41 66-68
FOOD42 69-74 MEAL42 76 SVG42 78-80
18/FOOD43 9-14 MEAL43 16 SVG43 18-20
FOOD44 21-26 MEAL44 28 SVG44 30-32

FOOD45 33-38 MEAL45 40 SVG45 42-44
FOOD46 45-50 MEAL46 52 SVG46 54-56
FOOD47 57-62 MEAL47 64 SVG47 66-68
19/PGENDER 29 PAGE 31-32 PHEIGHT 34-38 PWEIGHT 40-44
PENEEDS 46-50 PVITAMIN 52 PPREG 54 PSLEEP 56-59 PLIGHT61-
64 PMOD 66-69 PHEAVY 71-74
20/PCALORIE 9-14 KCRDA 15-20 KCSNACK 21-25
PROT 27-32 PRODA33-38 PRONAK 39-43
CHO45-50 CHORDA 51-56 CHOSNAK 57-61
TFAT 63-68 TFRDA 69-74 TFSNAK 75-79
21/POLFAT 9-14 PLFRDA 15-20 PLFSNAK 21-25
SFAT 27-32 STFRDA 33-38 STFSNAK 39-43
CLST 45-50 CLRDA 51-56 CLSNAK 57-61
ALCO 63-68 ALCRDA 69-74 ALCSNAK 75-79
22/VITAMA 9-14 VARDA 15-20 VASNAK 21-25
VITAMD 27-32 VDRDA 33-38 VDSNAK 39-43
VITAME 45-50 VERDA 51-56 VESNAK 57-61
THIA 63-68 THRDA 69-74 THSNAK 75-79
23/RIBOF 9-14 RIBRDA 15-20 RIBSNAK 21-25
NIAC 27-32 NIRDA 33-38 NISNAK 39-43
PYRIDOX 45-50 PYRRDA 51-56 PYRSNAK 57-61
VITB12 63-68 12RDA 69-74 12SNAK 75-79
24/FOLIC 9-14 FORDA 15-20 FOSNAK 21-25
VITAMC 27-32 VICRDA 33-38 VICSNAK 39-43
IRONB 45-50 IRRDA 51-56 IRSNAK 57-61
CALC 63-68 CCMRDA 69-74 CCMSNAK 75-79
25/PHOS 9-14 PHORDA 15-20 PHOSNAK 21-25
SOD 27-32 SODRDA 33-38 SODSNAK 39-43
POT 45-50 KRDA 51-56 KSNAK 57-61
MAGNE 63-68 MGRDA 69-74 MGSNAK 75-79
26/ZIN 9-14 ZINRDA 15-20 ZINSNAK 21-25
FIBER 27-32 DFIRDA 33-38 DFISNAK 39-43
CAFF 45-50 CFFRDA 51-56 CFFSNAK 57-61
27/FOODA1 9-14 MEALA1 16 SVG1B 18-20
FOODA2 21-26 MEALB1 28 SVG2B 30-32
FOODA3 33-38 MEALC1 40 SVG3B 42-44
FOODA4 45-50 MEALD1 52 SVG4B 54-56
FOODA5 57-62 MEALE1 64 SVG5B 66-68
FOODA6 69-74 MEALF1 76 SVG6B 78-80
28/FOODA7 9-14 MEALG1 16 SVG7B 18-20
FOODA8 21-26 MEALH1 28 SVG8B 30-32
FOODA9 33-38 MEALI1 40 SVG9B 42-44
FOODA10 45-50 MEALJ1 52 SVG10B 54-56

FOODA11 57-62 MEALK1 64 SVG11B 66-68
FOODA12 69-74 MEALL1 76 SVG12B 78-80
29/FOODA13 9-14 MEALM1 16 SVG13B 18-20
FOODA14 21-26 MEALN1 28 SVG14B 30-32
FOODA15 33-38 MEAL01 40 SVG15B 42-44
FOODA16 45-50 MEALP1 52 SVG16B 54-56
FOODA17 57-62 MEALQ1 64 SVG17B 66-68
FOODA18 69-74 MEALR1 76 SVG18B 78-80
30/FOODA19 9-14 MEALS1 16 SVG19B 18-20
FOODA20 21-26 MEALT1 28 SVG20B 30-32
FOODA21 33-38 MEALU1 40 SVG21B 42-44
FOODA22 45-50 MEALV1 52 SVG22B 54-56
FOODA23 57-62 MEALW1 64 SVG23B 66-68
FOODA24 69-74 MEALX1 76 SVG24B 78-80
31/FOODA25 9-14 MEALY1 16 SVG25B 18-20
FOODA26 21-26 MEALZ1 28 SVG26B 30-32
FOODA27 33-38 MEALAA1 40 SVG27B 42-44
FOODA28 45-50 MEALBB1 52 SVG28B 54-56
FOODA29 57-62 MEALCC1 64 SVG29B 66-68
FOODA30 69-74 MEALDD1 76 SVG30B 78-80
32/FOODA31 9-14 MEALEE1 16 SVG31B 18-20
FOODA32 21-26 MEALFF1 28 SVG32B 30-32
FOODA33 33-38 MEALGG1 40 SVG33B 42-44
FOODA34 45-50 MEALHH1 52 SVG34B 54-56
FOODA35 57-62 MEALII1 64 SVG35B 66-68
FOODA36 69-74 MEALJJ1 76 SVG36B 78-80
33/FOODA37 9-14 MEALKK1 16 SVG37B 18-20
FOODA38 21-26 MEALLL1 28 SVG38B 30-32
FOODA39 33-38 MEALMM1 40 SVG39B 42-44
FOODA40 45-50 MEALNN1 52 SVG40B 54-56
FOODA41 57-62 MEALOO1 64 SVG41B 66-68
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34/FOODA43 9-14 MEALQQ1 16 SVG43B 18-20
FOODA44 21-26 MEALRR1 28 SVG44B 30-32
FOODA45 33-38 MEALSS1 40 SVG45B 42-44
FOODA46 45-50 MEALTT1 52 SVG46B 54-56
FOODA47 57-62 MEALUU1 64 SVG47B 66-68
FOODA48 69-74 MEALVV1 76 SVG48B 78-80

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