EFFECT OF BREAKFAST EATING ON SCHOLASTIC PERFORMANCE AND BLOOD GLUCOSE LEVELS OF COLLEGE STUDENTS AT OKLAHOMA STATE UNIVERSITY

By

DEBORAH KAY CANTARAL

Bachelor of Science in Education

Indiana University of Pennsylvania

Indiana, Pennsylvania

1977

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
December, 1982

EFFECT OF BREAKFAST EATING ON SCHOLASTIC PERFORMANCE AND BLOOD GLUCOSE LEVELS OF COLLEGE STUDENTS AT OKLAHOMA STATE UNIVERSITY

Thesis Approved:

N. Sue Knight
Thesis Adviser

B. K. Kopelle

Joan Baird

Dean of the Graduate College

ACKNOWLEDGMENTS

In thinking back over this past year, I began to realize that there is a long list of people to whom gratitude should be expressed for their assistance and support. Though the contributions given by all these people are to numerous to mention here, they have been greatly appreciated. To them I wish to extend my thanks.

Specifically, I wish to express deep gratitude and indebtedness to Dr. Sue Knight for the guidance and the assistance she unselfishly gave to me from the beginning through the completion of this research project. I am also grateful to Dr. Esther Winterfeldt for her invaluable comments and suggestions given during the developing stages of this research. Greatest appreciation is expressed to Dr. Bernice Kopel and Dr. Joan Baird for their willingness to serve as advisory committee members.

Acknowledgments go to Dr. David Weeks for his assistance and for the development of the statistical program. Also a note of thanks to Mrs. Nancy Cessney for faithfully performing the weekly blood glucose tests.

A special thanks is given to the students enrolled in Science of Food Preparation, Spring 1982, for consenting to take part; without you, the research would not have been possible. I also wish to express gratitude for the financial funding which was appropriated by the Home Economics Research Fund at Oklahoma State University and provided by the State of Oklahoma.

I sincerely thank Mrs. Sandi Ireland for her patience and expertise in typing the thesis. Also thanks to both secretaries of the Food and Nutrition Institution Department; Mrs. Shirley Bahm for her assistance in many matters to numerous to mention here and Mrs. Vickie Martinez for typing the class quizzes.

Heartful appreciation is expressed to Mrs. Marie Oltmanns for providing me a home away from home, and for the tender loving care and friendship she bestowed upon me throughout this year of graduate school.

Praise be to God whose love, strength, and everlasting faithfulness was always available when needed.

This research is dedicated to my husband, Mark, whom I love deeply. His love, patience, encouragement, and support made this achievement possible.

TABLE OF CONTENTS

Chapter		Page
I.	INTRODUCTION	1
	Statement of Problem	3
	Objectives	3
	Hypotheses	4
	Limitations	4
	Assumptions	5
	Definition of Terms	6
II.	REVIEW OF LITERATURE	8
	Testing the Effect of Breakfast on Physiological Performance	8
	Description of Tests Used to Measure Physiological Performance	9
	Effect of Eating and Omitting Breakfast on Physiological Performance	10
	Breakfast and Blood Glucose	15
	Breakfast, Behavior, and Learning	18
	Review of Public School Breakfast Programs	20
	Effect of Fasting on Learning	20
	Breakfast Habits of College Students	21
	Blood Glucose Determination Using the Glucometer Reflectance Photometer	22
	Summary of Review of Literature	25
III.	METHOD AND PROCEDURES	26
	Description of FNIA 3133	26
	Breakfast Study	27
	Blood Glucose Study	29
	Weekly Quizzes	31
	Student Evaluation	32
IV.	RESULTS AND DISCUSSION	33
	Quiz Scores Received With and Without Breakfast	33
	Analysis of Variance of the Two Breakfast Regimens by Class	34
	Analysis of Variance of the Two Breakfast Regimens by Individual Students	34

Chapter Page

Analysis of Variance of the Two Breakfast Regimens by Individual Quizzes. 35
Blood Glucose Levels With and Without Breakfast. 40
Blood Glucose Levels and Quiz Scores 42
Breakfast Survey 42
Student Evaluation 44

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 47

Summary. 47
Conclusions. 49
Recommendations for Further Research 50

SELECTED BIBLIOGRAPHY. 53

APPENDIXES 57

APPENDIX A - RESULTS AND FORMS USED FOR THE STUDY OF THE TWO BREAKFAST REGIMENS 58

APPENDIX B - BREAKFAST SURVEY FORM. 69

APPENDIX C - UNITED STATES DEPARTMENT OF AGRICULTURE NUTRITIONAL SPECIFICATIONS FOR BREAKFAST BAR . . 71

APPENDIX D - RESULTS AND FORMS USED FOR THE BLOOD GLUCOSE PORTION OF THE STUDY 73

APPENDIX E - AN EXAMPLE OF A QUIZ 79

APPENDIX F - STUDENT EVALUATION FORM. 82

LIST OF TABLES

Table		Page
I.	Calculated and Tabulated F Values for Students' Quiz Scores With and Without Breakfast by Individual Quizzes . .	36
II.	Students' Average Blood Glucose Levels and Quiz Scores With and Without Breakfast.	41
III.	Student Evaluation of the Course, FNIA 3133 by Percentage for Spring of 1981 and Spring of 1982	46
IV.	Students' Quiz Scores With and Without Breakfast.	62
V.	Individual Quiz Score Means Ignoring Breakfast Regimens . . .	68
VI.	United States Department of Agriculture Nutritional Specification for Breakfast Bars.	72
VII.	Blood Glucose Levels and Quiz Scores With and Without Breakfast	76

LIST OF FIGURES

Figure Page

1. Bar Chart of Individual Quiz Score Means With and Without Breakfast 37

2. Block Chart of Individual Quiz Score Means With and Without Breakfast 38

3. Results of Breakfast Surveys Given in January and Repeated in May. 43

CHAPTER I

INTRODUCTION

Breakfast skipping is very prevalent among school children, teenagers, and adults (1) (2) (3). Nutritionists and other health-related professionals advocate the importance of breakfast in providing needed energy for the morning activities. Research has been done showing that without breakfast, blood sugar levels drop below the fasting levels, resulting in decreased physical work output and muscular fatigue (4) (5) (6) (7). It has been documented that many people who omit breakfast experience hunger, dizziness, weakness, and headaches as the morning progresses (1) (3).

The adoption of a school breakfast program by many schools across the nation strongly implies that many in government, as well as educators and parents, feel that breakfast is important for the well-being of children. A variety of studies on the effect of breakfast eating on the behavior of school children have been done. Most of these studies depend on data from teachers' observations or the child's ability to perform psychomotor tasks. Teachers have observed that children who eat breakfast appear to be more alert, steadier, have better concentration, and do more work than children who do not eat breakfast (1) (4). In spite of the widely held belief that there seems to be a correlation between breakfast eating and the child's improved

academic performance, there is little objective data to support these subjective claims.

However, if children's academic performance is hindered by the lack of breakfast, it can not be assumed that this theory is true for adults. Many research studies have been conducted with adults to show there is a correlation between an adequate breakfast and an employee's work efficiency, especially in the late morning hours. Subjects participating in physiological testing showed the omission of breakfast decreased maximum work output, increased neuromuscular tremor, and increased choice reaction time (4) (5) (6) (7). These studies indicate that omitting breakfast does affect physical performance.

Does omitting breakfast have a similar affect on adults' mental performance? Although not concerning breakfast, per se, a six-month study was conducted to determine the effects of a semi-starvation diet, approximately 1500 Calories, on men (8). During this study, tests were given to assess intellectual performance. The results indicated that intelligence did not significantly decrease during the semi-starvation phase, but there was a decrease in the subjects' desire to engage in mental tasks and their capacity for mental application.

Although intelligence in adults does not seem altered by inadequate nutrition, it does seem possible that hunger caused by a fast of short duration could interfere with mental performance. Since claims have been made that breakfast eating improves mental performance, an attempt should be made to support or refute such claims. This study attempts to address and answer the question, does breakfast eating improve adults' mental performance.

Statement of the Problem

Often the spacing of meals is arranged for convenience rather than to meet the body's need for energy. Lack of time in the morning encourages many people to skip breakfast. The omission of breakfast reportedly causes hunger, dizziness, headaches, and decreases physical work output. Observations of children's academic performance with and without breakfast has lead educators and health professionals to believe that breakfast skipping also hinders mental performance.

With little objective data, health professionals have made claims that breakfast eating will improve not only children's mental performance but that of teenagers and adults, too. Therefore this study was conducted to determine if there is a relationship between breakfast eating and the academic performance of college students in the morning as reflected by quiz scores. Students enrolled in the course FNIA 3313, Science of Food Preparation, were the subjects. Also blood glucose levels were determined each Friday on nine participants from the class to determine if a relationship exists among blood glucose levels at quiz time, breakfast eating, and students' quiz scores.

Objectives

The objectives of the study are:

1. To determine if there is a relationship between breakfast eating and the academic performance of college students as reflected by quiz scores.
2. To determine if there is a relationship between breakfast eating and blood glucose levels in college students.

3. To determine if there is a relationship between blood glucose levels and the academic performance of college students as reflected by quiz scores.
4. To determine if college students' attitudes toward breakfast eating and its effect on academic achievement has changed at the conclusion of this study.
5. To determine if a higher percentage of college students ate an adequate breakfast at the conclusion of this study than at its beginning.
6. To formulate suggestions and recommendations for future studies.

Hypotheses

For this study the following null hypotheses are postulated:

H_1: There will be no significant difference in students' quiz scores when students enrolled in the course FNIA 3313, Science of Food Preparation, eat an adequate breakfast and when they do not eat breakfast.

H_2: Blood glucose levels at quiz time for nine students enrolled in the course FNIA 3313, Science of Food Preparation, will not be significantly higher when they eat an adequate breakfast and when they do not eat breakfast.

H_3: The coefficient of correlation between the blood glucose levels and quiz scores of the nine students enrolled in the course FNIA 3313, Science of Food Preparation, will be zero.

Limitations

The limitations of this study are recognized as:

1. As the semester progresses the student may become accustomed to the type of quiz given.
2. All quizzes given throughout the semester may not be of equal difficulty.
3. The students' tests or assignments in other classes may interfere with their studying for the quiz and may affect their quiz scores.
4. The lecture presentation and laboratory assignments may not be equally effective in covering each week's class topic(s).
5. Other factors, such as minor illnesses, insufficient sleep, personal motivation, or emotional stress may affect quiz scores.

Assumptions

The assumptions of the study are:

1. All the student responses given on the weekly questionnaire as to whether they have or have not eaten breakfast are truthful.
2. Since the course FNIA 3133, Science of Food Preparation, is an upper level course, all the students enrolled in the course are capable of learning the material.
3. A difference in mental performance as reflected by quiz scores will be apparent even when the students only have to follow a certain breakfast regimen one day each week.
4. What the students eat at meals other than breakfast will not directly affect their quiz scores.
5. Having a blood glucose determination made just prior to test time will not affect the quiz scores of the students who participate in this part of the study.

Definition of Terms

In this study when the following words are used their meaning was defined as stated:

Breakfast - A meal eaten between 7:00 a.m. and 9:00 a.m. which consists of a minimum of foods from three of the four basic food groups and 15 grams of protein.

No Breakfast - No caloric food or beverage was consumed by the subject from the time he had arisen until after he had taken his quiz at 9:30 a.m.

Partial Breakfast - Any food eaten from the time the subject arose until after taking the quiz at 9:30 a.m. which contained less than prescribed by the above definition of breakfast but contained more food than prescribed by the above definition of no breakfast.

Knowledge Level Quiz Statements - Multiple choice statements that were written so that the student had to recall or recognize the subject matter taught in the course in order to choose the correct answer (9).

Comprehension Level Quiz Statements - Multiple choice statements that were written so that the student had to translate, interpret, or extrapolate the material taught in the course in order to choose the correct answer (9).

Application Level Quiz Statements - Multiple choice statements that were written so that the student had to apply principles and generalizations taught in the course in order to choose the correct answer (9).

Glucose - A monosaccharide ($C_6H_{12}O_6$) also known as dextrose found in the blood. It is the product of carbohydrate metabolism and is the chief source of energy for living organisms (10).

Blood Glucose Levels or Blood Sugar Levels - The amount of glucose measured in milligrams in 100 milliliters (one deciliter) of blood.

CHAPTER II

REVIEW OF LITERATURE

Emphasis on the importance of breakfast in mental performance is widespread, but not as much research had been done in this area as one might expect. Often the studies involved children as subjects with little data on other age groups. The effect of breakfast on physiological performance was better documented than on mental performance. Some studies had subjective but no objective data. This review of literature covered the scientific work done concerning the effect of breakfast on behavior and learning, blood glucose levels and physiological performance.

Testing the Effect of Breakfast on Physiological Performance

Many scientists studied the effect of eating breakfast on physiological performance. The tests chosen to compare the effect of eating or omitting breakfast and the effectiveness of breakfasts on different kinds of physical efficiency included: (1) simple reaction time, (2) choice reaction time, (3) neuromuscular tremor, (4) maximum work rate, and (5) maximum work output.

Description of Tests Used to Measure Physiological Performance

The simple reaction time was the amount of time measured in milliseconds which elasped between the appearance of a light stimulus and the response of the subject (11). Simultaneously when a light flashed, a chronoscope was started. The subject responded by pressing a switch as quickly as possible which stopped the chronoscope, and the elapsed time was recorded.

The choice reaction time was similar to the simple reaction time test except the element of choice was introduced (11). A bank of lights was used instead of just one light. The subject was instructed to respond to only one particular light though any or all of the five lights might flash. Again the reaction time was recorded in milliseconds by use of a chronoscope.

Neuromuscular tremor magnitude measured static tremors (11). The static tremor was measured from the index finger of the subject's arm which was outstretched and only supported by voluntary resistance against the force of gravity. The tremor from the finger was picked up by a strain guage, amplified, and the voltage recorded.

The maximum work rate and maximum work output were measured by the use of a bicycle ergometer which recorded the amount of work accomplished in terms of volts every five seconds (11). The maximum work rate was defined as the greatest voltage that was recorded while a subject rode the bicycle ergometer. Maximum work output was calculated by averaging the recorded voltage readings.

Effect of Eating and Omitting Breakfast on Physiological Performance

Tuttle, Daum, Myers, and Martin (12) studied the effect of omitting breakfast on the physiological response to ten college men. For a period of three weeks data was collected from each man with and without breakfast for the following tests: neuromuscular tremor, maximum work output, and choice reaction time. The men were fed a basic breakfast which contained one-fourth of their daily nutritional needs. For the majority of the men the omission of breakfast increased tremor magnitude, decreased work output, and decreased choice reaction time. Some of the men felt fatigue, were dizzy, felt nausea, and vomited after completing the test for work output when they skipped breakfast.

Tuttle and Herbert (5) recorded data on the effect of omitting breakfast and a mid-morning break on factory employees' work output. Ten women and men who held various types of jobs in the factory participated in the study. The treatments used included:

1. Basic breakfast - included one-fourth of the daily needs of protein and calories, but no mid-morning break.
2. No breakfast - ate nothing after 6 p.m. until lunch time the following day.
3. Breakfast plus a mid-morning break - the subjects ate a basic breakfast and participated in a mid-morning ad libitum snack break.
4. No breakfast plus a mid-morning break - the subjects ate no breakfast but participated in a mid-morning ad libitum snack break.

Riding a bicycle ergometer for 30 seconds was the technique used for measuring work output. In all cases the work output was greater with breakfast. In only one instance did the addition of a mid-morning break with breakfast increase work output. When the workers skipped breakfast but were given a mid-morning break, half of them did more work than when they omitted breakfast without a mid-morning break. The data indicated that having an adequate breakfast was more efficient in maintaining employees' work output during the late morning hours than the substitution of a mid-morning break for breakfast.

Daum, Tuttle, Martin, and Myers (6) compared the effect of various types of breakfasts on the physiological responses of ten university women. The different breakfasts the women received were adapted from a basic breakfast which included cereal, milk, bread, fruit, and contained 20 grams of protein and 600 Calories. The breakfast adaptations the women received for five-week periods each were (1) heavy breakfast containing 30 grams of protein and 1000 Calories, (2) light breakfast containing 10 grams of protein and 300 Calories, (3) no breakfast, (4) black coffee only, and (5) basic breakfast with coffee. The physiological responses tested were neuromuscular tremor, maximum work output, and choice reaction time. There was no difference between neuromuscular tremor or choice reaction time when the subjects ate a heavy or light breakfast. The physiological reactions of the subjects were also compared between the omission of breakfast and a basic breakfast. The results showed there was a difference between a basic breakfast and no breakfast. All subjects had increased neuromuscular tremor, decreased maximum work output, and shorter reaction times when they omitted breakfast. When the subjects had only black coffee instead of nothing

for breakfast, their tremor magnitude increased, work output decreased, and six subjects had increased choice reaction times. For the majority of the students, the addition of a basic breakfast with the coffee resulted in decreased neuromuscular tremor, greater work output, and in all cases significantly decreased choice reaction times.

Six healthy female workers participated in a study conducted by Tuttle, Wilson, and Daum (7) to determine the effect of breakfast habits on maximum work output, simple and choice reaction times, and neuromuscular tremor. Maximum work output was determined by use of a bicycle ergometer while the subject rode it for one minute. The following breakfast regimens were used in this experiment: (1) heavy breakfast, (2) light breakfast, (3) coffee only, and (4) no breakfast. The omission of breakfast resulted in decreased maximum work output, increased simple and choice reaction times, and increased tremor magnitude in the women. When the data obtained after eating a breakfast, either light or heavy, was compared with the coffee only regimen, the majority of the subjects increased their maximum work output and their tremor magnitude was significantly less in all cases. Choice reaction times were increased when the women ate a heavy breakfast or drank only coffee, however; the consumption of a light breakfast decreased their reaction times.

Tuttle, Daum, Imig, Martin, and Kisgen (13) studied the effects of four different types of breakfast on performance of ten young men. The various breakfasts used in the experiment were (1) a basic cereal breakfast containing 25 grams of protein and 750 Calories, (2) breakfast similar in protein and calories but composed of bacon and eggs, (3) a heavy cereal breakfast containing 38-40 grams of protein and 1200

Calories, and (4) similar heavy bacon and egg breakfast. The ten men were divided into two equal groups; then the groups were rotated on the four breakfast combinations. When the subjects ate either the basic cereal or basic bacon and egg breakfast, their physiologic responses on tests measuring magnitude of tremor, choice reaction, and maximum work output were similar. The same results were obtained when physiologic responses were compared after the consumption of a heavy cereal and heavy bacon and egg breakfasts. Results of tremor magnitude or choice reaction time were similar after the ingestion of a 750-Calorie breakfast compared to a 1200-Calorie. Seventy-five percent of the men, however, increased their work output when they ate the basic breakfast instead of the heavy one, regardless of whether the breakfast was built around bacon and eggs or cereal and milk.

Daum, Tuttle, Larsen, Roloff, and Salzano (14) collected data from ten boys age 12 to 14 to determine the effect of the size and content of breakfast on the physical efficiency in the late morning hours. The boys were divided into two groups and put on a rotating schedule of four different breakfast meals. The morning meals consisted of (1) basic cereal and milk breakfast containing one-fourth of the daily requirements of each individual, (2) similar breakfast built around eggs and milk, (3) a similar breakfast built around both plant and animal protein, and (4) a mixed heavy breakfast which provided 40 percent of the daily requirements. Records of the boys' performances on maximum work rate, maximum work output, neuromuscular tremor magnitude and choice reaction time were kept. Comparison of the data revealed there was no difference in the boys' physiologic responses studied after the consumption of the various breakfast meals.

In another study of boys aged 12 to 14 years (4), it was found that the maximum work output and maximum work rate were significantly less in the late morning hours when the boys omitted breakfast. The choice reaction time and the magnitude of neuromuscular tremor, however, were not affected if the boys did not eat breakfast.

Nutritional levels in breakfast sufficient to maintain students' physical and psychological function were investigated by Morrell and Atkinson (15). Thirty-four males and 18 females, all elementary school age children, were divided into four treatment groups of 13 students each. Two groups were fed a Type A breakfast containing approximately 11 grams of protein. The other two groups received a similar breakfast except it contained about 24 grams of protein. During the late morning hours, the students' behavior and attitude were observed; and they also participated in a battery of tests to measure task performance. For each breakfast regimen, one group was given a pre- and post-test, while the other group received only a post-test. Comparison of the data from the test results showed the students performed equally well after ingesting either breakfast. The researchers felt the Type A in which protein content varied between 8 and 16 grams had enough protein to maintain student task performance in the late morning hours.

Mann (16), after analyzing hundreds of accident cases at an ordnance depot, discovered the greatest number of accidents occurred the hour before lunch. Since the workers needed to get up between 5 and 6 a.m. to arrive at work on time, he felt the omission of or an inadequate breakfast was a cause of the increase in accidents during the late morning hours, but the data did not allow actual comparison of accident levels and breakfast omission.

Ingoldsby (3), an industrial nurse, reported that employees who visited the dispensary in the morning complaining of vague aches and pains usually had not eaten breakfast. In investigating her theory that there was a correlation between an adequate breakfast and workers' efficiency, Ingoldsby discovered that the employees who visited the medical department seldom or never gave a history of eating an adequate breakfast everyday. Reports of the working habits of the men showed workers who omitted or ate a poor morning meal generally did not perform as well as those who ate a good breakfast. Employees who skipped breakfast were found to be chronic complainers.

Breakfast and Blood Glucose

A study was conducted by Conway (17) to determine the effect of two different types of breakfast on college students' blood sugar levels. Both breakfasts consisted of a similar amount of fat and calories but varied in the quantity of protein and carbohydrate. The students' blood glucose concentrations were measured two, three and four hours after eating breakfast. When the subjects ate a breakfast high in carbohydrate (67 grams) and low in protein (5 grams), their serum blood sugar increased from an average fasting level of 106.2 mg/dl to a high of 128.2 mg/dl after two hours and then decreased rapidly to 104.5 mg/dl at the end of four hours. After consuming a breakfast high in protein (25 grams) and lower in carbohydrates (34 grams), the students' blood glucose levels peaked at 114.7 mg/dl and returned to 106.7 mg/dl at the end of four hours. The rapid fall in the participants' blood sugar when fed the high carbohydrate breakfast was associated with hunger. The students did not experience hunger after eating the high protein breakfast.

Coleman, Tuttle, and Daum (18) reported on the effect of the protein source in maintaining blood sugar levels after breakfast. Their subjects, both men and women, were fed breakfasts similar in the amount of fat, protein, and carbohydrate; but the source of the protein was different. One breakfast contained 95 percent animal protein while the other breakfast consisted of 100 percent plant protein. The researchers found that both breakfasts were equally effective in keeping the subjects blood glucose concentrations above the fasting levels for three and one-half hours.

Bryant, Martin, Schumacher, Daum, and Tuttle (19) made comparisons of blood sugar levels at 30 minute intervals for three and one-half hours between college men and men over 60 years of age after the men had eaten a breakfast containing 25 grams of protein and approximately 750 Calories. In both groups the men's blood sugar levels remained above their fasting levels for the entire three and one-half hour experimental period. When these men were fed a morning meal with only 10 grams of protein but with adequate calories, their blood sugar concentrations fell below the fasting levels at the three hour sampling interval and continued to drop during the rest of the experiment.

A similar experiment was done with breakfast providing 15 grams of protein by Addison, Tuttle, Daum and Rosemary (20). The subjects used were 14 adult women. These women were given two similar breakfasts, except one contained plant protein and the other animal protein. After eating either breakfast, the group's mean blood sugar levels rose to 160 mg/dl after 30 minutes, decreased to below fasting levels, but returned to fasting levels at the end of three and one-half hours. The researchers felt 15 grams of protein for breakfast is the least

amount of protein one should ingest to maintain blood sugar levels in the late morning hours, in either animal or plant protein breakfasts.

Orent-Keiles and Hallman (21) monitored blood glucose levels while studying the effect of different types and sizes of meals on the physiological reactions of women. When the breakfast consisted consisted of only black coffee, there was no rise in the subjects' blood sugar above the fasting levels. Instead their blood sugar fell progressively below the fasting levels during the three-hour monitoring period. The women experienced symptoms of hunger, weakness, and headaches. After eating a breakfast which contained from 9 to 17 grams of protein and from 400 to 500 Calories, there was a rapid increase in blood glucose the first half hour followed by a decrease to normal fasting levels after three hours. When the breakfast protein increased to 22 grams, chiefly by adding milk and eggs, there was a typical rise in their blood sugar, but the return of the blood sugar to the fasting levels was delayed beyond that following the lower protein breakfasts. The subjects reported a sense of well-being and satisfaction after eating the high protein breakfasts.

A study to compare the influence of breakfast between young adults' and teenage girls' blood sugar levels was done by Thorton and Horvath (22). A breakfast containing 35.9 grams of protein and 767 Calories was given to both groups. Both groups had similar fasting blood glucose levels. After ingesting the morning meal, the adults' blood sugar levels were always above their fasting levels; whereas, the teenagers' glucose values dropped below the fasting levels after two and one-half hours and remained below that level for the rest of the six and one-half hour experiment. When the adults omitted breakfast, blood

glucose remained above the fasting levels except for the first hour their blood levels were determined. The teenage girls responded quite differently to the fast; their blood glucose levels were notably below their fasting levels for the entire six hours.

A Canadian study was conducted to determine if the type of breakfast eaten by school children affected their blood sugar levels (23). Four hundred and ninety-four children, 6.5 to 11.5 years of age, served as subjects. Records of foods the children ate for breakfast were obtained by interviewing them individually. If was found that 10 children omitted breakfast, 122 has poor breakfasts, 348 had fair breakfasts, 12 had good breakfasts, and 2 ate excellent breakfasts. Though the children who omitted breakfast had fasted for 12 to 16.5 hours, their blood sugar values were within the normal range (86.2 to 119.8 mg/dl of serum). No relationship was found between the blood sugar levels and the amount or type of food eaten or the interval after eating. The children maintained normal blood sugar levels after 16 hours of fasting.

While trying to establish criteria for diagnosis of hypoglycemia during fasting, Merimee and Tyon (24) discovered there was no difference between men's and women's fasting blood sugar levels in up to 12 hours of fasting.

Breakfast, Behavior, and Learning

It is well documented that intelligence or mental capacity may be altered by malnutrition in the unborn baby, infant, or child; but there is controversy whether erratic meal patterns, such as breakfast skipping, have the same effect on learning (25) (26) (27) (28) (29) (30).

One part of the Iowa Breakfasts Studies was a research project undertaken to answer the question: Does omitting breakfast affect mental performance? The Iowa scientists used seven boys aged 12 to 14 as subjects who ate either a basic 750 Calorie cereal breakfast or ate no breakfast (4). During this experiment the boys were placed on a rigid diet so that the total daily nutrient intake was the same during the basic and no-breakfast periods. The boys' teacher made observations and recorded the academic achievements of the students. The teacher's report showed that a majority of the boys had a better attitude and received higher grades during the period when breakfast was included in their daily diet than when it was omitted. The teacher observed that some of the boys were careless, listless, and inattentive during the late morning hours when they had skipped breakfast. When breakfast was added to the daily dietary pattern these same students showed improvement in attitude and scholastic attainment. Both the teacher and the school principal felt that the boys benefited from eating breakfast in the areas of attitude and academic performance.

Galloway and Robertson (23) found that children's behavior in school was affected by the kind of breakfast eaten. The teachers of 350 school-aged children recorded when their pupils showed or did not show the signs of fatigue, inattention, misbehavior, complaints of headaches, nausea, pain in stomach, crying, or overly emotional behavior. Teachers reported that the children who ate poor breakfasts were not as attentive or active as those who ate fair, good, or excellent breakfasts.

Review of Public School Breakfast Programs

As a result of the inclusion of the school breakfast programs in many schools across the nation, surveys were conducted to determine its impact on the children. Dover (31), a member on the Detroit school breakfast committee, stated that as a result of the participation in the school breakfast program, the teachers felt the students had longer attention spans.

When Hallic and Fleming (32) surveyed 70 teachers in the Cleveland Public School District, 87 percent said the program benefited the students, 31 percent felt the students were more alert and had greater energy, 10 percent said the children had a better attitude in school, and 7 percent said the children's motivation increased.

The Food Research and Action Center (1) collected information nation-wide from school administrators, teachers, school staff, and food personnel about how they felt their respective school children benefited by receiving a nutritious breakfast via the school breakfast program. In Bridgeport, Connecticut, 52 percent of the teachers, coordinators, and principals thought, as a result of the children's eating breakfast, their behavior improved in that they were less restless and irritable. Further, 66 percent said the children's attention span during the morning had increased. In New York state, 416 of the 443 professionals surveyed felt that after the students were provided with a breakfast, they were more alert and attentive.

Effect of Fasting on Learning

Some researchers were not only interested in knowing whether

fasting inhibits mental efficiency but the type of learning process it may effect. Pollitt, Leibel, and Greenfield (33) studied the effects of skipping breakfast on speed and accuracy in a number of problem-solving tasks administered to 9 to 11 year olds in the late morning hours. Thirty-four children were divided into two groups; then, the two groups were rotated on performing the problem solving tasks with and without breakfast. The breakfast consisted of waffles, syrup, margarine, orange juice, and milk (15 grams of protein and 535 Calories). The children in the fasting state answered fewer problem solving questions correctly; however, when unfed, their immediate recal in short term memory improved.

Lapp (34) researched the effect of high blood sugar levels in the recall of low and high imagery nouns. Thirty-six eleventh graders of both sexes with matched academic averages were randomly selected. The students were divided into two groups. One group fasted from 10 p.m. the previous day until after participating in the study. The second group were fed a standard glucose tolerance test preparatory diet. During the testing process the subjects learned a paired-associate list with equal numbers of pairs in each list rated as high or low imagery nouns. Before being tested the students in the fasted state had to have blood glucose values below 80 mg/dl while the fed participants' blood sugar levels needed to be greater than 130 mg/dl. The subjects who had high glucose values had significantly increased recall of both high- and low-imagery paired nouns than did the students who had fasted.

Breakfast Habits of College Students

Research has shown that breakfast habits vary among college

students. Brown (35) had 280 college girls keep dietary records of the foods they ate for one week. During the course of the week the daily percentage of girls who ate breakfast varied from 29 to 75 percent. Jakobivits, Halstead, Kelly, Roe, and Young (36) surveyed the breakfast habits of 195 junior and senior college women. Forty-seven percent of the women never skipped breakfast, 34 percent missed breakfast no more than twice a week, and only 4 percent never ate breakfast. Haseva and Myrtle (37) interviewed college students in Hawaii and reported that 63 percent of the students ate breakfast more than five times each week. On the day surveyed 70 percent of the women and 62 percent of the males had a morning meal. The food habits of freshmen at Oregon State were reported by Young and Stovick (38). Seventy-six percent of the students ate breakfast daily, 15 percent had breakfast one to six times a week, and 9 percent always omitted breakfast. Only 18.9 percent of the breakfasts eaten by the students on the day interviewed were rated good.

Blood Glucose Determination Using the Glucometer Reflectance Photometer

A simplified procedure for determining blood glucose levels, the use of a Glucometer, has recently become available. Before this procedure could be used to obtain scientific data, is was necessary to review the studies that determined its reliability and validity.

The Glucometer quantitatively measures whole blood glucose when used with Dextrostix reagent strips. It is a compact, battery operated, portable, semiautomated machine. As opposed to the standard blood glucose tests that require the drawing of a sample of blood from a vein, the glucometer requires only a single drop of blood from a finger stick.

This instrument, developed for home use by diabetics, is cost efficient and simple to use.

Peterson, Jones, Dupuis, Levine, Berstein, and O'Shea (39) compared the results of determining blood sugar levels in patients between the Ames Eyetone System and an Auto Analyzer. They reported a correlation of 0.91 with blood glucose concentrations between 50 and 200 mg/dl.

The Dextrostix and an Eyetone meter were used in a study by diabetic patients to determine if home blood glucose monitoring could facilitate regulation of diabetes (40). In teaching the patients how to use the Ames Dextrostix and Eyetone meter, they found that accurate results could be obtained if the correct procedure was followed. This included regular machine calibration, periodic cleaning of the Eyetone instrument, and using only fresh Dextrostixs, which had been kept in a tightly closed bottle.

Ikeda, Tejima, Minami, Ide, Yojoyoma, and Abe (41) also used the Dextrostix and Eyetone meter in a study with diabetic patients. When the researchers compared the blood glucose Eyetone results with those obtained by the Auto Analyzer, ferricyanide reduction method, a positive correlation of $r = 0.96$ was found. When the glucose in the blood samples was higher than 200 mg/dl, then the values measured by the Dextrostix Eyetone system were slightly higher. Then three consecutive blood glucose measurements were determined by the diabetic patients using the Dextrostix Eyetone system. At the same time a technician took the blood and measured the glucose values with the Auto Analyzer. The patients own results showed little variation. There was more variation between the two methods when the blood glucose values were greater than 300 mg/dl.

Jovanavic, Peterson, Saxena, Dawood, and Sudek (42) used the Dextrostix Eyetone method in their study designed to test whether self-monitoring of blood glucose levels by pregnant diabetic patients would result in maintenance of normal glucose values. The Dextrostix Eyetone method was compared with the Beckman Glucose Analyzer using blood samples containing glucose concentrations between 50 and 200 mg/dl. The correlation coefficient for the results by the two methods was approximately 0.97.

Stewart (43) compared the Eyetone Dextrostix method with the hexokinase method, for measurement of glucose in whole blood. The hexokinase method is the standard procedure endorsed by the Food and Drug Administration to determine glucose values. One hundred and forty-two duplicate blood samples were assayed which resulted in a correlation coefficient of 0.99 for the two methods.

Jarrett, Kee, and Hardwick (44) assessed the accuracy of blood glucose values obtained using Dextrostix strips and an Ames reflectance meter against the results of the ferricyanide reduction method on the Auto Analyzer. Capillary blood samples were drawn from men having a diagnostic glucose tolerance test done and from patients attending the Guy's Hospital diabetic clinic. The results obtained by the two methods showed an over-all correlation of 0.98. Less accurate values were obtained when the blood glucose levels were less than 80 mg/dl or greater than 200 mg/dl. Below 80 mg/dl, the values read from the reflectance meter were either over or under those given by the Auto Analyzer method. Though duplicate and triplicate estimates were usually quite close using the Dextrostic-reflectance system, the method was not as reproducible as the Auto Analyzer technique. Eleven of the 48

replications done by the Dextrostix-Eyetone method differed by more than 10 mg/dl compared with one of the 13 replicates using the Auto Analyzer.

This method of determining blood glucose levels had been shown to be not only simple, quick, and convenient but also accurate.

Summary of Review of Literature

The research data tend to show that eating breakfast has a positive effect on the physiological performance. In most cases the addition of breakfast resulted in decreased neuromuscular tremor, increased maximum work output, and decreased simple and choice reaction time. Researchers agreed that the protein, whether it is from animal or plant sources, ingested during the breakfast meal helped to sustain blood glucose levels. As the levels of protein are increased in a breakfast containing adequate calories, blood glucose concentration remained above the fasting levels for a longer period of time.

Though studies indicate that breakfast eating improves school-aged children's academic performance, it must be recognized that much of the supporting evidence is subjectively based. Lack of research in this area makes it impossible to say conclusively how breakfast affects academic performance. The relationship between breakfast eating and mental performance for all age groups has not been investigated.

CHAPTER III

METHOD AND PROCEDURES

Students at Oklahoma State University were asked to participate in a study to determine whether breakfast eating affected the academic performance of college students. Students enrolled in the course, Science of Food Preparation, were subjects for the study. This course was chosen because it was the instructor's policy to give a weekly quiz throughout the semester. Also it was an upper division course so students who were incapable of comprehending college-level coursework should no longer be enrolled.

Description of FNIA 3313

Science of Food Preparation was a required course for all Food, Nutrition, and Institution Administration; Hotel and Restaurant; and Home Economics Education and Community Services majors at Oklahoma State University. The purpose of the course was to present basic food preparation principles so that the students became more familiar with the science of food cookery. The students attended two two-hour laboratory sessions and one hour of lecture each week. They were divided into two laboratory groups which met at different times; but all the students attended the same lecture class on Fridays. A graduate assistant taught one of the laboratory sections, and the instructor of the course

taught the other section. The graduate assistant and instructor met weekly to prepare and plan each week's laboratory experiences.

Breakfast Study

The purpose of the study and the procedures to be followed were explained to the students the first day of class. A 10-point bonus, to be added after grade levels for the semester were determined, was offered to participants. The bonus points were given to insure that changing the student's normal breakfast regimen would not lower their final grades in the course. However, it was promised that no student's grade would be penalized if he chose not to participate. Twenty-three females and 14 males taking the course volunteered to participate in the study. This included all the students enrolled in the class except one male.

Each subject was asked to fill out a personal data sheet. Information, such as name, age, year in school, phone number, and schedule of classes were included. This data sheet also included a consent form statement. A copy of the personal data sheet can be found in Appendix A.

The students were also instructed to complete a breakfast survey sheet. The purpose of the survey was to discover the participants' normal breakfast habits and whether they thought eating breakfast affected their academic performance. At the end of the experiment, the participants again completed the breakfast survey sheet. The information they gave on both surveys was compared. A sample of the breakfast survey is in Appendix B.

By use of a computer, each student was randomly assigned so that for six Fridays when a class quiz was given the student would eat

breakfast and the other six Fridays the student would not eat breakfast. This method of randomization was used to insure that each Friday a different group of students was eating or not eating breakfast. At the beginning of the experiment, each individual received a copy of the computer printout showing the personal breakfast eating schedule the student was to follow for the entire semester.

It was decided that an adequate breakfast would consist of at least one serving from three of the four basic food groups and should contain a minimum of 15 grams of protein. The students were given breakfast bars which, when eaten with one cup of milk, would meet the standard for an adequate breakfast. The students had to buy their own milk. The mix called Nutricake used to make the breakfast bars was manufactured by Nutrifood, Incorporated. The directions on the package of the mix were followed except the baked produce was cut into 60 bars instead of 80. The serving size of the breakfast bar was increased so that when the bar was consumed with milk the meal would contain 15 grams of protein. Each student was given a sack containing six individually wrapped breakfast bars. One breakfast bar could be eaten each Friday when the student was assigned to eat breakfast. The Nutricake breakfast bar had been approved by the United States Department of Agriculture (USDA) for use in the school breakfast program. (In Table VI, Appendix C, is the nutritional specifications a breakfast bar had to contain in order to obtain USDA approval [45].)

The students were instructed how to substitute another high protein feed for the milk if they did not like milk. Also the students had the option of choosing their own breakfast if it met or exceeded the standard (contained foods from three of the four food groups and 15

grams of protein) instead of the breakfast bar with milk. The students were instructed to eat breakfast between 7:00 a.m. and 9:00 a.m. on the Fridays they were assigned to eat breakfast.

When a student was assigned not to eat breakfast, he was not to eat or drink any food which contained calories from the time he arose until the time he took the quiz. Black coffee, black tea, water, and calorie-free soda could be consumed by non-breakfast eaters. Each participant received an instruction sheet explaining the project guidelines. (See Appendix A.)

Each Friday when a quiz was given a breakfast survey sheet was attached to each quiz. The students checked whether or not they had eaten anything that morning and what time they had eaten. If they had eaten or drunk any food that morning, they checked which foods they had consumed. (For an example of the weekly breakfast questionnaire each student completed prior to taking the quiz, see Appendix A.)

Weekly records were kept for each student showing whether the student ate an adequate breakfast, ate a partial breakfast, or did not eat breakfast. Their weekly quiz scores were also recorded. In order to encourage honesty in reporting, if a student failed to follow the assigned breakfast regimen, they were not threatened or criticized in any way. However, each week students were contacted if they did not follow their breakfast schedule and were asked why. They were then given advice how to adapt their situation so as to more easily follow the breakfast regimen in the future.

Blood Glucose Study

Studies had shown that persons who skipped breakfast had lower

blood glucose levels than individuals who ate breakfast. To determine if the students' blood glucose levels were affected when they did not eat breakfast, blood glucose levels were determined weekly for nine volunteers. The nine students chosen were picked from a larger group of volunteers because they did not have classes before the Science of Food Preparation lecture at 9:30 a.m., and their schedules were such that they could eat breakfast at 8:00 a.m. each Friday. These nine students, four males and five females, were also concurrently participating in the breakfast portion of the experiment. The students had blood drawn and their blood glucose levels determined every quiz Friday between 9:00 and 9:20 a.m.; the weekly quizzes were then given promptly at 9:30 a.m. These students were asked to eat their breakfast at 8:00 a.m. every Friday so that the time elapsed between eating breakfast and giving blood would be approximately the same for each individual. Also, a review of literature indicated that a breakfast containing 15 grams of protein should keep blood glucose values above fasting levels for at least two hours. (A copy of the instructions and the consent form given to each person who participated in the blood glucose portion of the experiment is included in Appendix D.)

Blood glucose levels were determined by use of Dextrostix (glucose oxidase reagent strips) and the Glucometer Reflectance Photometer, both products of the Ames Company, a division of Miles Laboratory. When whole blood was exposed to the pad of the strip, it underwent a color reaction proportional to the blood glucose concentration. When the Dextrostix strip was placed in the Glucometer, the color change was reflected by a digital reading indicating a blood glucose level for the subject in mg/dl (milligrams glucose per 100 milliliters of whole blood).

Each subject first washed his hands with soap under warm running water. This technique was used not only to prevent infection, but it also helped bring the blood to the finger surface. The finger was then wiped with alcohol on a cotton ball and allowed to air dry. The finger was pricked using an Autolet finger lancer to get a drop of capillary blood. The time button on the Glucometer was pushed so the machine would buzz after four seconds. At the sound of the buzzer a hanging drop of blood from the subject's finger was placed on the pad of the Dextrostix strip. After 60 seconds the machine buzzed again. At the sound of the second buzz, the blood was washed off the test strip using room temperature distilled water from a wash bottle. The test strip was gently blotted with a clean paper towel and immediately inserted in the Glucometer. The read button on the machine was pushed, and the Glucometer gave a large digital readout of the blood glucose level.

The same laboratory assistant performed all the blood glucose tests taken throughout the semester. On the eighth week of the experiment, the blood data obtained were not included in this study since the regular laboratory assistant was ill, and the tests were done by another.

Weekly Quizzes

Each of the 12 quizzes covered information obtained from the previous week's lecture and laboratory experiences and a question from the reading assignment for the current lecture. Each quiz was comprised of 10 multiple choice statements. The quizzes were constructed so that each quiz contained the same number of questions from the different levels of learning of the cognitive domain. On each quiz questions one

through four were knowledge questions, five through eight were comprehension questions, and questions nine and ten were application questions. (An example of the quizzes given to the students is included in Appendix E.) At the end of the semester, the grades received on the quizzes were added together to equal one major examination. All the quiz questions were checked by the instructor to be sure the necessary material had been covered. Each student's quiz was graded twice to prevent errors. A thirteenth quiz was given as a make up for a quiz missed due to absence, but these data were not a part of this study.

Student Evaluation

Near the end of the semester the students were asked to complete a standard evaluation form used by Oklahoma State University. This form asked for information that allowed evaluation of both the class and the instructor and had been routinely used in all courses at Oklahoma State University for many years prior to this study. The forms completed by the students were compared with the evaluation forms completed by the students enrolled in the same course the previous spring to determine whether their being asked to participate in the research project had any effect on their attitudes toward the course. (A duplicate evaluation form is included in Appendix F.)

CHAPTER IV

RESULTS AND DISCUSSION

Three hypotheses were tested in this study. The first one was that there would be no significant difference between the students who ate breakfast and the students who omitted breakfast. These data were examined in terms of the class as a whole, individual students, and individual quizzes. The second hypothesis was that students' blood glucose levels would not be significantly higher when they ate breakfast and when they did not. The third hypothesis tested was that the coefficient of correlation between blood glucose levels and quiz scores would be zero.

Quiz Scores Received With and Without Breakfast

Statistically, the first hypothesis was tested using one-way analysis of variance with unequal numbers followed by an F-test. Data for the study were collected during the Spring semester of 1982. All 37 of the students who consented to participate completed the study. Though each student's breakfast regimen schedule was designed so that the student would take six quizzes with breakfast and six without, due to inclement weather, student illness, unforeseen authorized absences, and students not correctly following the breakfast schedule, not all students received scores for all 12 quizzes. Data collected were 206 quiz scores (92.8 percent of the 222 possible) with breakfast and

196 quiz scores (88.3 percent of the 222 possible) without breakfast. These percentages indicated a high degree of compliance with the research study requirements on the part of the subjects. However, because of several instances of missed quizzes or students' incorrectly following the breakfast regimen guidelines, it was necessary to use methods of analysis developed for unequal numbers. (In Table IV, Appendix A, the raw data are given listing the student, quiz number, breakfast regimen, and corresponding quiz score for each quiz.)

Analysis of Variance of the Two Breakfast Regimens by Class

A one way analysis of variance followed by an F-test was used to compare the 402 quiz scores in terms of whether or not there was a significant difference in the class mean quiz scores with and without breakfast. The mean quiz scores for all quizzes taken with breakfast was 7.14 while the mean scores for all quizzes without breakfast was 7.01. These means indicate a slight trend toward improved scores with breakfast. However, the quizzes consisted of only 10 points. With such a small sample size, it is unlikely to have a large enough difference between the two class means to show significance. Statistically there was no difference in the quiz scores with and without breakfast.

Analysis of Variance of Two Breakfast Regimens by Individual Students

To determine whether individual student's mean quiz scores with and without breakfast were statistically different, a one way analysis of variance followed by an F-test was computed. For only one of the 37

students was there a significant difference in mean quiz scores with and without breakfast. That student's mean quiz score was significantly higher when he skipped breakfast, 8.75 compared to 7.00.

Analysis of Variance of Two Breakfast Regimens by Individual Quizzes

Though the quizzes were standardized so that each contained the same number of questions from the knowledge, comprehension, and application levels, the means did vary, irrespective of the breakfast regimen, indicating that the students found some more difficult than others. The quiz score means ranged from 5.36 to 8.23 as seen in Table V, Appendix A.

In order to determine possible difference between quiz scores with and without breakfast, an F-test was performed. The calculated F value indicated that there was no significant difference for 11 of the 12 quizzes. (See Table I.) The calculated F value for quiz 10 was 6.02 which was significant at the 0.05 level. For quiz 10 the mean score of quizzes taken without breakfast was higher than the mean score of the quizzes taken with breakfast. Therefore, the null hypothesis that there would be no difference in quiz scores with and without breakfast can only be rejected for one of the 12 quizzes at the 0.05 level of significance. Figure 1 and Figure 2 are graphs both of which show the mean quiz scores with and without breakfast for the 12 quizzes given.

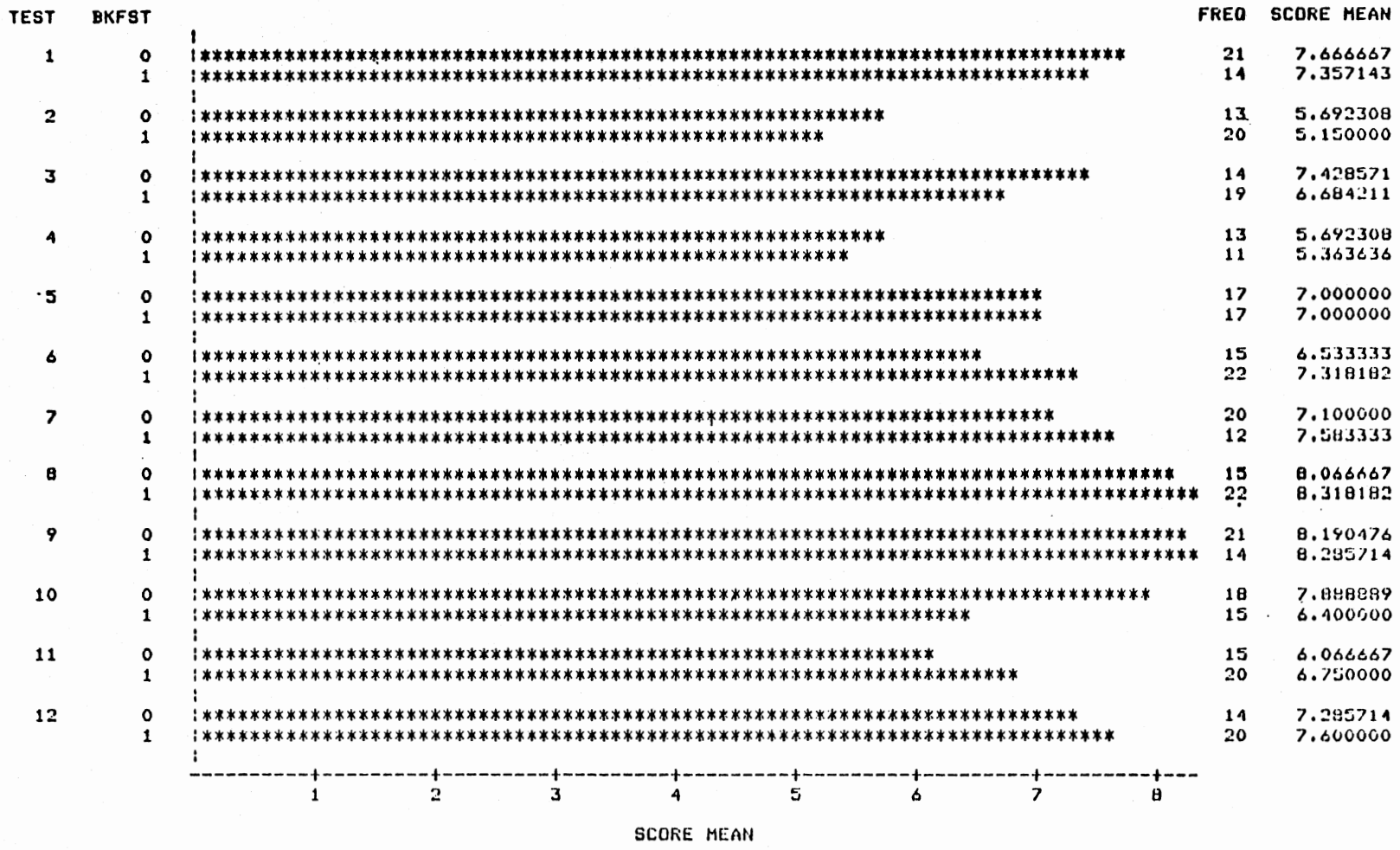
It was undetermined why the results for quiz 10 were different. According to Pollott, Leibel, and Greenfield (39), scores on questions over certain type of learning (immediate recall) were improved if the subjects had experienced a short fast; however, scores on questions

TABLE I

CALCULATED AND TABULATED F VALUES FOR STUDENT QUIZ SCORES WITH AND WITHOUT BREAKFAST BY INDIVIDUAL QUIZZES

Quiz Number	Calculated F Value	Tabulated F Value (0.05 Significance Level)	N
1	0.36	4.14	35
2	0.91	4.16	33
3	1.48	4.16	33
4	0.17	4.28	24
5	0.00	4.15	34
6	2.39	4.12	37
7	0.51	4.17	32
8	0.37	4.12	37
9	0.04	4.14	35
10	6.02*	4.16	33
11	1.82	4.14	35
12	0.31	4.15	34

*Significant at the 0.05 level.



0 means no breakfast
1 means breakfast

Figure 1. Bar Chart of Individual Quiz Score Means With and Without Breakfast

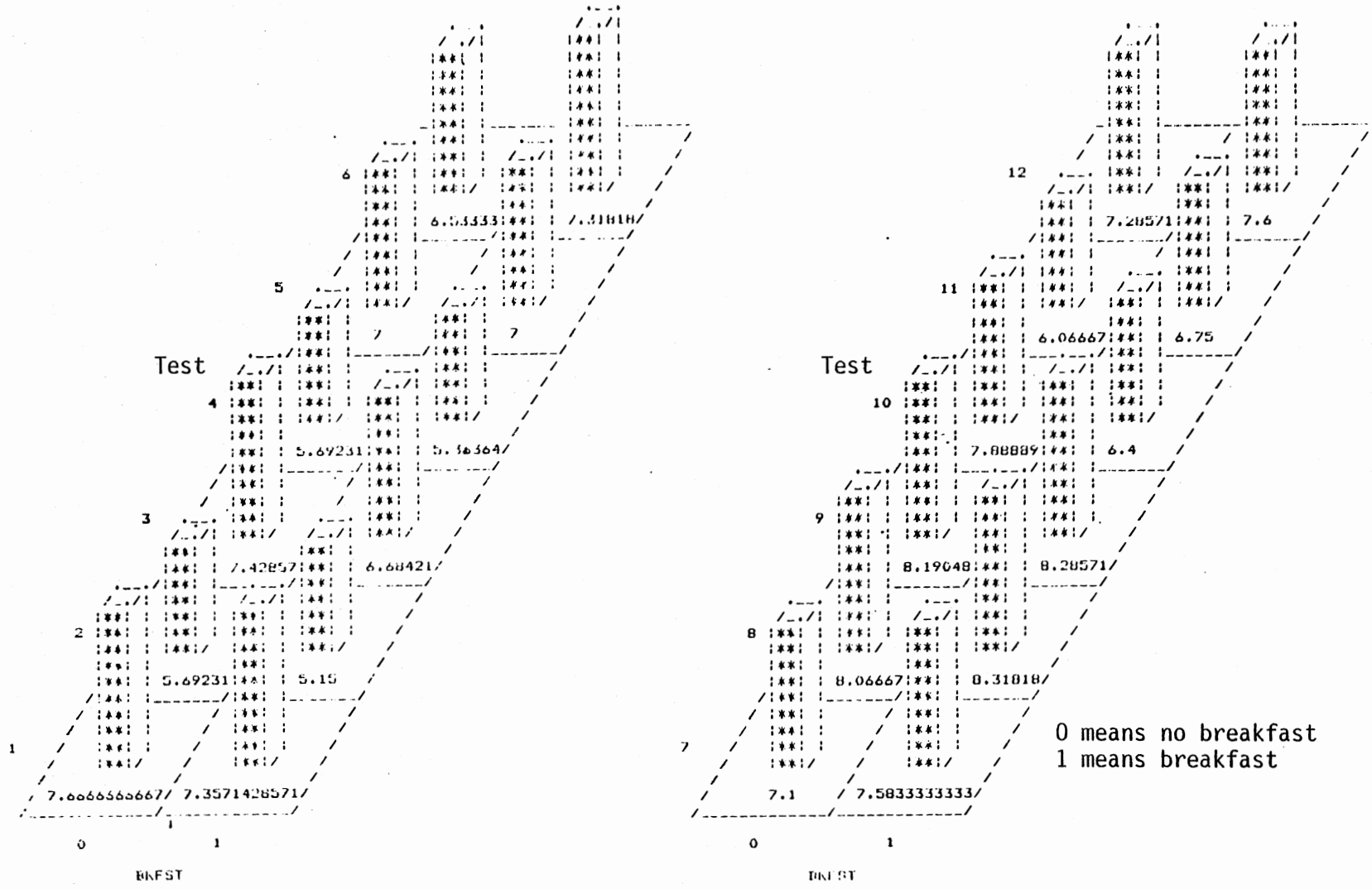


Figure 2. Block Chart of Individual Quiz Score Means With and Without Breakfast

that required problem solving were better if the subjects were fed. Although attempts were made to assure uniformity of learning levels among all 12 quizzes, it may have been that quiz 10 was more reflective of immediate recall information and was, therefore, easier for the students who had experienced a short fast (i.e., missing breakfast).

In summary there was no significant difference between quiz scores taken with or without breakfast when looking at all quizzes for all students. There was no difference in 11 of the 12 quizzes when the quizzes were examined individually. When the test scores with or without breakfast were examined in terms of individual students, only one student's score showed a statistical difference. Based on these data the first hypothesis was accepted that there was no difference in quiz scores, with and without breakfast.

A problem not addressed in the design of this pilot study was the effect of fasting while learning was taking place rather than being tested. Although it would have been possible to check the student's fed or fasted state during the previous week's lecture, material covered on the quiz was learned from various additional sources (reading assignments, laboratory experiences, and prior experiences). Being unable to control whether the students were in the fasted or fed state during the learning process may have effected these results.

Many of the students stated when they skipped breakfast they did not feel hungry during the time they took the quizzes but did an hour or two later. If the quizzes had been given later in the morning, the omission of breakfast might have had more effect.

Blood Glucose Levels With and Without Breakfast

Table II presents the nine participants' average blood glucose levels and quiz scores with and without breakfast. (For raw data of quiz number, score, breakfast regimen, and blood glucose levels at quiz time for each participant, see Table VII, Appendix B.) The data for quiz eight is not included since the laboratory person was ill and the tests were done by another person that Friday. Due to student illnesses, inclement weather, students' incorrectly following the breakfast regimen guidelines, and omitting the results of the blood glucose tests for quiz eight, only 82.4 percent of the possible blood glucose tests were determined. The hypothesis tested was that the students' blood glucose levels would be lower when they ate an adequate breakfast compared with when they omitted breakfast. A one-sided t test using the following formula was used to test the hypothesis (46, p. 92):

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_{\bar{x}_1 - \bar{x}_2}}$$

where

$\bar{x}_1$ = mean of blood glucose values with breakfast,

$\bar{x}_2$ = mean of blood glucose values without breakfast,

$s_{\bar{x}_1 - \bar{x}_2} = \sqrt{s^2[n_1 + n_2)/(n_1 \times n_2)]}$ = pooled variance

$s^2 = \Sigma s^2/(n_1 - 1) + (n_2 - 1)$ = pooled mean square, and

n = number of observations.

The average blood glucose values with and without breakfast were 83.78 and 79.02 mg/dl, respectively. The null hypothesis was rejected leading to the conclusion that the blood glucose values were greater when the subjects ate breakfast compared with when they omitted it at the 0.01

level of significance. This finding agreed with other researchers who have reported, using blood serum, blood glucose levels one hour after breakfast of 119 to 139 mg/dl and fasting levels of 95 to 108 mg/dl. Since the Glucometer/Dextrostix method used whole blood, blood glucose values approximately 15 percent lower than corresponding serum values were to be expected. Even after taking into account this method of measuring blood sugar, the values recorded in this study were still lower than those given by others when individuals ate an adequate breakfast. The difference may be due to the fact that our subjects' activity was not restricted; whereas, in the other studies cited, the participants were only allowed to engage in sedentary activities.

TABLE II

STUDENTS' MEAN BLOOD GLUCOSE LEVELS AND MEAN QUIZ SCORES WITH AND WITHOUT BREAKFAST

Student Number	Blood Glucose Levels		Quiz Scores	
	With Breakfast	Without Breakfast	With Breakfast	Without Breakfast
1	77.17	75.80	5.83	5.80
2	91.25	81.75	7.25	6.25
13	86.86	75.50	5.40	6.00
22	80.60	80.50	8.40	8.00
27	91.20	76.60	6.60	6.60
29	72.40	79.30	9.00	8.00
32	85.83	78.00	8.50	7.60
33	92.60	84.50	7.00	8.75
34	77.25	80.00	6.00	6.70
Group Mean	83.78	79.02	7.13	7.07

Blood Glucose Levels and Quiz Scores

The hypothesis was tested that the coefficient of correlation between blood glucose levels and quiz scores would be zero. In a two-tailed test the table value of r with 87 degrees of freedom, 0.05 level of significance was approximately 0.210; and the calculated value was -0.039 (46) (47). Therefore the null hypothesis was accepted.

Though the addition of breakfast increased the blood glucose concentrations of university students, it did not seem to improve the performance of the students participating in this part of the study. Assuming the nine participants were representative of the whole population of students enrolled in Science of Food Preparation class, indications were that their quiz scores were not affected by their blood glucose levels.

Breakfast Survey

A survey of breakfast habits and attitudes was given to the students at the beginning and again at the end of the study. The results of both surveys are presented in Figure 3. Most of the students ate breakfast at the resident dining hall, at home with their family or in an apartment. In January, 9 of the 14 students who skipped breakfast gave "did not have time" as the reason and 3 of the 14 said they "were not hungry". These were also the most common reasons given for missing breakfast in the May survey.

Similar reasons for missing breakfast had been reported by other researchers (37) (48). A very large majority of the school-age children (K-12) surveyed by the Oklahoma Nutritional Needs Assessment Study said

Sex: Total 37 Male 14 Female 23

Year in School: Freshman 0 Junior 18
Sophomore 2 Senior 17

Number of students that ate anything for breakfast on the days surveyed.

January				May			
Total 23	Males 5	Females 17		Total 28	Males 8	Females 20	

Number of students that ate an adequate breakfast on the days surveyed.

January				May			
Total 12	Males 3	Females 9		Total 13	Males 4	Females 9	

Reasons why students did not eat breakfast on the days surveyed.

	January	May
Did not have time	9	3
Not hungry	3	2
Nobody to prepare it	0	0
Did not feel good	0	0
On a diet	0	0
Food not available	1	1
Did not like what was served	0	0
Did not want to eat alone	0	0
Eating breakfast makes me sick	0	0
Did not get up until lunch time	1	1

Number of Students who usually eat breakfast at least five times per week.

January				May			
Total 23	Males 6	Females 17		Total 22	Males 9	Females 13	

Response to the question: "Do you think breakfast has any effect on your academic achievement?"

January				May			
Yes				Yes			
Total 30	Males 9	Females 21		Total 27	Males 7	Females 20	
No				No			
Total 7	Males 5	Females 2		Total 10	Males 7	Females 3	

Figure 3. Results of Breakfast Surveys Given in January and Repeated in May

that when breakfast was skipped it was because they were not hungry or had insufficient time (2).

In this survey, the percentage of students who ate something for breakfast increased from 62.2 percent in January to 75.7 percent in May. However, the percentage of persons who ate an adequate breakfast was 32.4 percent in January and only increased by one person (to 35.1 percent) in May. When comparing breakfast habits between males and females on both surveys, a higher percentage of females ate something for breakfast. The number of males who reported eating breakfast at least five times per week increased from January to May, but less females said they ate breakfast five times per week in May.

When the data for the two surveys was pooled, 53.6 percent of the males, 65.2 percent of the females, and 60.8 percent of all the students, male and female, had breakfast five times per week. This compared closely with the 63 percent of college students who were reported having similar breakfast eating patterns by Haseba and Myrtle (37); although others have reported higher percentages of college students who ate breakfast (38).

In January before the students began the study, 30 students responded positively that breakfast had an effect on their academic achievement. After the completion of the study when asked the same question, three less students responded positively. Since the students were knowledgeable of their quiz scores with and without breakfast this attitude was not surprising.

Student Evaluation

The students' evaluation of the course, Science of Food Preparation,

for both Spring of 1981 and Spring of 1982 are given in Table III. The Oklahoma State University evaluation form used was based on a one-to-four point scale, four-points being the highest. It was a concern that as a result of participating in a research project the students might view the course differently than previous classes and feel this was affecting their learning experience. Comparing the mean responses of the students Spring semester, 1982, with the responses given the previous Spring semester, the students rated the course approximately the same or higher in almost all categories. It was particularly interesting that the students viewed the testing and evaluation procedures as better than the previous Spring semester, 3.06 and 2.82, respectively.

TABLE III

STUDENT EVALUATION OF THE COURSE, FNIA 3133 BY PERCENTAGE FOR SPRING OF 1981 AND SPRING OF 1982

Student Responses	Learned A Lot		Workload Appropriate		Assignment Useful		Testing and Evaluation Good		Involved Students		Worthwhile		Overall	
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
Definitely Yes	44.7	44.4	21.3	25.7	27.7	34.3	12.8	29.4	21.3	26.5	31.9	35.3	36.2	35.3
Yes	45.8	50.0	55.3	65.7	63.8	60.0	59.6	52.9	68.1	61.8	59.5	55.9	57.4	55.9
No	4.3	2.8	10.6	5.7	2.1	2.9	12.8	11.8	2.1	5.9	6.4	2.9	4.3	0.0
Definitely No	2.1	2.8	10.6	0.0	4.3	2.9	8.5	5.9	4.3	2.9	2.1	5.9	2.1	5.9
Not Applicable	2.1	0.0	2.1	2.9	2.1	0.0	6.4	0.0	4.3	2.9	0.0	0.0	0.0	2.9
Standard Deviation	0.68	0.68	0.88	0.54	0.68	0.66	0.79	0.81	0.65	0.67	0.66	0.77	0.65	0.75
Mean	3.37	3.36	2.89	3.21	3.17	3.26	2.82	3.06	3.11	3.15	3.21	3.21	3.28	3.24

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this pilot study was two-fold. First, to determine if there was a relationship between breakfast eating and quiz scores of free-living college students enrolled in the course FNIA 3133, Science of Food Preparation, Spring 1982. Second, blood glucose levels were determined each Friday for nine of the participants to determine if there was a relationship among blood glucose levels before the quizzes were taken, breakfast eating, and students' quiz scores.

Summary

Thirty-seven students enrolled in the course, Science of Food Preparation, in the Spring of 1982 were the subjects. The experimental phase was conducted every Friday for 12 Fridays when the class was given a 10-point quiz for credit. Each student was given a randomly assigned sheet telling which Fridays he was to eat breakfast and which Fridays he was to omit breakfast. By the end of the semester each student had approximately the same number of quiz scores recorded with and without breakfast. Also each Friday before the quiz was given, blood glucose levels of nine students were determined using Dextrostrips and a Glucometer Spectrophotometer from the Ames Company.

Each Friday the students who were assigned to eat breakfast ate at least a minimum breakfast. They had a choice of eating either the

breakfast bar furnished them, and milk, or a breakfast of their own choosing if it met the requirements of containing at least a serving from three of the four basic food groups and 15 grams of protein. Before the experiment began and after its completion, the students were asked to fill out a questionnaire about their attitude towards breakfast eating and their usual breakfast habits.

Analysis of variance was used to test the hypothesis that there would be no significant difference in students' quiz scores received when an adequate breakfast was eaten and when breakfast was omitted. Results of the statistical test, contrasting all scores with and without breakfast, showed the hypothesis could be accepted. The mean score for all test quizzes taken after skipping breakfast was 7.01 and after eating breakfast was 7.14.

When individual quizzes were examined, on one of the quizzes, quiz 10, the students who skipped breakfast had significantly higher mean score ($p \leq 0.05$), than the students who ate breakfast (7.89 without, 6.40 with). When looking at individual students, for all but one student, there was no significant difference in scores with and without breakfast. That student did have quiz scores that were significantly ($p \leq 0.05$) better without breakfast (8.74 without breakfast as compared to 7.00 with breakfast).

A t-test was used to compare the students' mean blood glucose values with and without breakfast. The null hypothesis that the blood glucose levels of the students would not be significantly higher with breakfast compared to without breakfast was rejected at the 0.01 level of significance. The mean blood glucose value without breakfast was 79.02 mg/dl and with breakfast was 83.78 mg/dl.

The hypothesis that the coefficient of correlation between blood glucose levels and quiz scores would be zero was also tested. The coefficient of correlation was calculated, and there was no evidence to reject the null hypothesis ($r = -0.039$).

From the results of the breakfast surveys it was determined that approximately 60 percent of the students ate breakfast at least five times a week though only about half of them who ate breakfast had an adequate morning meal on the days surveyed. The most frequently given reasons for the students' skipping breakfast was that they did not have time or they were not hungry. At the conclusion of the study, a large majority of the students, 73 percent, responded positively that breakfast had an effect on their academic achievement; but 81 percent had responded positively at the beginning of the study. However, at the beginning of the study only 62 percent had reported eating breakfast on the day surveyed, but 76 percent of the students had eaten breakfast on the day of the repeat survey.

Although the students had to conform to a rigid breakfast schedule for 12 weeks and had to fill out numerous questionnaires and surveys, and some had to submit to weekly finger-prick blood tests, they rated the course about the same or higher for almost all categories as had the students in a previous semester.

Conclusions

The results of this study led to the conclusion that college students enrolled in the course, Science of Food Preparation, had overall academic performances, as reflected by quiz scores, that were not significantly influenced by the addition or omission of an adequate

breakfast. This implied that other factors, such as student initiative to learn, study habits, attentiveness in class, adequate sleep, etc., might be more influential in affecting academic performance; although one individual out of the 37 students did receive significantly better quiz scores in the fasted state. Also the small sample size (10-point quiz) could have affected significance.

It was further concluded from the results of this research that university students who ate an adequate breakfast had higher blood glucose levels from one to one and one-half hours after they had eaten compared with students who omitted breakfast. This conclusion is reasonable since students in the fed state were using available food eaten for breakfast as their energy source; whereas, the students in the fasting state were using their body stores.

From this study, a third conclusion could be made. There was no significant correlation between students' blood glucose levels and their academic performance as reflected by quiz scores.

There was little evidence that students' attitude toward breakfast changed as a result of the study but more students did report having eaten breakfast at the end of the study.

The student evaluation forms, as compared with a previous semester, indicated that being asked to participate in a research project did not adversely affect their attitude toward the course.

Recommendations for Further Research

Many difficulties are encountered when trying to develop a research project to determine the effect of one variable, such as breakfast, on a concept, such as academic performance. In this study, interfering

variables such as student initiative, lack of sleep, insufficient study or previously acquired information may have masked the effects of breakfast on the quiz scores. Although the benefits of breakfast eating are widely stated, too little research has been conducted in this area to draw a definite conclusion about the effects of breakfast on mental efficiency. Recommendations for further research are the following:

1. In this study it became evident the class quizzes were not of equal difficulty. The use of standardized tests should be considered.
2. To insure that each student had an adequate breakfast, the students should be congregated and fed the same breakfast at the same time.
3. Since many of the students did not feel hungry when they omitted breakfast until later in the morning, the effect of breakfast may be more evident if mental efficiency is measured in late morning.
4. Participants' entire daily food intakes should be monitored so that they received adequate amounts of nutrients and calories based on body size with and without breakfast.
5. Fasting blood glucose levels should be determined in each subject and glucose levels should be monitored with and without breakfast throughout the morning to determine when blood glucose levels peak and when they return to fasting levels.
6. Studies determining the relationship of breakfast on mental efficiency should be conducted with all of the various age groups.

7. In this study, the students were asked to comply with a particular breakfast regimen only one day a week. The effect of breakfast may be more evident if the participants follow the same breakfast regimen for longer periods of time.
8. In future research done to study the effect of breakfast on mental performance, the relationship might be more evident if the study is limited to a smaller group of participants who are willing to follow a more controlled daily routine during the experiment.
9. Research should be conducted to determine the effect of fasting while learning is taking place.
10. Research should be conducted to determine which levels of learning in the cognitive domain may be effected by the omission of breakfast.

SELECTED BIBLIOGRAPHY

1. Food and Research Action Center: If We Had Ham, We Could Have Ham and Eggs . . . If We Had Eggs. Yonkers, New York: Gazette Press, Inc., 1972.

2. Baird, J., and Wohlberg, L.: Nutrition Education: A Needs Assessment for Oklahoma. Stillwater: College of Home Economics, Oklahoma State University, 1979.

3. Ingoldsby, M.E.: Be smart - eat a good breakfast. Am. J. Nurs. 51:599, 1951.

4. Tuttle, W.W., Daum, K., Larsen, R., Salzano, J., and Roloff, L.: Effect of school boys of omitting breakfast: physiologic responses, attitudes, and scholastic attainments. J. Am. Dietet. A. 30:674, 1954.

5. Tuttle, W.W., and Herbert, E.: Work capacity with no breakfast and a mid-morning break. J. Am. Dietet. A. 87:137, 1960.

6. Daum, K., Tuttle, W.W., Martin, C., and Myers, L.: Effect of various types of breakfast on physiologic response. J. Am. Dietet. A. 26:503, 1950.

7. Tuttle, W.W., Wilson, M., and Daum, K.: Effect on altered breakfast habits on physiologic response. J. Appl. Physiol. 1:545, 1949.

8. Keys, A.B., Brozek, J., Henschel, A., Mickelson, O., and Taylor, H.L.: The Biology of Human Starvation. Vol. I and II. Minneapolis: Minneapolis University of Minnesota Press, 1950.

9. Bloom, S., Madaus, G.F., and Hasting, J.T.: Evaluation to Improve Learning. New York: McGraw-Hill, 1981.

10. Dorland's Illustrated Medical Dictionary. 26th ed. Philadelphia: W.B. Saunders Co., 1981.

11. A Complete Summary of the Iowa Breakfast Studies. Cereal Institute Inc. Chicago, Ill., 1976.

12. Tuttle, W.W., Daum, K., Myers, L., and Martin, C.: Effect of omitting breakfast on the physiological response of men. J. Am. Dietet. A. 26:322.

13. Tuttle, W.W., Daum, K., Imig, C.J., Martin, C., and Kisgen, R.: Effects of breakfast of different size and content on physiologic response of men. J. Am. Dietet. A. 27:190, 1951.

14. Daum, K., Tuttle, W.W., Larsen, R., Roloff, L., and Salzano, J.: Physiologic response of boys 12 to 14 years old to different breakfasts. J. Am. Dietet. A. 31:359, 1955.

15. Morrell, G. and Atkinson, D.R.: Effects of breakfast program on school performance and attendance of elementary school children. Education. 98:111, 1977.

16. Mann, J.: Analysis of 1009 consecutive accidents cases at one ordnance depot. Ind. Med. 13:368, 1944.

17. Conway, M.C.: The effect of breakfast in the mid-morning hypoglucemia lag. Unpublished M.S. theses, University of Washington, 1947.

18. Coleman, M.C., Tuttle, W.W., Daum, K.: Effect of protein source on maintaining blood sugar levels after breakfast. J. Am. Dietet. A. 29:239, 1953.

19. Bryant, K., Martin, C., Schumacher, M.T., Daum, K., and Tuttle, W.W.: Effect of aging and various types of breakfasts on blood sugar level. J. Am. Dietet. A. 28:17, 1952.

20. Addison, V.E., Tuttle, W.W., Daum, K., and Larsen, R.: Effect of amount and type of protein in breakfast on blood sugar levels. J. Am. Dietet. A. 29:674, 1953.

21. Orent-Keiles, E. and Hallman, L.: The breakfast meal in relation to blood-sugar values. Bureau of Human Nutrition and Home Economics Report No. 827, USDA, 1949.

22. Thorton, R. and Horvath, M.: Blood sugar levels after eating and after omitting breakfast. J. Am. Dietet. A. 42:474, 1965.

23. Galloway, M.E. and Robertson, E.C.: Types of breakfasts eaten and their effects on the level of the blood sugar in school children. J. Can. Dietet. A. 10:53, 1948.

24. Merimee, T.J. and Tyson, J.E.: Stabilization of plasma glucose during fasting: normal variation in two separate studies. New Engl. J. Med. 291:1275, 1974.

25. Champakam, S., Srikantia, S.G., and Gopalon, C.: Kwashiorkor and mental development. Am. J. Clin. Nutr. 21:844, 1968.

26. Cravioto, J. and De Licardie, E.R.: Mental performance in school age children: findings after recovery from early severe malnutrition. Am. J. Dis. Child. 120:404, 1970.

27. Freeman, H.E., Klein, R.E., Kagan, J., and Yarbough, C.: Relations between nutrition and cognition in rural Guatemala. Am. J. Public Health. 67:233, 1977.

28. Graves, P.L.: Nutrition and infant behavior: a replication study in the Katmandu Valley, Napal. Am. J. Clin. Nutr. 31:541, 1978.

29. Liang, P.H., Hie, T.T., Jan, O.H., and Giok, L.T.: Evaluation of mental development in relation to nutrition. Am. J. Clin. Nutr. 20:1290, 1967.

30. Richardson, S.A., Birch, H.G., and Hertzig, M.E.: School performance of children who were severely malnurished in infancy. Am. J. Ment. Defic. 77:623, 1973.

31. "Why serve breakfast at school?" Food and Nutr. 8:2, 1978.

32. Hallic, F. and Fleming, M.: Nutritional Improvement Project, DPPF, Fund 97, Component 4. 1971-72.

33. Pollitt, E., Leibel, R.L., and Greenfield, D.: Brief fasting, stress, and cognition in children. Am. J. Clin. Nutr. 34:1526, 1981.

34. Lapp, J.E.: Effects of glycemic alterations and noun imagery on the learning of paired associates. J. Learn. Dis. 14:35, 1981.

35. Brown, A.R.: The value of breakfast on meeting the nutritive needs of college girls. Unpublished M.S. thesis, Oklahoma State University, 1957.

36. Jakobovits, C., Halstead, P., Kelley, L., Roe, D.A., and Young, M.: Eating habirs and nutrients intakes of college women over a thirty-year period. J. Am. Dietet. A. 71:405, 1977.

37. Haseba, J. and Brown, M.L.: Breakfast habits of college students in Hawaii. J. Am. Dietet. A. 53:334, 1978.

38. Young, C.B. and Storvick, C.A.: Food habits of freshmen at Oregon State College. J. Am. Dietet. A. 25:318, 1949.

39. Peterson, C.M., Jones, R.L., Dupuis, A., Levine, B.S., Berstein, R., and O'Shea, M.: Feasibility of improved blood glucose control in patients with insulin-dependent diabetes mellitus. Diabetes Care. 2:329, 1979.

40. Skylar, J.S., Lasky, I.A., Skyler, D.L., Robertson, E.G., and Mintz, D.H.: Home blood glucose monitoring as an aid in diabetes management. Diabetes Care. 1:150, 1978.

41. Ikeda, Y., Rajima, N., Minam, N., Ida, Y., Yokoyama, J., and Abe, M.: Pilot study of self-measurement of blood glucose using the dextrostix-eyetone system for juvenile-onset diabetes. Diabetologia. 15:91, 1978.

42. Javanovic, L., Peterson, C.M., Saxena, B.B., Dawood, M.Y., and Saudek, C.D.: Feasibility of maintaining normal glucose profiles in insulin-dependent pregnant diabetic women. Am. J. Med. 68:105, 1980.

43. Stewart, T.C.: Evaluation of a reagent-strip method for glucose in whole blood, as compared with a hexokinase method. Clin. Chem. 22:74, 1976.

44. Jarrett, R.J., Keen, H., and Hardwick, C.G.: "Instant" blood sugar measurement using dextrostix and a reflectance meter. Diabetes 19:724, 1970.

45. Food and Nutrition Service: National school lunch program. Federal Register 38:No. 70, Part III, April 12, 1973, p. 9237-9238.

46. Snedecor, G.W. and Cochran, W.: Statistical Methods. 7th ed. Ames, Iowa: Iowa State University Press, 1980

47. Decision-Making Sourcebook. Texas Instruments Incorporated, 1977.

48. Richardson, A.M.: Breakfast habits of youth of Caddo, Oklahoma, with implications for nutrition education program. Unpublished M.S. thesis, Oklahoma State University, 1963.

APPENDIXES

APPENDIX A

RESULTS AND FORMS USED FOR THE STUDY OF THE TWO BREAKFAST REGIMENS

PERSONAL DATA SHEET

NAME:

Local address:

Local phone: Other phone you can be reached:

Male_____ Female_____ Age_____ Height_____ Weight_____

Where do you eat the majority of your meals? (name of dining hall, apt., etc.)

How many times do you usually eat (include snacks) during the day? _____

What time do you usually get up on Fridays? _____

Do you usually smoke before 9:30 in the morning? _____yes _____no

Do you usually have a caffiene containing beverage before 9:30 in the morning?

_____yes _____no

Please fill out your class schedule in the chart provided below:

CID Number	Course Prefix	Course Number	Type	Sec.	Cr. Hrs.	M	T	W	T	F	S	Bldg. & Room

Do you have any medical reasons why you will not be able to participate in the study? If so specify:

I understand the terms of the Breakfast Study and agree to either eat or not eat breakfast according to the schedule and to cooperate fully with the conditions of the Study, I also understand that I may withdraw from the study at anytime.

Signature_____Date_____

Instruction Sheet

BREAKFAST PROJECT

First, I would like to thank you for being willing to participate in the Breakfast Project. Your participation in this project will add some new insights and knowledge to help determine the role that nutrition has with mental performance. Also you as an individual will be able to determine for yourself whether breakfast affects your academic performance. The scientific merit of this project depends greatly on your cooperation in following the breakfast regimen assigned each week and spending the necessary amount of time studying for the weekly quizzes. Listed below are some helpful hints and general guidelines you need to follow as a participant in the breakfast study. Please put this paper in a safe, convenient place so that you may refer to it as needed.

1. You will be receiving a sack containing breakfast bars and a copy of your personal breakfast regimen to follow. Remember you have been randomly assigned a breakfast regimen so each Friday you must check to see whether you are to eat or not eat breakfast.

2. You may like to copy your breakfast schedule on a calendar, refrigerator, or another convenient place as a reminder.

3. On the Fridays you are not supposed to eat breakfast, that also includes NOT drinking any beverages that contains calories. Black tea, black coffee, no-calorie soda, and water are allowed. If possible, please try not to eat or drink any calorie-containing beverage after 12 O'clock midnight on Thursdays.

4. On the Fridays you are supposed to eat breakfast, you need to eat breakfast between 7:00 A.M. and 9:00 A.M.

5. On the Fridays you are supposed to eat breakfast, you need to eat at least the breakfast bar provided and drink an eight-ounce glass of milk. Of course you may eat or drink more than this if desired.

6. If you prefer to eat a breakfast of your choosing, you must eat at least one serving from three of the four food groups; and the total protein content of the meal should be at least 15 grams.
   Example I: cereal, one slice of toast, 1 cup milk and 1 orange.
   Example II: 2 eggs, 1 slice of toast, and 1 banana.

7. If you would like to eat the breakfast bar but dislike milk, then you may substitute another high-protein food for milk, such as, 1 egg, 1 ounce cooked meat (except bacon), 1 ounce cheese or ½ cup cottage cheese.

8. If you misplace or lose your assigned breakfast schedule, a master copy will be available in Home Economic East, Room 201A (student lounge), and in Home Economic West on the door of room 401 (Dr. Knight's office). If it is Thursday night and you need to know your breakfast assignment for Friday, you may call 372-7021 after 8:30 P.M. (I have a class until 8:20 P.M.). Ask for Mrs. Debbie Cantaral.

9. If you accidentally do not follow the correct breakfast regimen assigned that Friday, it is imperative that you are truthful. Please indicate on the weekly questionaire what you actually ate or if you did not eat at all.

Deborah K. Cantaral

Weekly Breakfast Survey

Name_____ BREAKFAST SURVEY Quiz Score_____

Quiz NO._____

Did you eat anything this morning? _____yes _____no About what time?_____

If yes please mark with a check the food(s) eaten.

Project breakfast bar_____ milk_____

_____tea

_____coffee _____soda _____kool aid

_____cream or sugar _____diet soda _____hot cocoa

_____fruit or fruit juice _____vegetable or vegetable juice

_____bread, toast, muffin, etc. _____cereal with milk _____sweet roll, doughnut

_____cereal no milk _____pancakes, waffles

_____egg _____sausage _____ham _____bacon

Other food(s) eaten not listed above (please specify).

TABLE IV

STUDENTS' QUIZ SCORES WITH AND WITHOUT BREAKFAST

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
1	1	1	7	3	1	1	10	5	1	0	9
1	2	0	5	3	2	1	8	5	2	1	7
1	3	0	7	3	3	0	8	5	3	0	8
1	4	1	8	3	4	-	-	5	4	-	-
1	5	0	7	3	5	1	6	5	5	1	5
1	6	1	6	3	6	1	6	5	6	1	9
1	7	1	4	3	7	0	7	5	7	0	6
1	8	1	8	3	8	1	7	5	8	1	7
1	9	0	6	3	9	0	8	5	9	0	7
1	10	1	6	3	10	0	8	5	10	1	6
1	11	1	4	3	11	0	7	5	11	1	6
1	12	0	4	3	12	1	9	5	12	0	9
2	1	1	8	4	1	0	9	6	1	0	7
2	2	1	6	4	2	1	6	6	2	-	-
2	3	1	9	4	3	1	8	6	3	1	10
2	4	0	5	4	4	1	5	6	4	1	7
2	5	-	-	4	5	0	6	6	5	0	9
2	6	0	5	4	6	0	4	6	6	1	9
2	7	-	-	4	7	0	7	6	7	0	7
2	8	1	9	4	8	1	9	6	8	1	9
2	9	0	7	4	9	0	8	6	9	0	9
2	10	0	9	4	10	1	6	6	10	0	6
2	11	1	6	4	11	0	8	6	11	1	8
2	12	0	8	4	12	0	6	6	12	1	9

TABLE IV (Continued)

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
7	1	0	10	9	1	0	8	11	1	1	6
7	2	0	5	9	2	1	6	11	2	1	6
7	3	-	-	9	3	1	8	11	3	-	-
7	4	0	7	9	4	-	-	11	4	-	-
7	5	1	5	9	5	0	6	11	5	1	9
7	6	0	6	9	6	1	9	11	6	0	7
7	7	0	7	9	7	1	7	11	7	0	8
7	8	1	9	9	8	0	8	11	8	1	8
7	9	1	8	9	9	0	10	11	9	0	8
7	10	-	-	9	10	0	10	11	10	-	-
7	11	0	5	9	11	1	7	11	11	1	9
7	12	1	8	9	12	1	8	11	12	1	7
8	1	1	8	10	1	0	9	12	1	0	6
8	2	1	5	10	2	1	5	12	2	0	7
8	3	0	10	10	3	0	5	12	3	0	7
8	4	-	-	10	4	1	3	12	4	1	7
8	5	1	8	10	5	1	8	12	5	1	4
8	6	0	7	10	6	1	7	12	6	1	7
8	7	1	10	10	7	1	6	12	7	1	6
8	8	1	9	10	8	0	9	12	8	0	9
8	9	0	10	10	9	0	9	12	9	1	9
8	10	0	10	10	10	1	8	12	10	-	-
8	11	1	7	10	11	-	-	12	11	0	5
8	12	0	9	10	12	-	-	12	12	1	7

TABLE IV (Continued)

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
13	1	0	8	15	1	0	6	17	1	-	-
13	2	1	6	15	2	1	2	17	2	0	5
13	3	1	5	15	3	0	7	17	3	1	6
13	4	-	-	15	4	1	3	17	4	1	4
13	5	1	4	15	5	0	5	17	5	0	8
13	6	1	6	15	6	1	4	17	6	1	6
13	7	1	6	15	7	1	7	17	7	-	-
13	8	1	7	15	8	0	5	17	8	1	6
13	9	0	8	15	9	0	9	17	9	1	8
13	10	-	-	15	10	0	8	17	10	0	8
13	11	0	2	15	11	1	6	17	11	-	-
13	12	0	6	15	12	1	8	17	12	0	7
14	1	1	6	16	1	0	8	18	1	0	9
14	2	1	2	16	2	1	7	18	2	-	-
14	3	1	4	16	3	1	8	18	3	1	3
14	4	1	5	16	4	-	-	18	4	1	6
14	5	0	9	16	5	0	9	18	5	1	8
14	6	0	4	16	6	0	7	18	6	0	7
14	7	0	6	16	7	-	-	18	7	0	3
14	8	0	8	16	8	0	9	18	8	0	8
14	9	1	7	16	9	1	8	18	9	0	7
14	10	1	7	16	10	0	10	18	10	0	10
14	11	1	7	16	11	1	8	18	11	1	7
14	12	0	7	16	12	1	10	18	12	1	6

TABLE IV (Continued)

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
19	1	0	7	21	1	-	-	23	1	0	5
19	2	-	-	21	2	1	4	23	2	0	3
19	3	-	-	21	3	-	-	23	3	1	4
19	4	0	6	21	4	-	-	23	4	1	4
19	5	0	8	21	5	1	7	23	5	-	-
19	6	0	6	21	6	1	7	23	6	0	7
19	7	-	-	21	7	0	3	23	7	-	-
19	8	1	7	21	8	1	6	23	8	0	6
19	9	-	-	21	9	1	9	23	9	-	-
19	10	1	7	21	10	0	7	23	10	1	3
19	11	0	8	21	11	0	6	23	11	0	5
19	12	1	7	21	12	0	7	23	12	1	7
20	1	1	7	22	1	0	7	24	1	1	8
20	2	1	3	22	2	1	6	24	2	0	8
20	3	0	8	22	3	1	8	24	3	1	6
20	4	-	-	22	4	-	-	24	4	0	7
20	5	0	6	22	5	1	9	24	5	0	6
20	6	0	9	22	6	0	8	24	6	1	8
20	7	1	9	22	7	0	10	24	7	1	9
20	8	1	10	22	8	0	9	24	8	1	10
20	9	0	10	22	9	1	10	24	9	0	9
20	10	1	6	22	10	0	7	24	10	1	7
20	11	1	6	22	11	1	7	24	11	0	5
20	12	0	7	22	12	1	10	24	12	1	3

TABLE IV (Continued)

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
25	1	1	8	27	1	0	9	29	1	1	9
25	2	0	5	27	2	1	5	29	2	0	7
25	3	0	7	27	3	1	6	29	3	0	7
25	4	0	6	27	4	0	7	29	4	0	9
25	5	0	7	27	5	0	5	29	5	1	8
25	6	0	7	27	6	1	7	29	6	1	10
25	7	1	9	27	7	0	7	29	7	0	8
25	8	1	9	27	8	1	8	29	8	1	9
25	9	1	9	27	9	0	7	29	9	1	10
25	10	1	5	27	10	0	5	29	10	0	9
25	11	0	7	27	11	1	7	29	11	1	8
25	12	1	6	27	12	1	8	29	12	0	8
26	1	0	9	28	1	0	5	30	1	0	6
26	2	0	6	28	2	0	4	30	2	1	5
26	3	1	5	28	3	0	9	30	3	0	6
26	4	-	-	28	4	0	7	30	4	0	2
26	5	1	8	28	5	1	9	30	5	0	8
26	6	0	7	28	6	1	10	30	6	0	7
26	7	0	10	28	7	1	9	30	7	1	9
26	8	1	10	28	8	1	10	30	8	0	9
26	9	1	10	28	9	0	8	30	9	1	5
26	10	0	6	28	10	1	10	30	10	1	5
26	11	1	7	28	11	1	7	30	11	1	5
26	12	1	9	28	12	0	10	30	12	-	-

TABLE IV (Continued)

Name	Test	Breakfast	Score	Name	Test	Breakfast	Score	Name	Test	Breakfast	Score
31	1	0	7	33	5	-	-	35	9	0	9
31	2	1	5	33	6	1	7	35	10	0	9
31	3	1	9	33	7	0	9	35	11	1	7
31	4	0	6	33	8	0	9	35	12	0	9
31	5	0	7	33	9	0	8				
31	6	1	5	33	10	1	5	36	1	1	5
31	7	0	6	33	11	0	7	36	2	-	-
31	8	0	9	33	12	1	8	36	3	1	6
31	9	1	7					36	4	-	-
31	10	1	9	34	1	1	5	36	5	1	4
31	11	0	7	34	2	1	5	36	6	1	7
31	12	-	-	34	3	0	6	36	7	0	8
				34	4	0	3	36	8	0	8
32	1	1	8	34	5	0	8	36	9	0	8
32	2	0	5	34	6	1	7	36	10	0	5
32	3	1	7	34	7	0	7	36	11	0	3
32	4	0	7	34	8	1	8	36	12	1	7
32	5	1	9	34	9	0	7				
32	6	1	9	34	10	0	8	37	1	0	7
32	7	0	9	34	11	0	8	37	2	1	4
32	8	0	7	34	12	1	7	37	3	1	6
32	9	1	10					37	4	0	2
32	10	0	9	35	1	0	10	37	5	0	5
32	11	0	8	35	2	0	5	37	6	1	6
32	12	1	8	35	3	1	9	37	7	0	6
				35	4	-	-	37	8	0	8
33	1	1	8	35	5	1	8	37	9	1	6
33	2	0	9	35	6	1	9	37	10	1	6
33	3	0	9	35	7	0	8	37	11	1	6
33	4	1	7	35	8	1	8	37	12	0	5

Note: "0" = no breakfast; "1" = breakfast; "-" = student ate a partial breakfast or did not take the quiz.

TABLE V

INDIVIDUAL QUIZ SCORE MEANS IGNORING BREAKFAST REGIMENS

DEPENDENT VARIABLE: SCORE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	23	315.81846974	13.73123781	5.37	0.0001	0.24[illegible]231	[illegible]
ERROR	378	966.79098299	2.55764810		STD DEV		SCORE MEAN
CORRECTED TOTAL	401	1282.60945274		[illegible]	1.59926486		7.0771[illegible]443

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
TEST	11	276.74713860	9.84	0.0001	11	262.59043620	9.33	0.0001
BKFST	1	0.24612092	0.10	0.7566	1	0.43011066	0.17	0.6[illegible]
BKFST*TEST	11	38.82521022	1.38	0.1792	11	38.82521022	1.38	0.1[illegible]

GENERAL LINEAR MODELS PROCEDURE

MEANS

TEST	N	SCORE
1	35	7.54285714
2	33	5.36363636
3	33	7.00000000
4	24	5.54166667
5	34	7.00000000
6	37	7.00000000
7	32	7.28125000
8	37	8.21621622
9	35	8.22857143
10	33	7.21212121
11	35	6.45714286
12	34	7.47058824

BKFST	N	SCORE
0	196	7.14285714
1	206	7.01456311

APPENDIX B

BREAKFAST SURVEY FORM

BREAKFAST SURVEY

Course Name and Number of class you are presently in: _____

Please check one: _____Male _____Female

Please check one: _____Freshman _____Junior
_____Sophomore _____Senior

Did you eat anything this morning? _____yes _____no

If yes please mark with a check the food(s) eaten.

_____tea _____fruit punch _____coffee _____kool aid
_____soda _____milk _____diet soda _____hot cocoa

_____fruit or fruit juice _____vegetable or vegetable juice

_____bread, toast, muffin, etc. _____cereal with milk _____sweet roll, doughnut
_____pancakes, waffles _____cereal no milk

_____egg _____sausage _____ham _____bacon

Other food(s) eaten not listed above (please specify).

If you ate this morning where did you eat? (check only one)
_____Residence Hall Dining Room _____At home with family _____Apartment
_____Bought breakfast on the way to class _____Other (please specify)_____

If you did not eat breakfast today indicate why.(check only one)
_____Did not have time _____Food not available
_____Not hungry _____Did not like what was served
_____Nobody to prepare it _____Did not want to eat alone
_____Did not feel good _____Eating breakfast makes me sick
_____On a diet

Do you usually eat breakfast at least five times per week.(check one) _____yes _____no

Do you think breakfast has any effect on your academic achievement? (check one)
_____yes it does _____no it does not

APPENDIX C

UNITED STATES DEPARTMENT OF AGRICULTURE

NUTRITIONAL SPECIFICATIONS FOR

BREAKFAST BARS

TABLE VI

UNITED STATES DEPARTMENT OF AGRICULTURE NUTRITIONAL SPECIFICATION FOR BREAKFAST BARS

Nutrient	Unit	Minimum	Maximum
Weight	Ounce	2.00	4.00
Moisture	Percent	--	40.00
PER	Casein 2.5	2.00	--
Fat	Percent	--	22.00
Fiber	Percent	--	0.08
Protein	Gram	5.00	--
Energy	Kilocalorie	2.00	--
Vitamin A	International unit	785.00	1,250.00
Vitamin E	International unit	5.00	--
Thiamine	Milligram	0.26	--
Tiboflavin	Milligram	0.13	--
Vitamin B_6	Milligram	0.26	--
Vitamin B_{12}	Microgram	1.25	--
Vitamin C	Milligram	25.00	--
Niacin	Milligram	2.65	--
Iron	Milligram	4.40	--
Calciam	Milligram	120.00	--
Phosphorus	Milligram	120.00	--
Magnesium	Milligram	30.00	--
Folacin	Milligram	0.04	--

Source: (45, p. 9238).

APPENDIX D

RESULTS AND FORMS USED FOR THE BLOOD GLUCOSE PORTION OF THE STUDY

Instruction Sheet

Breakfast Project: Blood Glucose Participant

First, I am grateful for your willingness to participate in the blood glucose portion of the Breakfast Project. I am sure you will find it very interesting to know how much your blood glucose fluctuates with and without breakfast. Listed below are some guidelines you will need to follow as a participant in the blood glucose portion of the Breakfast Project. Please put this paper in a safe, convenient place so that you may refer to it as needed.

1. On the Fridays which you are to have your blood glucose determined (every Friday when a class quiz is given) you must be at room 403 by 9:00 a.m.

2. To help insure consistency of the blood glucose levels determined for each participant, it is very important to consume your morning meal at 8:00 a.m. on the Fridays that you are assigned to eat breakfast.

3. Through out the semester be as consistent in both your activities and the drinking of caffeinated beverages as possible on Friday mornings, that is, do the same routine every Friday. If you normally walk to school on Friday, then walk the same distance to school every Friday. If you usually drink coffee on Friday morning then drink coffee every Friday morning. Please do not engage in excessive exercise (swimming, jogging, etc.) before 9:30 a.m. on Friday, since this will lower your blood sugar and give inaccurate results of blood sugar levels with and without breakfast.

4. On the Friday, which you are to have your blood sugar levels determined do NOT smoke before you have given blood. Smoking temporarily raises one's blood sugar.

5. If you do not follow one of the above guidelines one Friday, it is important you let the researcher know. Please write a short note on the questionaire attached to your weekly quiz indicating which guideline you did not follow. Example I: I smoked at 8:30 a.m. Example II: I jogged three miles around 8:30 a.m.

Deborah K Cantaral

Blood Glucose Participant Consent Form

Informed consent form that only participants in Part II of the breakfast study will be asked to sign.

I understand the procedures and requirements involved in the blood glucose portion of the breakfast study and agree to participate fully by furnishing one or two drops of blood via a finger prick performed following accepted clinical procedures at the scheduled times. I also agree to be as consistent as possible in my behavior and habits on the test days involved in the study. I understand, furthermore, that I may withdraw without penalty, at any time.

_____

Signature Date

TABLE VII

BLOOD GLUCOSE LEVELS AND QUIZ SCORES WITH AND WITHOUT BREAKFAST

Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level	Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level
1	1	1	7	92	13	1	0	8	72
1	2	0	5	79	13	2	1	6	93
1	3	0	7	54	13	3	1	5	89
1	4	1	8	78	13	4	-	-	-
1	5	0	7	79	13	5	1	4	80
1	6	1	6	85	13	6	1	6	84
1	7	1	4	70	13	7	1	6	88
1	9	0	6	83	13	9	0	8	80
1	10	1	6	65	13	10	-	-	-
1	11	1	4	73	13	11	0	2	70
1	12	0	4	84	13	12	0	6	80
2	1	1	8	91	22	1	0	7	87
2	2	1	6	110	22	2	1	6	81
2	3	1	9	77	22	3	-	-	-
2	4	0	5	78	22	4	-	-	-
2	5	-	-	-	22	5	1	9	79
2	6	0	5	77	22	6	0	8	76
2	7	-	-	-	22	7	0	10	81
2	9	0	7	98	22	9	1	10	73
2	10	-	-	-	22	10	0	7	78
2	11	1	6	87	22	11	1	7	82
2	12	0	8	74	22	12	1	10	88

TABLE VII (Continued)

Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level	Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level
27	1	0	9	80	32	1	1	8	91
27	2	1	5	104	32	2	0	5	86
27	3	1	6	79	32	3	1	7	91
27	4	0	7	88	32	4	0	7	81
27	5	0	5	70	32	5	1	9	78
27	6	1	7	77	32	6	1	9	84
27	7	0	7	70	32	7	0	9	76
27	9	-	-	-	32	9	1	10	92
27	10	0	5	75	32	10	0	9	70
27	11	1	7	86	32	11	0	8	77
27	12	1	8	110	32	12	1	8	79
29	1	1	9	78	33	1	1	8	83
29	2	0	7	77	33	2	0	9	80
29	3	0	7	84	33	3	0	9	93
29	4	0	9	82	33	4	1	7	88
29	5	1	8	68	33	5	-	-	-
29	6	1	10	79	33	6	1	7	110
29	7	0	8	83	33	7	0	9	81
29	9	1	10	74	33	9	0	8	84
29	10	0	9	76	33	10	1	5	93
29	11	1	8	63	33	11	-	-	-
29	12	0	8	74	33	12	1	8	89

TABLE VII (Continued)

Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level	Student Number	Quiz Number	Breakfast Regimen	Quiz Score	Glucose Level
34	1	1	5	82	34	7	0	7	75
34	2	1	5	76	34	9	0	7	84
34	3	0	6	73	34	10	0	8	77
34	4	0	3	91	34	11	0	8	78
34	5	0	8	82	34	12	1	7	78
34	6	1	7	73					

Key: Breakfast Regimen--0 means no breakfast was eaten by the student; 1 means an adequate breakfast was eaten by the student; Dash--used when the student did not eat an adequate breakfast, did not take the quiz, or his blood glucose levels were not determined.

APPENDIX E

AN EXAMPLE OF A QUIZ

FN1A/HRAD 3133 NAME_____

April 9, 1982 TEST 10 SECTION_____

DIRECTIONS: The following items are multiple choice items. Write the letter of the best answer in the blank to the left of the numbered item.

_____ 1. Pasteurized milk is

A. A good source of all water soluble vitamins
B. A pure, germ-free product
C. An emulsified product
D. Heat treated but still contains bacteria

_____ 2. A gelatin that has been quickly formed

A. Has a less stable structure than a gel which has been slowly formed
B. Has a more stable structure than a gel which has been slowly formed
C. Would be extremely grainy
D. Would have an off flavor

_____ 3. The best definition for hydrophylic is

A. A disease
B. A water/fat colloidal dispersion
C. Water-loving
D. Water-repelling

_____ 4. A fishy or beany flavor in cooking fat is called

A. Hydrolytic rancidity
B. Reversion
C. Saluration
D. Saponification

_____ 5. The development of this fishy type of off flavor could be controlled by

A. Addition of metal sequesterant (ETDA)
B. Addition of mono and diglycerides
C. Never reusing frying fat
D. Storing in a well lighted and ventilated place

_____ 6. An example of a permanent emulsion would be

A. A vinegar and oil dressing
B. Fresh, unprocessed cow's milk
C. Mayonnaise
D. Vinegar and oil dressing with paprika

_____ 7. Without proper processing and handling, polyunsaturated fats are subject to

A. Enzymatic rancidity
B. Hydrolytic rancidity
C. Oxidative rancidity
D. Saponification

_____ 8. Janice made an orange gelatin salad with pineapple tidbits for dessert. In preparing the gelatin salad she added one 3 oz. package flavored gelatin to 2 cups hot water to dissolve the gelatin. Then she stirred in one 8 oz. can of pineapple tidbits. Next she poured the gelatin into a mold. After chilling, she discovered the gelatin mixture was too soft to properly unmold. This was probably because

A. She did not allow for the juice in the can
B. The bromelin enzyme in the pineapple broke down the gelatin
C. The mold was too large
D. The refrigerator was set too warm

_____ 9. In order to make a gelled product for 16 people (1/2 cup serving size), the required amount of gelatin would be

A. 2 T
B. 4 T
C. 6 T
D. 8 T

_____10. If the product in question number 9 was tomato aspic with lemon juice, the amount of gelatin to use would be

A. A little less than usual
B. A little more than usual
C. At least twice as much as usual
D. The regular amount

APPENDIX F

STUDENT EVALUATION FORMS

Student Survey of Instruction- Oklahoma State University

Student surveys are conducted for every instructor and course at Oklahoma State University. Information gained from this survey will be useful to the instructor, the department, students, and administrators responsible for instruction at OSU. You are asked to give some information about yourself, then your views of the INSTRUCTOR and then your views of the COURSE The reverse side of this form has space for written comments.

All questions below are to be answered by blackening *with # 2 pencil* the appropriate answer space at the bottom of the page. Please make broad *pencil* marks that completely fill the area indicated. Do not mark beyond the edges of the boxes, and erase any pencil marks you wish to delete.

FOR items 1 through 5 mark your responses in answer spaces 1 through 5 below.

1. My college is: A *Agriculture* B *Arts and Sciences* C *Business* D *Education* E *Engineering* F *Graduate* G *Home Economics* H *School of Technology* I *Veterinary Medicine* J *None of These*
2. Classification: A *Freshman* B *Sophomore* C *Junior* D *Senior* E *Graduate or Special*
3. Purpose for taking course: A *Major* B *Related to major* C *General Studies* D *Elective*
4. Course was required: A *yes* B *no*
5. Type of course: A *Lecture* B *Lab* C *IPI* D *Short Course* (E) *Other*

FOR items 6 through 12 RANK THE INSTRUCTOR using this scale:

(A) *Very High*
(B) *High*
(C) *Average*
(D) *Low*
(E) *Very Low*

6. Preparation and organization
7. Effort devoted to teaching
8. Presentation of material
9. Knowledge of subject
10. Ability to explain subject matter
11. Positive attitude toward students
12. Overall INSTRUCTOR appraisal

FOR items 13 through 19 give your views of THE COURSE using this scale:

(A) *Definitely yes*
(B) *Yes*
(C) *Not applicable*
(D) *No*
(E) *Definitely no*

13. I learned a lot in this course.
14. The workload was appropriate for the hours of credit.
15. Assignments were relevant and useful.
16. Testing and evaluation procedures were good.
17. Students were adequately involved.
18. This course was worthwhile to me.
19. Overall, this was a good COURSE.

After marking your responses on this side of the form, please add any additional comments on the reverse side.

Information about yourself	Rank the INSTRUCTOR	Views of the COURSE
A B C D E F G H I J	A B C D E	A B C D E
1	6	13
2	7	14
3	8	15
4	9	16
5	10	17
	11	18
	12	19

VITA

Deborah Kay Cantaral

Candidate for the Degree of

Master of Science

Thesis: EFFECT OF BREAKFAST ON SCHOLASTIC PERFORMANCE AND BLOOD GLUCOSE LEVELS OF COLLEGE STUDENTS AT OKLAHOMA STATE UNIVERSITY

Major Field: Food, Nutrition, and Institution Administration

Biographical:

Personal Data: Born in New Cumberland, Maryland, June 28, 1955, the daughter of R. Edward and Wilma Whetstone.

Education: Graduated from Shippensburg Senior High School, Shippensburg, Pennsylvania, in May, 1973; received the Bachelor of Science in Education degree with a major in Food and Nutrition Education from Indiana University of Pennsylvania, in May, 1977; completed requirements for the Master of Science degree at Oklahoma State University in December, 1982.

Professional Experience: Graduate Research Assistant in the Department of Food, Nutrition, and Institution Administration, Oklahoma State University, 1981-1982; Expanded Food and Nutrition Aide for the Comanche County Extension Office, Lawton, Oklahoma, 1979-1981; Assistant Foodservice Manager for University Dining Facility at Indiana University of Pennsylvania, 1978-1979; Dietician for Cameron Manor Nursing Home, Indiana, Pennsylvania, 1978.

Professional Organizations: The American Dietetic Association, Kappa Delta Pi.