DIETARY INTAKE STUDY OF OKLAHOMA STATE UNIVERSITY STUDENTS PARTICIPATING IN TWO SYSTEMS OF FOOD SERVICE

By

LOIS TIEFEL SHIRLEY

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California Polytechnic State University

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Thesis Approved:

Mary E. Leidigh

Evelyn Montgomery

Nick Stinnett

N. N. Durham

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

College food services of today are having to compete to survive. Many have redesigned the decor as well as style of service to meet the demands of today's students. As a general rule, universities all over the nation are aiming, more than ever before, to please the students' desires in food service (1). Some universities are now serving a la carte, where students choose the foods they want and pay for each item separately. Others are allowing students unlimited "seconds" on all food, while still using the contract system of paying for a designated number of meals per week. Some campuses are serving students in a variety of types of restaurants, similar to the restaurants students would patronize off campus. Several universities offer students the choice of a cafeteria where only vegetables are served while other universities provide a "health food" cafeteria.

Before these changes began to take place, the dietitian and parents could feel fairly certain that students were provided with balanced meals--ones which met the Recommended Dietary Allowances (RDA). Students were served meals designed to meet these requirements and

were given little, if any, chance to vary from the set menu. As already discussed, this method of serving meals has changed on many campuses today. The current philosophy of most food services is best expressed by a quote from the head of food services at Fairleigh Dickinson University, Teaneck, New Jersey:

> We assume that a student mature enough to chart his own future by choosing a certain college and a certain curriculum is mature enough to choose his own food and balance his meals according to his needs, likes, or dislikes (2, p. 62).

Statement of Problem

Several studies of the eating habits of college women have pointed to the fact that many college and university students fall short of meeting the RDA, especially for calcium, iron and ascorbic acid (3). In discussing the RDA established by the National Research Council, Harper (4) stated that nutrient intakes above or below the RDA do not necessarily indicate an inadequate diet, nevertheless,

> ...with no way of predicting whose needs are high and whose are low, it does mean that the farther habitual intake falls below the.../RDA/ and the longer the period of low intake, the greater is the risk of deficiency (4, p. 151).

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

Availability of food is the main determinant in food choice but other factors also have an influence, such as

cultural background, religious laws, education, and family relationships. Therefore, "the availability of nutritionally desirable food does not mean.../these foods/ will be eaten" (5, p. 205).

In the Fall semester of 1972 all of the residence hall cafeterias at Oklahoma State University (O.S.U.) changed from a non-continuous to a continuous food service system. Under the non-continuous system serving hours were limited and "seconds" on foods were not offered. The new system (continuous) however, served continually from 6:45 A.M. to 6:15 P.M. and students were permitted unlimited "seconds". This study will be concerned with determining differences in nutrient intakes between the two systems of service by studying the nutrient intakes of female students who participated in these two types of food service.

Need for Research

The food service cafeterias at O.S.U. have used the continuous-type of food service for two years but no study has been attempted to determine if students are selecting nutritionally adequate diets. Such information is useful to the food service administration at O.S.U. in order to evaluate the continuous-type and non-continuous-type of food service.

Objectives of the Study

The objectives of this research were to:

1. Review the literature related to college food services and studies of the dietary habits of college students.
2. Determine if there were differences in the nutrient intakes of female students participating in continuous and non-continuous types of food service at O. S. U.
3. Determine if the students in the study chose nutritionally adequate diets.
4. Provide the O. S. U. food service administration with information to aid in evaluation of the continuous and non-continuous types of food service.

Assumptions

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

1. Students living in the residence halls ate in the residence hall cafeterias.
2. The meals recorded for the dietary study were eaten in the O. S. U. residence hall cafeterias.
3. All O.S. U. residence hall cafeterias provide students with meals which could satisfy the RDA.
4. The fact that all subjects were enrolled in a nutrition class did not significantly influence their dietary behavior.

Definition of Terms

Non-continuous food service system: The hours of meal service were:

Breakfast	6:30 - 8:15
Continental Breakfast	8:15 - 9:00
Lunch	11:00 - 1:00
Dinner	4:30 - 6:15

A 15 or 20 meal plan ticket could be purchased. There were no second servings of food allowed. Milk was unlimited.

Continuous food service system: The hours of meal service were:

Breakfast	6:45 - 8:30
Continental Breakfast	8:30 -10:00
Lunch	10:00 - 3:00
Dinner	3:00 - 6:15

A 15 or 20 meal plan ticket could be purchased. Unlimited second servings of food were offered. Students could stay in the dining hall as long as they wished.

Recommended Dietary Allowances (RDA): The RDA used in this research were those established by the National Research Council in 1968. The RDA are recommendations for nutrient intakes. Harper (4) defines the RDA as "...'goals' at which to aim in providing for the nutritional needs of groups of people" (p. 151).

Hypotheses

The following hypotheses were made:

1. There will be no significant difference with regard to nutrient intakes between female students who ate in a non-continuous food service system and female students who ate in a continuous food service system.
2. The availability of a nutritionally adequate diet does not necessarily indicate a nutritionally adequate diet was consumed.

CHAPTER II

REVIEW OF LITERATURE

This research was concerned with the nutrient intakes of college students in two different types of food service. Therefore, the literature related to this study has been divided into the following sections: (1) Methods of Dietary Studies, (2) Dietary Habits of College Students, and (3) Types of Food Services on College Campuses.

Methods of Dietary Studies

The main steps in any type of dietary survey include determining the quantity of food consumed and determining the amount of each nutrient provided by each food (6). Pekkarinen (7) best explains the need and aim for conducting dietary studies:

> The collection of food consumption data is an essential part of food consumption surveys conducted for nutritional, medical and economic purposes. The aim of these surveys is to continually assess the diet of populations, population groups or individuals and its possible deficiencies or faults (p. 145).

Pekkarinen goes on to point out several factors which are to be taken into consideration when determining the method of dietary study to use: the aim of the study (this determines the accuracy needed), the size of the sample

needed, and the funds and personnel available.

Trulson and McCann (8) discussed four methods of dietary surveying: the dietary record, where subjects kept a record of each food and the estimated amount eaten; the weighed diet, where subjects weighed each food to be consumed; the questionnaire; and the interview. When repeated, the food record and the dietary interview showed little variation for a group but a great deal of variation for the individual.. Pekkarinen (7) indicated, "...for many purposes the degree of accuracy obtained by /the food record/ method is sufficient" (p. 145). Trulson, McCann, and Pekkarinen, felt that the weighed diet was the most accurate method, but it tended to alter the amount of intake by the subject due to the inconvenience of weighing all foods.

A study was undertaken by Young, et al. (9) to compare the use of the dietary history versus 24-hour recall and the seven-day record versus 24-hour recall. The results of the study showed, for the individual, the 24-hour recall did not give the same results as the dietary history or as the seven-day record. It was also shown that the dietary history gave higher estimates than did the 24-hour recall for the group. However, the seven-day record and the 24-hour recall gave similar results when studying a group of people. The researchers concluded that the 24-hour recall could not be used interchangeably with diet history and seven-day record when observing individuals. Also, the 24-hour recall could not be used interchangeably with diet

history when observing a group, while under some circumstances the 24-hour recall could be used in place of the seven-day record.

Hankin, et al. (10) designed an electronic digital computer program whereby,

> ...large quantities of data on food intake could be used to characterize and differentiate diets of individuals by means of their nutrient intakes and/or selected nutrient relationships (p. 387).

Information concerning the weight or measure of the edible portion of each food consumed was read into the computer which printed out information on 36 chemical components and 32 of their interrelationships. The researcher then interpreted the results. The computer program was designed to study individuals as well as homogeneous or heterogeneous groups. This particular computer program was used to study old data which contained a record of a seven-day food intake of 159 pregnant women in the New Orleans area, and another group of old data which was a seven-day record of the food offered to patients in a hospital for lepers (11, 12). This same system was used to analyze newly collected data. One study dealt with the dietary intake of New Orleans families and the other dealt with a nutrition survey of school lunches in Louisiana (13, 14). The computer proved to be rapid, flexible, and accurate in all four studies. The researchers felt that:

> ...by use of more rapid, accurate, and standardized methods for assessing dietary data, it may become possible to characterize and to differentiate diets and dietary habits. By means of

> longitudinal studies, it may also become possible to identify new trends as they develop (10, p. 387).

Tullis, Lawson, and Williams (6) investigated the use of a digital computer for various dietary studies conducted in a research nutrition clinic. Each subject kept a six-day dietary of food intake. This summary was reviewed in an interview with a dietitian, using plastic food models for estimating quantities consumed. The food item and the number or fraction of servings was then read into the computer. The computer printed out the values for 12 nutrients and averaged the totals for the six day period. The RDA were shown at the bottom of the print-out so a comparison to the actual intake could be made. The researchers found that using the computer was quite satisfactory in dietary studies. It was particularily valuable in the amount of time it saved in laborious calculations by the dietitian.

Thompson and Tucker (15) discussed a similar use of computers in dietary studies indicating one limiting factor was the high cost of initial card preparation. However, they also pointed out that once the cards were prepared the following costs were minimal with respect to the cost of manual calculations. Concerned with the use of computers in dietary studies, Thompson and Tucker concluded:

> With increasing attention being directed to nutritional status as related to longevity, physiologic and mental disorders, as well as world population dynamics, the development of new techniques and measures of human health will be accelerated. The ability to meet these problems will be enhanced when

> basic data can be most effectively calculated and evaluated. An increased use of computers to provide these values for both intensive and extensive application will be a major advance in accelerating the program in the saving of human beings in terms of time, labor and cost (p. 308).

An experimental method for direct measurement of food intake in man was designed at the University of Pennsylvania. Subjects ingested a liquid diet through a straw from a hidden reservoir of the liquid. After three to five days subjects showed a consistent intake of liquid diet. Subjects were not able to estimate the amount ingested and "subjective hunger ratings correlated well with the rate and amount ingested" (16, p. 836). Researchers concluded that this experimental method was a powerful tool for analysis of many factors which may influence food intake.

Dietary Habits of College Students

McKenzie and Yuakin (5) indicate that the availability of nutritionally desirable foods does not mean people will eat these foods. For example, there are other determinants of food choices such as: social factors, cultural patterns, family relationships, religious beliefs, education, advertising, and food instincts.

Bennett (3) pointed out that several studies have shown that many college students fall short of the RDA for calcium, iron and vitamin C. Bennett suggested this was due to a lack of education in nutrition. Stasch, Johnson, and Spangler (17) concluded from later research

that college students did not drink sufficient milk and did not eat sufficient amounts of vegetables and fruits because of a lack of knowledge of the need for such foods. However, more recent research conducted by Schorr, Sanjur, and Erickson (18) showed that nutrition information did not affect food habits of teenagers. In a study with adult homemakers, Amudson (19) concluded that knowledge of nutrition had little effect on food selection. Whitehead (19) added to this that nutrition education would change eating patterns only when the method of teaching was geared toward bringing about change.

From research with 101 university students, Brown (20) summarized the factors which the students felt had influenced the development of food habits:

- Parental influence -- especially of the mother
  Parental policies concerning food served at mealtime.
  Variety and appearance of foods served.
- Place of residence
- Income of the family
- Size of the family
- Pressures of life
- Influence of peers
- Influence of eating situations beyond the home
- Living arrangements outside the home
- Ease with which meals can be secured (preparation distance)
- Student's own income and hours of job

A survey was conducted in 1966 on the University of Hawaii campus to determine the breakfast habits of college students. Results of the survey clearly indicated that

students were more likely to eat breakfast when it required little effort to obtain the meal, when money was not exchanged over the counter, and when it took only a short time to obtain the meal (21). A more recent study by Wakefield and Miller (22) indicated that breakfast was "...consumed at the university 20 per cent more frequently than at home" (22, p. 45).

Schuck (23) suggested that eating habits vary according to the economic situation as well as the traditional eating patterns of the people. Therefore, food habits will vary in different sections of the country. Schuck's study with South Dakota State University and Alcorn A. and M. College (Mississippi) students showed grapefruit, cottage cheese, and butter or margarine to have low acceptance in Mississippi while they were well liked in South Dakota. The Mississippi students put chicken and pork at the top of the meat list while the South Dakota students preferred beef. A different study taken at North Central College in Illinois showed strawberry shortcake, ice cream, hamburgers, roast turkey, beef steak, roast beef, and doughnuts to have the greatest popularity. More than 50% of these same students indicated a dislike for: french fried eggplant, turnips, carrot-raisin salad, and clam chowder (24). Nugent (25) reported in 1965 that the "...average student consumes a quart of milk daily, enjoys salads, and prefers fresh fruit to sweet desserts" (p. 59). Nugent also reported that college students are conscious of their

vitamin, mineral and calorie intake. In 1967 Einstein and Hornstein (26) conducted a survey which included 50,000 college students across the nation. Results of the survey showed that the best sources for vitamin A were among the most disliked foods.

Research by Guild, Deethardt, and Rust (27) established the fact that the foods served at a particular university food service enabled students, if they made the appropriate choice, to meet the RDA. Further research showed that the students eating in this same food service were indeed, as a general rule, meeting or exceeding the RDA, except for iron intake of women.

The type of food service used also can alter the dietary habits of students. A study by Chilson and Knickerhm (28, 29) compared the nutrient intake of college students on the contract system of food service to students on the a la carte system of service. Results of the research showed that while students under the contract system had a significantly higher intake of most nutrients than did students under the a la carte system, both systems could be favorably recommended. The majority of students preferred the a la carte system.

In 1965, in an effort to determine the nutritional status of the American population, the USDA sponsored a national dietary survey. Results indicated that females ages 9 through 64, were under the recommended allowances for calcium by at least 20 percent. Iron intakes showed to

be 30 percent or more below the recommended amounts except for women 55 - 64. Thiamine intakes were slightly below the RDA for all of the age groups of females (30). These results can be compared with the 1971 preliminary findings from HANES (Health and Nutrition Examination Survey) of the National Center for Health Statistics. This survey reported iron intakes of women as being below the standard used. Calcium, vitamin A, and ascorbic acid were found to be adequate for most of the population (31).

Types of Food Services on College Campuses

There are records of group feeding of college students dating back as far as medieval times. More recent records show that administrators of the early American colleges were responsible for housing and feeding students. In later years, colleges and universities lost interest in student living conditions, leaving this responsibility to sororities and fraternities which at that time had no faculty supervision. The twentieth century however, has brought about a change; colleges and universities now recognize their responsibility to the students' total well-being and take an interest in providing students with satisfying living and eating conditions (32).

When student complaints about food service at Wartburg college, Iowa, became frequent, the administration set up a committee of students to meet with the food service

administration. Menus were submitted to the committee by the administration and the students made suggestions to the food service. A professional food service director and chef were hired and more money was allotted for food service. This money was used to purchase higher quality food and for the first time, seconds were offered to students (33).

Another variation of style of food service was at Fairleigh Dickinson University, New Jersey, where students were issued tickets which entitled them to 21 meals per week. Students ate the pre-planned meal or chose what was desired from the counter, up to a certain cash limit. A Sunday brunch buffet was served to give students a break from the normal routine--table cloths and water goblets were used and flowers decorated the tables. This procedure reportedly gave "student morale a lift" (2).

At the University of the Pacific, Stockton, California, all residents were required to purchase a meal ticket, but meals could be obtained in the residence dining halls or at the campus snack bar (34). On the other hand, students at Union College, Lincoln, Nebraska, purchased all of their meals on an a la carte basis (28).

It was reported in 1972 that the University of Massachusetts had initiated a food service program which provided students with a "basic foods" dining hall. The "basic foods" concept was defined by the university as being:

> ... primarily vegetarian but with enough latitude to accommodate those vegetarians who feel that eggs, fish and poultry fit into their food consumption patterns (35, p. 52).

About the same time, the University of California at Santa Cruz initiated a health food program in which 50 of the 1,700 boarders were eating health foods exclusively, while more than 300 students were mixing health foods with standard fare (35).

Even more recently than the health food programs, Mount Royal College in Calgary, Canada, designed its eating areas to "...duplicate what students patronize off campus...." (36, p. 40). Students were consulted while the system was being planned and will continue to be consulted. The facilities consisted of:

> ...a mix of seven boutique operations, two traditional buffets, and a forum that could be converted to a banquet hall. Environments range from plush to rustic, from traditional to mod. The combined menus offer everything from an ice cream bar to a seven course banquet.... (p. 40).

Another example of a new style of food service was found at a university where three previously unoccupied fraternity houses were converted into three separate food service buildings. Students paid for the meals with cash or with meal coupon books and had a choice of eating in a standard cafeteria and snack bar, a delicatessen and grill combination, or in the third facility which offered a fixed rate lunch and dinner with unlimited seconds (37).

CHAPTER III

METHOD AND PROCEDURE

The general idea for this research was suggested by Mrs. J. S. Pattillo, assistant to the Director of Residence Hall Food Services at O. S. U. Mrs. Pattillo indicated that there had been no study (other than student acceptance) made of the continuous food service system since its introduction two years ago.

Sample

The population for this study was the female dormitory residents at O. S. U. The sample was drawn from students enrolled in a beginning nutrition class, FNIA 1112. The majority of the students enrolled in the class were in the College of Home Economics, while a small percentage of the students were in other colleges on the O. S. U. campus.

Collection of Data

All FNIA 1112 students (general semester enrollment was about 280 students) were required to do a self dietary intake study for which a two-day dietary record was maintained. A computer print-out sheet for each student reported the total nutrient intake for each individual for

the two days recorded. (A sample of this class assignment is found in Appendix A.) The computer print-out sheets for female dormitory residents provided the author with the necessary information for studying the nutrient intakes of female students in the non-continuous and continuous food service systems. (A sample print-out sheet is found in Appendix B.) Information relating to the sex of the individual was obtained from the print-out sheets while the information regarding the year in school was acquired from class roll sheets. A list of dormitory residents during the school years 1971 - 1972 and 1972 - 1973 was obtained from the O. S. U. Housing Office. A comparison of the housing office list with FNIA 1112 class roll lists for the same years identified students living in the dorm at the time they were enrolled in the course. The course instructor indicated the place of residence of each student on the print-out sheets for the school year 1973 - 1974. (All of the subjects used in this research project were enrolled under the same instructor.) The sample included 58 from the fall semester 1971 and 55 from the spring semester 1972; totaling 113 samples for the non-continuous food service system. There were 49 samples taken from the enrollment of fall semester 1972, 51 from the fall semester 1973, and 80 from the spring semester 1974; totaling 180 samples for the continuous food service system.

Analysis

Two computer cards, one for each day of the dietary intake, were used for each individual. The total nutrient intake information from the computer print-out sheets was put on the computer cards. The nutrients which were analyzed were: calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. An analysis of variance was used to test the hypothesis that there will be no significant difference with regard to nutrient intakes, between female dormitory residents who ate in a non-continuous food service and those who ate in a continuous food service system. A statistical analysis system (SAS) from North Carolina State University[1] was used for computing the analysis of variance.

The mean intake of each nutrient was determined and the *t* test was used to test the hypothesis that the availability of a nutritionally adequate diet does not indicate a nutritionally adequate diet was consumed. Calories and protein were expressed as a percentage of individual calculated needs for the testing of this hypothesis.

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[1] *Statistical Analysis System* (Copyright Institute of State, Raleigh Division, 1972).

CHAPTER IV

RESULTS AND DISCUSSION

Two hypotheses were tested in this study. The first one was that there will be no significant difference, with regard to nutrient intakes, between female students who ate in a non-continuous food service system and female students who ate in a continuous food service system. The second hypothesis was that the availability of a nutritionally adequate diet does not necessarily indicate a nutritionally adequate diet will be consumed.

Statistically, the first hypothesis was tested by analysis of variance using the F test, while the t test was used to examine the second hypothesis. Data for the study was collected from two-day dietary intake records kept by students in the beginning nutrition class at Oklahoma State University. There were 113 samples from non-continuous food service and 180 samples from continuous food service. The Recommended Dietary Allowances (RDA), Revised 1968, for females, age group 18 - 22, was used as the standard of nutrient allowances. (See Table I.) The mean intakes of each nutrients of all samples are presented in Table I.

TABLE I

RECOMMENDED DAILY DIETARY ALLOWANCES REVISED 1968, AND MEAN INTAKES OF OKLAHOMA STATE UNIVERSITY DIETARY STUDY FOR FEMALES, 18 TO 22 YEARS

Class	Calories	Protein mg.	Iron mg.	Vitamin A I.U.	Thiamin mg.	Ribo-flavin mg.	Niacin mg.	Ascorbic Acid mg.	Calcium mg.
Recommended	2000	55	18.0	5000	1.00	1.50	13.0	55	800
Non-continuous Food Service	1802	80	11.0	4997	0.94	1.72	14.3	93	860
Continuous Food Service	1806	77	10.9	4754	1.02	1.64	13.7	103	803
Overall Means	1805	79	10.9	4848	0.99	1.67	13.9	99	825

Analysis of Variance of the Two Food Service Systems

In order to determine possible differences between non-continuous and continuous food services an F test was run from the mean square values obtained from the analysis of variance tables. The sum of squares was partitioned into systems, persons within systems, and days within persons. The calculated F value for each nutrient was less than the tabulated F value at the .05 level of significance. (See Table II.) Therefore, the null hypothesis that there would be no significant difference in nutrient intakes between the two systems can not be rejected.

One possible explanation for this outcome could be that the majority of college age women are weight conscious; the students were satisfied with the amount of food available under the non-continuous system and although there was unlimited food under the continuous system the students simply did not choose to eat more.

The study by Chilson and Knickrehm (28, 29) showed that students under a contract system had significantly higher nutrient intakes than did students under an a la carte system. These results related to the results of a survey at the University of Hawaii which showed that students were more likely to eat meals when there was no exchange of money over the counter (21). These two studies may have implications for the present research

TABLE II

CALCULATED F VALUE FOR NUTRIENT INTAKES IN AN OKLAHOMA STATE UNIVERSITY DIETARY STUDY

Variable	Calculated F Value
Calories	0.006
Protein	1.243
Iron	0.078
Vitamin A	0.257
Thiamin	3.111
Riboflavin	1.168
Niacin	1.180
Ascorbic Acid	1.723
Calcium	1.498

The calculated F values must be greater than 3.84 to be significant at the 0.05 level.

in that the non-continuous and the continuous food service systems were both contract systems where no money was exchanged over the counter. Therefore, any influence money had on the students' eating patterns would not have varied between the two systems studied in this research project.

A third possible explanation for not being able to determine a significant difference between the systems, could be the influence on the students of keeping a dietary record. It is possible that students under both systems were particularly careful of their eating habits when they knew everything they ingested had to be recorded and turned in to their nutrition instructor.

Nutrient Intakes Compared With the RDA

Table III presents the results of the t test comparing the nutrient intake with the RDA. Because of the number of t tests run, the .01 significance level was used to minimize Type I errors. The hypothesis tested was that the mean intake of each nutrient was equal to the RDA for that nutrient, as opposed to the alternate hypothesis that the mean was not equal to the RDA. The following formula was used to test the hypothesis:

$$t = \frac{\bar{x} - RDA}{s_{\bar{x}}}$$

TABLE III

THE t TEST AT 0.01 LEVEL FOR HYPOTHESIS THAT MEAN INTAKE EQUALS THE NATIONAL RESEARCH COUNCIL RDA (TWO TAIL TEST)

Class	Calories	Protein mg.	Iron mg.	Vitamin A I.U.	Thiamin mg.	Ribo-flavin mg.	Niacin mg.	Ascorbic Acid mg.	Calcium mg.
Non-continuous Service	t=6.035 p <.0001 Under	t=7.790 p <.0001 Over	t=18.25 p <.0001 Under	t=0.008	t=1.591	t=3.640 p <.0003 Over	t=2.892 p <.0040 Over	t=6.851 p <.0001 Over	t=1.646
Continuous Service	t=6.602 p <.0001 Under	t=9.108 p <.0001 Over	t=23.49 p <.0001 Under	t=0,827	t=0.825	t=2.841 p <.0045 Over	t=1.911 (p <.056)	t=10.76 p <.0001 Over	t=0.107
Overall Means	t=9.071 p<.0001 Under	t=12.095 p<.0001 Over	t=29.75 p<.0001 Under	t=0.653	t=0.338	t=4.480 p<.0001 Over	t=3.274 p<.0042 Over	t=12.69 p<.0001 Over	t=1.106

$t_{.01} = 2.576$

Where: $\bar{x}$ = mean

$s_{\bar{x}} = \sqrt{\frac{\text{mean square within persons}}{n}}$ = pooled variance

n = number of observations

Vitamin A, thiamin, and calcium were not significantly different from the recommended allowances in either of the food service systems. Niacin intakes were not significantly over or under the RDA in the continuous food service although intakes were significantly over in the non-continuous food service and in the overall mean. (Table III) Niacin intakes in the continuous food service were close to being significantly over the RDA, which would explain the significance on the overall basis. Riboflavin and ascorbic acid were both significantly over the RDA in both food services. Iron intakes, on the other hand, were significantly under the RDA. The recommended amounts for calories and protein had been previously calculated by each person to meet their individual bodily needs and were recorded on the dietary intake reports. For this reason, calories and protein were expressed as percentages of the calculated individual needs. Both proved to be significantly different from the calculated amounts at the .0001 significance level. However, calories were shown to be under, while protein was significantly over, the calculated needs.

The results of this part of the study contrast those of Einstein and Hornstein (26) who indicated that foods high in vitamin A were the least liked foods among college

students. The findings of this research showed that the students studied ate sufficient vitamin A foods to receive the RDA for that nutrient. Leafy green and yellow vegetables are excellent sources for vitamin A and in more recent years college students have had a greater interest in eating vegetables than they have in the past. This could, at least in part, be the reason for the difference in results from Einstein's 1967 study and this research which used students enrolled from 1971 to 1974.

Bennett (3) suggested that college students' diets are generally low in calcium and ascorbic acid due to a lack of nutrition education. In direct contrast to Bennett's findings, the O. S. U. study showed students ingesting an amount of ascorbic acid significantly over the RDA while calcium was not significantly different from the RDA. These differences in results could possibly be due to the fact that the students in the O. S. U. research were enrolled in a nutrition class at the time of the study. Bennett also reported a lack of iron in students' diets which does agree with results of this study. Guild, Deethardt and Rust (27) showed that students were, as a general rule, meeting or exceeding the RDA except for iron. Their results do not completely agree with results of this study because the O. S. U. students were low in calories as well as iron.

The findings of this study agree with the statement by McKenzie and Yuakin (5) that the availability of

nutritionally desirable foods does not mean people will eat these foods. Although the students in this study did eat enough nutritionally desirable foods to attain the RDA for most of the nutrients, they did not eat sufficient amounts of foods which are high in iron. They also failed to eat sufficient amounts of foods to meet the caloric requirements. McKenzie and Yuakin have suggested that social factors and advertising affect food choices. These two factors could very well be the cause of the low caloric intake of the students in this study. Advertising and the American society seem to impress people with the importance of keeping thin and dieting. For most people, it is difficult to meet the RDA for iron because those foods which are high in that nutrient are not well liked by the general population. With a low intake of calories there could be more likelihood of these disliked foods being eliminated from the diet.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this research was to study the nutrient intake of female students who ate in a non-continuous or a continuous type of food service system at Oklahoma State University. The following nutrients were considered: calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid.

Two-day dietary intake records, kept by FNIA 1112 students were used to obtain the data. There were 113 samples for the non-continuous system from the school year 1971 - 1972. There were 180 samples for the continuous food service system from the fall semester 1972 and the school year 1973 - 1974.

Analysis of variance was used to test the hypothesis that there would be no significant difference with regard to nutrient intake between the two systems. Results of the test showed that the hypothesis could not be rejected for any of the nutrients at the .05 level of significance.

The t test was used to compare the mean intake of each nutrient with the Recommended Dietary Allowances of the National Research Council (RDA). Iron and calories proved to be the only factors which were significantly

under the recommended amounts at the .01 level of significance. Results showed protein, riboflavin and ascorbic acid to be significantly over the RDA in both food service systems at the .01 significance level. All other variables were not significantly different from the RDA in both food service systems with the exception of niacin. Within the non-continuous system, niacin was significantly over the RDA at the .01 significance level.

The results of this study lead to the conclusion that the type of food service, continuous or non-continuous, did not significantly influence the nutrient intakes of female students at O. S. U. This may imply to the food service administration that the style of food service can be altered to meet the needs and desires of students without altering the nutritional intake of students.

It is further concluded from the results of this study that when female students are provided with a nutritionally adequate diet, they generally will not eat a nutritionally adequate diet. This would imply, according to the results of this study, that students need to develop a liking for the foods which are high in iron. Perhaps a more practical application would be for food processors to fortify more of the popular foods with iron. If more iron foods were added to the diets the caloric intake might also increase.

The author found it to be a disadvantage to use previously collected data because the information was

limited. Nevertheless, this particular research would have been impossible without the use of the previously collected data. It is suggested for further research, to study only the current food service system so that the researcher can choose the amount and type of data to be collected. The author also suggests that the subjects record their dietary intake for a seven day period rather than just two days. More days of data for each individual would lessen the error caused by variation within persons. A possible suggestion for further research would be to compare the nutrient intake of nutrition majors with the nutrient intake of non-nutrition majors.

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APPENDIX A

FNIA 1112 DIETARY ASSIGNMENT

FNIA 1112

A. Dietary Study of your food habits for the semester

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

This problem consists of:

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

II. Suggestions for making the dietary study:

a. Pages 12 and 13 of packet
   1. Write the exact amount of food eaten for a typical two-day period (school days, not week-ends) on pages 12 and 13 in this packet.
   2. List all the foods you put into your mouth and swallow.
   3. Include all extras, as butter and jelly for bread; butter or sauce on the vegetables; dressing for salads.
   4. List separately the different foods that compose one diet item. Example - Ham sandwich: 2 slices bread, 2 oz. ham, 1 Tbsp. mayonnaise. Should you select a salad composed of several items, you would list these as 1 lettuce leaf, 1 slice pineapple, 2 Tbsp cottage cheese, etc.
   5. Observe the size of the serving and visualize the amount of food served (tablespoons, cups, slices, etc). List the amount (in household measure) you actually ate, under column heading "amount eaten"
   6. List food as soon as eaten. Preferably at the table. Do not trust your memory.
   7. List code number for each food item from Home & Garden Bulletin #72
   8. Calculate the portion of the amount listed in the Bulletin #72 that you actually ate.
      Example: Frozen orange juice, diluted (code number 298) is listed in Bulletin 72 as 1 cup. If you consume 4 oz. (½c) the "multiple of amount listed" is .5. Always use decimals instead of fractions.
   9. Determine the food group in which each item belongs (following the guidelines pages 7,8,9)

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

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

Example of recording the dietary information.

Food	Bul. #72 Code No.	(a/b) Multiple	(a) Amt. Eaten	(b) Bul. #72 Amt. Listed	Calories
Milk	001	.5/1 =.5	½ cup (.5c)	1 cup	80
Lettuce	205	.25/1=.25	¼ head (.25)	1 head	15
Bacon	077	3/2=1.5	3 slices	2 slices	135
Cantaloupe	263	.25/.5=.5	¼ melon(.25)	½ melon	30

The amount of a serving will be discussed in class. The minimum amount of each kind of food item that will be considered a serving will be listed here for reference according to food groups.

MILK GROUP

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

MEAT GROUP

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

Generally, the amount listed in the Bulletin #72 for beef, pork, lamb, veal, chicken, fish and sausage = 1 serving

Special information

#091 Corned Beef Hash	3 oz. = 1 serving (meat & veg)
#093 Beef & Veg Stew	1 cup = 1 serving (meat, veg. Vit A)
#094 Beef Pot Pie	1 pie = 1 serving (meat, veg, Vit A, cereal
#101 Chicken Pot Pie	1 pie = 1 serving (meat, veg, Vit A, cereal)

#125	Deviled Ham	3 Tbs = 1 serving
#130	Vienna Sausage	5 = 1 serving
#137	Fish Sticks	3 = 1 serving
#140	Oysters	½ cup = 1 serving
#142	Sardines	1.5 oz = 1 serving
#160	Peanut Butter	4 Tbs = 1 serving

VEGETABLE AND FRUIT GROUP

Serving portion based on ½ cup per serving or as normally served.

#199	Cucumber	¼ = 1 serving
#204, 205	Lettuce	¼ head = 1 serving
#240	Tomato	½ medium = 1 serving
#263	Cantaloupe	¼ melon = 1 serving
Juices		1 glass = 1 serving
Dried Apricots, Prunes, Peaches, Dates		1/3 cup = 1 serving

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

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

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

ENRICHED BREAD AND CEREAL GROUP

Bread	1 slice = 1 serving
Cereal, cooked	½ cup = 1 serving
Cereal, dry	1 cup = 1 serving
Brownie	1 = 1 serving
Cookies	3 = 1 serving
Crackers	4 = 1 serving
Cake	1 piece or 1 cupcake = 1 serving
Pie	1 sector = 1 serving
Fruit Pie	1 sector = 1 serving (fruit, cereal)
Custard Pie	1 sector = 1 serving (milk, cereal)

Pecan Pie	1 sector = 1 serving (meat, cereal)
Pumpkin Pie	1 sector= 1 serving (veg, Vit A, cereal)
Pancake	1 = 1 serving
Waffle	1 = 1 serving
Pizza	1 sector = 1 serving (meat, cereal)
Macaroni, cooked	1 cup = 1 serving
Macaroni & Cheese	1 cup = 1 serving (meat, cereal)
Noodles, cooked	1 cup = 1 serving
Rice, cooked	½ cup = 1 serving
Spaghetti	1 cup = 1 serving
Spaghetti & Meat Balls	1 cup = 1 serving (meat, cereal)
Spaghetti - Tomato Sauce	1 cup = 1 serving (meat, cereal)

SOUPS

The soups made with milk	1 cup = 1 serving (milk)
#585 Tomato with milk	1 cup = 1 serving (milk, veg)
#586 Bean with pork	1 cup = 1 serving (meat)
#592 Minestrone	1 cup = 1 serving (veg, Vit A)
#593 Split Pea	1 cup = 1 serving (meat)
#594 Tomato	1 cup = 1 serving (veg)
#595 Vegetable Beef	1 cup = 1 serving (veg)
#596 Vegetarian	1 cup = 1 serving (veg, Vit A)

b. Pages 16 & 17 of packet
   1. Select one day's meals, either page 12 or 13, to be used as a basis for calculating the nutritive value of your diet. Choose the day more representative of your regular eating habits.
   2. Record the food for the complete nutritive analysis on pages 16 and 17, calculating each meal separately.

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

1. Score Card - page 14 of packet.
2. Analysis of nutritive value as outline in Evaluation I and II (pages 15, 18 and 19 of packet).

*Duplicates are included for worksheets.
Please hand in only 1 copy of all pages, but be careful to have nutritive values of foods in the corresponding lines with Code No. preceding each item.
Draw line across page under each item listed.
Carry all figures to the decimal place as shown in Bulletin #72.

COMPUTATION OF YOUR TOTAL CALORIE REQUIREMENTS (Approximation)

Energy expenditure is dependent upon:

1. Internal Work - Basal Metabolism

   a. Body Size
      Change your DESIRED weight _____ lb to kg (2.2 lb = 1 kg). 1._____kg

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

   c. Sex - Females subtract 10% of above figure 3. –_____cal

      Difference 3 from 2 4._____cal

   d. Subtract calories saved while sleeping
      0.1 cal x kg x hr in sleep = cal saved 5. –_____cal

      Total calories for Basal Metabolism 6._____cal

2. External Work - Physical Activity

   Determine the hours spent in light or severe activities

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

   a. Total hrs in light activity _____ hr x 0.792 x _____kg = _____cal

   b. Total hrs in severe activity_____ hr x 1.69 x _____kg = _____cal

   c. Total hrs in sleep _____ hr
      Total hours 24

      Total calories for physical activity 7._____cal

   Total calories for Basal Metabolism 6 and physical activity 7 8._____cal

3. Specific Dynamic Action of Food (SDA) - cost of food intake in energy

   Add 10% of the total calories 8 9. +_____cal

      Estimated daily TOTAL CALORIES 10._____cal

Name _____ Sex _____
Subject No._____ Day 1
Eating Place _____

Name of Food and Description	Code No. (Bul. #72)	Multiple a/b	a Amt. of food eaten	b Amt. listed (Bul. #72)	Calories	Milk	Meat	Fruits & Veg. (All)	Fruits & Veg. Vit A	Fruits & Veg. Vit C	Bread & Cereal
Brkft:											
Lunch:											
Dinner:											
Snacks:											
TOTALS					(Cal.)		(Food Groups)				

- 14 -

AN EVALUATION OF YOUR FOOD HABITS

A. Calculations

1. On pages 9 and 10, calculate the calorie value of the two-day diet and show average: _____cals.

2. At the same time on pages 11 and 12, calculate total nutritive values for one day's food intake. Use Table 2, p 558-579 Bogert.

3. Considering your size, age, sex, and types of activity, determine your estimated calorie needs on page 8 of packet and use throughout study for your RDA for calories: _____cals.

4. Compute your protein needs according to size and age:_____gms. pro.

5. For minerals and vitamins, use Recommended Daily Dietary Allowance, NRC, 1968 (in packet)

6. Using the Four Essential Food Groups, score your diet for the two-day period (p 13 packet).

B. Evaluation of Calories for Energy

1. How does your weight compare with the standard set for your height and build?

Your height: _____ Build: _____ Age: _____

Your weight: _____ Desirable weight: _____

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

C. Evaluation by Rapid Method

1. Compare your food intake with the guide to good eating (Bogert p 16). If your diet is inadequate in any respect, list amount of food in each group that should be added to bring your intake to a perfect score.

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

Name _____

Subject Number _____

Sex _____

FOOD SELECTION SCORE CARD

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

GUIDE FOR SCORING -

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

Part Two - AN EVALUATION OF YOUR FOOD HABITS - CALCULATED

A. Select one day's meals to be used as a basis for calculating the nutritive value of your diet. Choose the day most representative of your regular eating habits. Avoid (as far as possible) meals made up of complicated food mixtures. Use Table 2: Bogert p. 557 - 579.

B. Calculate each meal separately. Total each meal and the entire day.

C. According to your age and sex, record your own nutritional allowances for minerals and vitamins (given in packet). Use your calculated calorie needs from worksheet (p. 8). Protein may be calculated on basis of .9 gm. per kg.

D. Calculate in percentages the nutritive value of this day's diet.

EVALUATION OF YOUR DIETARY ANALYSIS:

1. Place each nutrient in its correct place:

Percentage of R.D.A.		
100+ - 90%	89 - 65%	64% and below

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

3. What foods should have been added to or substituted in the diet to meet the R.D.A.? (Example: Diet inadequate in thiamine. Pork chop substituted for tuna fish salad would provide adequate thiamine.)

4. What have you learned from making this study?

DIETARY SHEET #1

FOOD	Code No.	Multiple a/b	a Amt. of food eaten	b Amt. listed	Calories	Protein Gm	MINERALS Ca Mg	MINERALS Fe Mg	VITAMINS Vit A IU	VITAMINS Thiamin Mg	VITAMINS Ribo-Flavin	VITAMINS Niacin Mg	VITAMINS Vit C Mg
BRKFT:													
Lunch:													
TOTAL FOR PAGE													

DIETARY SHEET #2

FOOD	Code No.	Multiple a/b	a Amt. of food eaten	b Amt. listed	Calories	Protein Gm	MINERALS Ca Mg	MINERALS Fe Mg	VITAMINS Vit A IU	VITAMINS Thiamin Mg	VITAMINS Ribo-Flavin	VITAMINS Niacin Mg	VITAMINS Vit C Mg
DINNER													
TOTALS													
SNACKS													
TOTALS													
TOTALS pg. 17													
TOTALS pg. 16													
TOTALS FOR DAY pg. 16 & 17													
RECOMMENDED ALLOWANCES													
PERCENT R.D.A.													

APPENDIX B

COMPUTER PRINT-OUT OF STUDENT

DIETARY INTAKES

DAY 2 PAGES 12-16 CODE NUMBER 61

RECORD OF FOOD INTAKE

FOOD CODE NO.	AMOUNTS OF SERVING	MULTIPLE OF AMT. LISTED	CALORIES	MILK	MEAT	(FRUIT&VEGETABLE) ALL	VIT.A	VIT.C	BREAD & CEREAL	PROT	CALCM	IRON	VIT. A	THIA	RIBO	NIAC	ASCO
248	150.	1.00	70.	C.0	0.0	1.00	0.0	0.0	0.0	0.	8.	0.4	50.	C.04	0.02	0.1	3.
361	21.	1.00	65.	C.C	C.C	C.C	0.0	0.C	1.00	2.	20.	0.6	0.	0.06	0.05	0.6	C.
284	250.	1.00	135.	C.0	0.0	2.00	0.0	0.C	0.0	1.	8.	0.3	10.	0.05	0.08	0.5	0.
77	15.	1.CC	90.	C.0	C.30	0.0	0.0	0.0	0.0	5.	2.	0.5	0.	0.08	0.C5	C.8	C.
81	85.	1.00	245.	C.0	1.00	0.C	0.0	0.0	0.0	21.	9.	2.7	30.	0.07	0.18	4.6	0.
240	30.	0.15	6.	0.0	0.0	0.15	0.07	0.15	0.0	0.	4.	0.1	246.	0.02	0.C1	0.2	6.
206	25.	0.50	5.	C.C	0.C	0.50	0.0	0.0	0.0	1.	17.	0.3	475.	0.01	0.02	0.1	5.
360	48.	2.00	130.	C.0	C.C	0.C	0.C	0.0	2.00	4.	40.	1.2	0.	0.12	0.10	1.2	0.
523	4.	0.30	3C.	C.0	C.0	0.C	0.0	0.0	0.0	0.	1.	0.0	12.	0.0	0.00	0.0	C.
96	94.	1.00	155.	C.C	1.CO	C.C	0.0	0.0	0.0	25.	9.	1.3	70.	0.04	0.17	11.2	0.
227	98.	0.50	93.	0.0	0.0	1.00	0.0	0.C	0.C	2.	24.	0.4	165.	0.08	0.05	0.9	9.
169	72.	C.30	13.	C.0	C.C	0.60	0.0	0.0	0.0	1.	24.	0.9	207.	0.02	0.03	0.2	3.
197	77.	0.30	51.	C.C	C.C	0.60	0.0	0.0	0.0	1.	3.	0.3	207.	0.02	0.04	0.7	4.
571	120.	0.50	70.	0.0	0.0	0.0	0.0	0.C	0.0	2.	0.	0.0	0.	0.0	0.0	0.0	0.
2	123.	C.5C	45.	C.5C	C.C	0.C	0.0	0.0	0.0	5.	148.	0.0	5.	0.04	0.22	0.1	1.
460	24.	4.00	100.	C.0	C.C	0.C	0.0	0.C	0.0	4.	4.	0.4	0.	0.0	0.0	0.0	0.
562	369.	1.00	145.	C.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.0	0.	0.0	0.C	0.0	0.
TOTALS			1448.	C.50	2.30	5.85	0.07	0.15	3.00	73.	320.	9.5	1477.	0.66	1.02	21.2	31.
RECCMMENDED			2116.	2.00	2.00	2.00	1.00	1.00	4.00	49.	800.	18.0	5000.	1.00	1.50	13.0	55.
PCRTICN			0.68	C.25	1.15	2.92	0.07	0.15	0.75	1.5C	0.40	0.53	0.30	0.66	0.68	1.63	0.56
SCORE				5.	30.	10.	1.	1.	15.	TOTAL POINTS = 62.							

VITA

Lois Tiefel Shirley

Candidate for the Degree of

Master of Science

Thesis: DIETARY INTAKE STUDY OF OKLAHOMA STATE UNIVERSITY STUDENTS PARTICIPATING IN TWO SYSTEMS OF FOOD SERVICE

Major Field: Food, Nutrition and Institution Administration

Biographical:

Personal Data: Born in Culver City, California, March 11, 1951, the daughter of Mr. and Mrs. Joe L. Tiefel. Married to Ralph E. Shirley, August 11, 1973.

Education: Graduated from Culver City High School, Culver City, California, in 1969; completed one year at West Los Angeles College, 1970; graduated from California Polytechnic State University (San Luis Obispo, California) in 1973 with a Bachelor of Science degree in home economics with the dietetics option; studied at Oklahoma State University from 1973-1974 and completed the requirements for the Master of Science degree in December, 1974.

Professional Organizations and Honors: Member of Phi Upsilon Omicron and Cardinal Key honor societies.