RELATIONSHIPS BETWEEN BREAKFAST, MIDMORNING SNACK AND STUDENT ACHIEVEMENT TEST PERFORMANCE IN LATE MORNING

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

DONALD C. TAVANO

1971

This is to certify that the

thesis entitled

RELATIONSHIPS BETWEEN BREAKFAST, MIDMORNING SNACK AND STUDENT ACHIEVEMENT TEST PERFORMANCE IN LATE MORNING

presented by

Donald C. Tavano

has been accepted towards fulfillment of the requirements for

Ph.D. degree in Education

Date July 22,

O-7639

ABSTRACT

RELATIONSHIPS BETWEEN BREAKFAST, MIDMORNING SNACK AND STUDENT ACHIEVEMENT TEST PERFORMANCE IN LATE MORNING

By

Donald C. Tavano

Problem

The major purpose of this study was to examine relationships between breakfast, midmorning snack and school performance. Specifically, the study was designed to determine (a) if a relationship existed between the performance of students on an achievement test administered in late morning and the type and amount of breakfast eaten that same morning; and (b) the effect of a liquid mid-morning snack on the performance of students on an academic achievement test administered in late morning.

Procedure

The study subjects were fourth and seventh grade students enrolled in the Lansing, Michigan School District. Five elementary schools, each having two regular fourth grade classrooms not participating in a school breakfast program, and one junior high school were randomly selected

for the study. Two hundred eighty-six fourth grade students and 333 seventh grade students participated in the investigation.

The data were collected by administering a breakfast survey form and by conducting a field experiment in which the administration of a midmorning liquid snack was varied in the target population.

The fourth grade subjects were randomly divided into two groups. One group was given a placebo drink at midmorning, the other a liquid snack of pineapple juice. Later that same morning, an achievement test was administered. The seventh grade subjects did not participate in the midmorning snack phase of the study.

The test score results and the information obtained from the breakfast survey forms were used to answer the research questions. Statistical treatments included univariate analyses of variance and multivariate analyses of variance with each of the covariables considered individually, and Scheffe' post hoc procedure for analysis of difference between means. All study questions were tested at the .05 per cent level of significance.

Findings

The pertinent findings of this study were:

1. There was no significant difference in test performance between the fourth grade subjects who ate an adequate breakfast on the test day

and those who ate an inadequate breakfast. Classification of the subjects into the "adequate" and "inadequate" breakfast groups was made on the basis of whether or not the breakfast contained 10 grams of protein.

2. There was a significant difference in the test performance between the seventh grade subjects who ate an adequate breakfast on the test day and subjects who did not eat any breakfast on the test day.
3. There was no significant difference in the test scores between those subjects who received a placebo drink at midmorning on the test day and those who received a juice drink.

Responses to two ancillary questions on the breakfast survey form produced the following findings:

1. The fourth grade subjects were generally regular breakfast eaters, the seventh graders were not (only 45% ate breakfast regularly).
2. Over half of all the subjects reported that they get tired and/or hungry at school during the morning hours.
3. Few of the study subjects appeared to be eating a breakfast that was judged nutritionally equal to or better than the U.S.D.A.

approved breakfast served by the Lansing, Michigan School District breakfast program.

Recommendations for Future Research

The findings of this study point to several areas of needed additional research. These include:

1. Controlled research into the relationships between hunger and/or "moderately" inadequate dietary intake and school learning, including the effect of skipping breakfast.
2. Further research into the total impact of school feeding programs on the child, the curriculum, and on the family.
3. Further research into the status of nutrition education in our schools and how it can be made more effective.

RELATIONSHIPS BETWEEN BREAKFAST, MIDMORNING SNACK AND STUDENT ACHIEVEMENT TEST PERFORMANCE IN LATE MORNING

By

Donald C. Tavano

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Secondary Education and Curriculum

1971

DEDICATION

TO PATTI, TIM AND JILL

ACKNOWLEDGMENTS

Sincere appreciation is expressed to the many persons who contributed to this study.

The writer is especially grateful to Dr. Charles Blackman, thesis director and chairman of the doctoral committee for his kindness, valuable guidance and generous assistance during the development of this study and throughout the writer's doctoral studies. He has exemplified the true meaning of the words scholar and educator.

Grateful acknowledgment is extended to Dr. Dena Cederquist, member of the writer's doctoral committee for her special counsel and support during the planning and conduct of the study. Appreciation is also extended to Dr. Beatrice Paolucci and Dr. Joseph Dzenowagis, the other members of the committee for their friendship, advice and encouragement.

The writer would like to express sincere thanks to Mr. Geoffrey Yager, in the Office of Research Consultation in the College of Education at Michigan State University for his generous assistance throughout the study.

Appreciation is extended to the Lansing, Michigan Board of Education for their approval to conduct the study

in the Lansing school system. Special thanks is given to the many employees of the Board of Education who gave so much direct assistance: Dr. Edward Remick and Dr. Richard Benjamin with the Office of Research and Planning and Mr. James Kitson and Mrs. Mary Ann LeMay with the Food Service Program were generous in their counsel and cooperation. The writer is also grateful to the teachers and school administrators and students whose participation was essential to the completion of the study.

Thanks are also due to Miss Nancy Pratt for her assistance in typing the draft manuscripts.

Finally a special kind of appreciation is extended to my wife Patti and children Tim and Jill. Their love, patience, understanding and self-sacrifice were foremost to the completion of this effort.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

In hearings of the United States Senate Select Committee on Nutrition and Human Needs, held in Lansing, Michigan on May 25, 1971, Dr. John W. Porter, Michigan's Superintendent of Public Instruction, made the following statement as a part of his opening testimony to the committee:

> A hungry child cannot concentrate on his studies, cannot attack the day's lesson with desire and enthusiasm, and faces his work with attention that lags and waivers.[1]

Other testimony at the hearings implied that sound eating habits can improve behavior and enhance a child's interest in learning.[2]

Reports in the literature or through the popular press attesting to the negative effect of hunger on school performance and the positive effect of school feeding programs seem to be increasing. As an educator with a professional background in public health and with a special concern for the health of the school age child, the writer

---

[1] Marcia Van Ness, "Simple Lunch Complex Issue," Lansing State Journal, May 26, 1971, p. F9.

[2] Ibid.

has a special interest in the program implications of Dr. Porter's remarks. Is there a scientific basis for his statement? What is the relation of hunger to learning?

In light of the growing interest in school feeding programs, it is felt any study which attempts to clarify this relationship and/or which helps to identify other critical issues and questions related to these programs would be useful, thus the main purpose of this investigation.

Nature of the Problem

Teachers who work with disadvantaged children report that these children are often cross, irritable, apathetic, lethargic and unable to concentrate.[3] Since learning is generally recognized as progressing in stages, this inability to concentrate could have a compounding negative effect on the child, since he may be limited in the experiential foundations necessary for later learning. He may also find it difficult to respond to social interaction with his teacher and with his peers. The consequence may be that others will stereotype him as slow or dull, causing him to be further disadvantaged as a learner. In the recent past, a great deal of attention has been given to the conviction that many children fail in school because of experiential deprivation. There seems to be a

---

[3]Rita Bakan, "Malnutrition and Learning," Phi Delta Kappan, June, 1970, pp. 527, 529.

growing concern, however, as reported by Birch and Gusson,[4] that compensatory education, important and useful as it may be, will never of itself solve the educational problems of these children. Greater attention must be given to their economic conditions, health, and nutritional status. There seems to be growing evidence that poor nutrition and learning are inextricably related.[5,6,7,8]

The relationship between dietary intake and physiological response and efficiency has been carefully studied. The studies which seem to have most significance to the educator and educational policy maker are the Iowa Breakfast Studies, which have produced at least twenty-three scientific papers reporting the results of breakfast studies in journals in the field of nutrition.[9]

Other studies show that malnourishment during critical stages in the development of the fetus and the

---

[4]Herbert G. Birch and Joan D. Gusson, Disadvantaged Children (New York: Harcourt, Brace and World, Inc., 1970), pp. 264-265.

[5]Ibid.

[6]Bakan, op. cit., pp. 527-530.

[7]Nevin S. Scrimshaw and John E. Gorden, eds., Malnutrition Learning and Behavior (Cambridge: The M.I.T. Press, 1968), p. 566.

[8]H. F. Eichenwald and P. C. Fry, "Nutrition and Learning," Science, February, 1969, p. 664.

[9]Cereal Institute Inc., A Complete Summary of the Iowa Breakfast Studies (Chicago: 1962).

infant can have a severe and often irreversible effect on the child's learning ability.[10,11,12,13]

There is less scientific study of the problem of undernourishment and hunger in school children and how this may affect school performance, though it seems to be a well accepted educational axiom that the child who goes to school hungry can't learn.[14] A relationship between hunger and learning was at least partly recognized in setting forth the objectives of the now well established National School Lunch Program.[15]

According to reports given at the White House Conference on Food, Health, and Nutrition,[16] however, seven million children are attending schools in which there are no facilities for school lunch programs. An additional 21 million children do not participate because, in many

---

[10] Bakan, op. cit.

[11] Ibid.

[12] Scrimshaw and Gorden, op. cit.

[13] Eichenwald and Fry, op. cit.

[14] "School Food Service: New Laws Can Help You Provide It," Nations Schools, Vol. 86, No. 5 (November, 1970), 61.

[15] Delbert Oberteuffer and Mary K. Beyer, School Health Education (New York: Harper and Row, Publishers, 1966), p. 419.

[16] White House Conference on Food, Nutrition, and Health, Final Report (Washington, D.C.: Superintendent of Documents, United States Government Printing Office, 1970).

cases, they cannot afford to pay for the lunch. While still concerned with extending lunch to these children, over the last few years, there has been concern and feeling that some schools must go beyond a lunch program since, for many children, this is the only really nutritious meal that is eaten.[17] It was stated earlier that testimony at the U.S. Senate hearings in Lansing implied that without an adequate breakfast, a child may become so fatigued and hungry that by late morning, he may be physically unable to learn. Although human factors such as motivation and interest may produce this same result,[18] hypoglycemia (low blood sugar) as a result of inadequate early morning dietary intake may be implicated as a causal factor.[19]

The actual number of children who come to school without an adequate breakfast is hard to determine due to difficulty in getting accurate survey data.[20] The data

---

[17] Ibid.

[18] R. Levine, "Role of Carbohydrate in the Diet," in Modern Nutrition in Health and Disease, 4th ed., ed. by M. G. Wohl and R. S. Goodhart (Philadelphia: Lea and Febinger, 1968), pp. 156-174; and M. E. Shils, "Food and Nutrition Relating to Work and Environmental Stress," in Modern Nutrition and Health and Desease, 4th ed., ed. by M. G. Wohl and R. S. Goodhart (Philadelphia: Lea and Febinger, 1968), pp. 1159-1182.

[19] W. W. Tuttle, et al., "Effect on School Boys of Omitting Breakfast. Physiologic Responses, Attitudes and Scholastic Attainments," Journal of the American Dietetic Association, Vol. 30 (1954), 674.

[20] James N. Gill, "A Breakfast Survey," The Instructor, August-September, 1964.

that are available, however, seem to indicate a high percentage of children in all socio-economic groups skip and/or skimp on breakfast for one reason or another.[21,22,23]

This undoubtedly was an important basis for the Child Nutrition Act of 1966, which authorized a two year test of breakfast programs in schools with a high percentage of needy children or with pupils who travel long distances to school. Breakfasts met minimum requirements under nutrition standards set by the U.S.D.A. Council on Foods and Nutrition. Schools that have participated in these pilot breakfast programs have reported substantial improvement in many aspects related to school performance, including increased attendance, greater class participation, and better grades.[24,25,26,27]

---

[21] Ibid.

[22] Stanford Fellers, "A Study of the Effects of Breakfast on Scholastic Attainment, Dropout Rate, and Knowledge of Nutrition Among High School Sophomores," (unpublished PH.D. thesis, Boston University, 1967).

[23] Evelyn B. Spindler, "Eating Habits of Teenagers," Food and Nutrition News, Vol. 39, No. 8 (May, 1968).

[24] Louis Monteleone, "Report of Breakfast Program," Nation's Schools, Vol. 72, No. 1 (July, 1963).

[25] J. F. Bundy, "Breakfast Follows A.M. Calesthenics," Nation's Schools, Vol. 78, No. 3 (September, 1966).

[26] April Bramyche, "Two Million Free School Breakfasts," The Times Education Supplement, November 15, 1968, p. 1074.

[27] Margaret Kaiser, "Breakfast Program Combats Pupil Apathy," Instructor, August-September, 1970, p. 114.

Although there appear to be few, if any, published surveys providing data on the extent of midmorning feeding programs in schools, this practice seems to be well established in many pre-school and kindergarten classes throughout the country.[28] In some schools the serving of a midmorning snack is justified on the basis of the nutritional value it may have in contributing to weight gains, preventing late morning fatigue, etc. In other schools the midmorning snack seems to be justified primarily in relation to its social value. Whatever the reason given to justify this practice, Keister,[29] in 1950, reported she found little in the way of experimental evidence to provide a sound rationale for providing a midmorning snack or not providing a midmorning snack. A review of the recent literature still shows few if any studies which attempt to justify or explain this practice. The fact remains that, in the absence of more and better controlled studies, the relation of early morning and/or mid-morning feeding programs to performance of young children has not been clearly established.

---

[28] Mary C. Keister, "Relation of Mid-Morning Feeding to Behavior of Nursery School Children," Journal of the American Dietetic Association, Vol. 26 (January, 1950), 256-259.

[29] Ibid.

Nature of the Investigation

The purpose of this study is to investigate (a) the possible effect of breakfast on a selected measure of school performance, and (b) a selected, immediate educational benefit that may be observed from administering a mid-morning snack to a group of school children. More specifically, the study is designed to provide answers to the following questions:

a. Will there be a relationship between the performance of fourth and seventh grade students on an academic achievement test administered in the late morning, and the type and amount of breakfast eaten that same morning?

b. Will there be a significant difference in the scores on an academic achievement test administered in late morning, between fourth grade students who receive a liquid mid-morning snack of pineapple juice and fourth grade students who receive a "placebo" drink, when type and amount of breakfast is considered a variable?

The study was not concerned with the long range nutritional effects of early morning or midmorning feeding programs.

Procedures

The data needed to answer the research questions were collected by administering a questionnaire and by conducting a field experiment in which a midmorning snack was varied in the target population in which juice and placebo drinks were administered. The basic plan for the study was as follows:*

1. All seventh graders in a large junior high school in Lansing, Michigan were given a breakfast survey form on the morning of the day in which the second part of a three part State Assessment Test was administered. The data from the questionnaire were used to group these students according to the amount and type of breakfast eaten. The test scores were used to see if a relationship existed between the type and amount of breakfast eaten and how well they performed on the test.
2. Ten fourth grade classes in Lansing, Michigan were selected to investigate the relationship between breakfast, midmorning snack and school performance. The fourth grade children in each of these classes were randomly divided into two groups. Each child in one group received at least four ounces of pineapple juice at

*Specific procedures are outlined in Chapter III.

midmorning. Each child in the second group received at least four ounces of an artificially sweetened drink that was colored to resemble the pineapple juice. While drinking their "liquid snack," they filled out a breakfast survey form. In the later hours of the morning the second part of a three part State Assessment Test was administered. This test and the data from the questionnaire were used to answer the research questions. On the third day this same procedure was repeated, with the major difference being the reversing of the study groups, e.g., the children who received the juice drink on the second day of testing received the "placebo" drink on the third day of testing.

Selection of the Type of Midmorning Snack and Placebo Drink

Consideration was given to the type of snack provided. If, as some have suggested, there is a relationship between low blood sugar and some of the subjective feelings associated with this condition (e.g., fatigue, irritability, etc.) that may interfere with learning, a snack that would contribute to an increase in blood sugar would add another important variable to the study. Pineapple juice was selected for the following reasons: (1) it could be

premixed, placed in plastic containers and would be very easy to administer under the test conditions; (2) the work of Haggard and Greenberg[30] suggests that pineapple juice would give a prompt and definite rise in blood sugar levels.

It was thought desirable to offer only juice as the midmorning snack in order to better control the study and to derive results that were more clear cut. Pineapple juice had the additional advantage of being very well liked by the study group.

The placebo drink was an artifically sweetened product without nutritive value. It could be premixed in the same type of plastic containers and with the addition of food coloring, made to look very much like the pineapple juice. A pilot study (discussed in Chapter III) indicated that the subjects would like the taste of the placebo drink as much as they would the pineapple juice drink.

Assumptions

In conducting this study it was assumed that:

a. There was a nutritive difference between the juice and placebo drinks; any difference in test scores between the juice and placebo study groups could be attributed to this nutritive difference.

---

[30] H. W. Haggard and L. A. Greenberg, "Selection of Foods for Between-Meal Feeding in Industry," Journal of the American Dietetic Association, Vol. 17 (1941), 753-758.

b. An analysis of variance based on classes and schools was considered in the statistical design of the study. Any significant differences in test scores between the "placebo" and "juice" groups could not be attributed to these factors.

c. Accurate data related to the type and amount of breakfast eaten by the subjects on the study days will be recorded on the breakfast survey form.

d. The information from the breakfast survey form can be analyzed on the basis of type and amount of breakfast eaten to accurately group the subjects.

Delimitations

The study was confined to 4th and 7th grade students in the Lansing, Michigan school district. Findings in this investigation were limited to a sample of five elementary schools (ten 4th grade classes) and the entire 7th grade population from one large junior high school. Socioeconomic and academic characteristics of the study groups are presented in Chapter III. Any inferences derived from this study are limited by the similarity of the participants to the general population of 4th and 7th grade students.

The study was conducted between January 18-23, 1971. The seasonal variable might have been an influence on the amount and type of breakfast eaten by the subjects. It might be concluded, for example, that the subjects would be more likely to eat breakfast during the cold month of January than at another time of the year. Any assumption made related to the amount of breakfast eaten by the subjects, therefore, would have to take this into consideration.

The inability to provide effective controls was a major limitation in the study. It was impossible to separate the possible effect of breakfast on test scores from other environmental factors that may be related to the breakfast eating patterns of the subjects. These factors may also have significantly influenced test performance. Therefore, if a significant difference is found between a "breakfast - no breakfast group" as indicated by test performance, can this really be attributed to a lack of breakfast or to other related environmental influences?

Definition of Terms

Terms and phrases which were of prime importance in this investigation are defined as follows:

Adequate breakfast: A breakfast that contains at least 10 grams of protein.

Inadequate breakfast: A breakfast that contained less than 10 grams of protein.

U.S.D.A. approved breakfast: A breakfast, as defined in the Child Nutrition Act of 1966, consisting of at least 1/2 pint of milk, 1/2 cup of fruit or full strength fruit or vegetable juice, enriched bread, rolls or muffins or 3/4 cups of whole grain cereal or its equivalent.

Juice drink: At least 4 ounces of pure unsweetened Hawaiian pineapple juice.

Placebo drink: At least 4 ounces of an artificially sweetened, non-nutritive drink that resembled the juice drink.

Test 1: Assessment based on reading skills.

Test 2: Assessment based on mathematic skills.

Overview

In Chapter II, the pertinent literature related to this investigation has been reviewed. Studies related to the relation of nutrition, breakfast and between meal feeding to learning have been described.

Chapter III describes the procedures used in the conduct of the study. The population, selection of the sample, instruments and procedures used to collect and analyze the data are delineated.

The analyses of the data related to the research questions and an analysis of the information obtained from the ancillary questions on the breakfast survey form are presented in Chapter IV.

Chapter V includes the summary of findings and discussion related to these findings, conclusions, implications and recommendations for future research.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The capacity of educators to make wise decisions related to program planning is largely dependent upon the ability to analyze and interpret the results of research related to program goals. If, for example, an educational goal is to facilitate optimal intellectual and psychological development in children, the proportion of effort which should go into school feeding programs, relative to other programs, should depend upon the results of research related to nutrition and intellectual and psychological development. The program planner must present a rationale for proposed programs.

The literature reviewed focuses on studies most relevant to nutrition, learning and behavior since the main purpose of this study is to investigate the relation between breakfast and midmorning snack and school performance.

The review of the literature relevant to the study falls into three main areas. Pertinent studies dealing with (a) the relation of nutrition to learning and behavior

in children; (b) performance and behavior in school children in relation to frequency, type and amount of breakfast eaten; and (c) performance and behavior in school children in relation to between meal feeding.

Relation of Nutrition to Learning and Behavior in Children

In Chapter I it was stated that there is concern over attempts to remedy school failure exclusively through educational intervention.[1] The argument does not seem to be for fewer positive alterations in our educational systems but as Birch and Gussow[2] plead, for more and greater recognition of the negative consequences of poor health and nutrition. As they soberly point out, "compensatory education may make up for a home in which the 'cognitive environment' is restricted, but it cannot make up for a childhood spent with an empty belly."[3]

Judging from a study of the literature over the past few years, the relation of nutrition to learning is being studied more carefully than ever before, both in experimental animals and in human subjects. It seems clear that there is an intimate association between poor

---

[1] Birch and Gussow, op. cit.

[2] Ibid., pp. 264-265.

[3] Ibid., p. 267.

nutrition and a variety of diseases and health problems.[4,5,6,7] Numerous other studies reported by Birch and Gussow,[8] and Scrimshaw and Gordon[9] add to the ample research evidence to support this conclusion. The full educational implications are not clear but if it is known that a child is less responsive to his environment at the time he is ill or in poor health, he will have, at the very least, less time in which to learn. If illness is frequent or extended it may well follow that the child may become significantly retarded in his intellectual development. Two other possible indirect effects of illness and poor health caused by malnutrition are stated

---

[4]G. G. Graham and E. Morales, "Studies in Infantile Malnutrition 1. Nature of the Problem in Peru," Journal of Nutrition, Vol. 79 (1963), 479-487.

[5]J. Cravioto, "Malnutrition and Behavioral Development in the Pre School Child," in Pre School Child Malnutrition: Primary Deterrent to Human Progress. An International Conference on Prevention of Malnutrition in the Pre School Child, Washington, D.C., December 7-11, 1964 (Washington, D.C.: National Academy of Sciences National Research Council Publication No. 1282, 1966).

[6]N. S. Scrimshaw, C. E. Taylor, and J. E. Gordon, "Interactions of Nutrition and Infection," WHO Monograph Series, No. 57, 1968.

[7]N. S. Scrimshaw, "Malnutrition and the Health of Children," Journal of the American Dietetic Association, Vol. 42 (1963), 203-208.

[8]Birch and Gussow, op. cit., pp. 177-184.

[9]Scrimshaw and Gordon, eds., Malnutrition Learning and Behavior, op. cit.

by Birch and Gussow.[10] They refer to the evidence suggesting that interference with the course of the learning process at specific times may result in retarded development which is profound and, in some cases, irreversible. Although they point out that these critical periods in human learning have not been definitely established, they refer to the works of Cravioto,[11] Scott,[12] and Keys et al.,[13] which indicate a strong association between the age of onset and duration of malnutrition and the effects of subsequent mental performance.

Another indirect effect of illness caused by malnutrition, discussed by Birch and Gussow, related to the effects of ill health in altering the child's responsiveness to stimulation and the emergence of various degrees of irritability or apathy. They state:

> Such behavior on the part of an infant can function to reduce his value as a positive stimulus, diminishing the adult's responsiveness to him in turn and thus contributing to a cumulative pattern of reduced child-adult interaction. If this occurs, it can have consequences for stimulation, for learning, for maturation, and for interpersonal relations--the end results being a significant

---

[10] Birch and Gussow, op. cit., pp. 261-262.

[11] Cravioto, op. cit.

[12] J. P. Scott, "Critical Periods in Behavioral Development," Science, Vol. 138 (1962), 949-958.

[13] A. Keys, et al., The Biology of Human Starvation (Minneapolis: University of Minnesota Press, 1950).

backwardness in performance on later, more complex learning tasks.[14]

A number of other recent studies have suggested a positive link between nutrition and learning. It might be helpful to review some of the most significant findings.

Ricciuti,[15] identifies the question which is central to most of these studies: "What is the influence of malnutrition on intellectual development, learning and educational achievement in children; can this influence be separated from the concominant effects of other social, environmental, and biological conditions typically associated with malnutrition?"

It becomes apparent from a review of the literature that one of the major problems confronting researchers dealing with this question is that it is very difficult to secure reliable and valid assessments of the nutritional status of children. This seems to be especially true when the researcher wishes to explore questions related to nutrition and learning that do not involve clinically obvious and severe malnutrition. Aware of the difficulty in human subject studies, many researchers have confined their investigations into the effect of learning

---

[14]Birch and Gussow, op. cit., p. 262.

[15]Henry N. Ricciuti, Malnutrition, Learning and Intellectual Development, Cornell Research Program in Early Childhood Education (Ithaca, N.Y.: Cornell University, 1969), p. 5.

and malnutrition to animal studies, with the assumption (or hope) that they would have some heuristic value as far as children are concerned.

Several reported investigations[16,17,18,19] of the effect of poor nutrition on animals have shown consistent results--undernutrition prior to birth and in infancy appears to have direct negative effects on the development of the brain. The crucial variables appear to be the extent and duration of undernutrition and the period of time (age) at which the undernutrition occurs. Significant behavioral changes in animals are also reported as the result of malnutrition.[20,21]

---

[16] R. H. Barnes, "Developmental Consequences of Malnutrition: Experimental Studies in Animals." Paper read at Conference on Nutrition, Growth and Development of North American Indian Children, Oklahoma City, May, 1969.

[17] Scrimshaw and Gordon, eds., op. cit., pp. 167-250.

[18] M. Winick, "Malnutrition and Brain Development," Journal of Pediatrics, May, 1969, p. 667.

[19] Birch and Gussow, op. cit., pp. 196-220.

[20] R. H. Barnes, et al., "Effect of Food Deprivation on Behavioral Patterns," in Scrimshaw and Gordon, eds., op. cit., pp. 203-217.

[21] B. S. Platt, C. R. C. Heard, and R. J. C. Stewart, "Experimental Protein-Calorie Deficiency," in Mammalian Protein Metabolism, Vol. 2, ed. by H. N. Monro and J. B. Allison (New York: Academic Press, 1960).

A substantial amount of evidence from human studies has been reported[22,23,24,25,26,27,28] which seem to reinforce the findings of experiments with animals. These investigations strongly suggest that, as in animals, the period before birth and during infancy is a critical period in the development of the central nervous system. Further, these studies suggest that adequate nutrition during critical stages of growth seems to be critical to the proper development of the brain and subsequent intellectual development of the child. Few, if any, reported studies on malnutrition and intellectual development were conducted in the United States. Recently, however, one such study in Colorado was conducted and reported by Chase and Martin.[29]

---

[22]Scrimshaw and Gordon, eds., op. cit., pp. 252-310.

[23]Winick, op. cit.

[24]Birch and Gussow, op. cit., pp. 177-220.

[25]H. F. Eichenwald and P. C. Fry, "Nutrition and Learning," Science, February, 1969, p. 664.

[26]M. T. Erickson, "Intelligence: Prenatal and Preconception Environmental Influences," Science, September, 1967, p. 1210.

[27]M. Winick and P. Rasso, "Head Circumference and Children," Journal of Pediatrics, May, 1969, p. 774.

[28]F. Monekeberg, "Nutrition and Mental Development," a Paper presented at the Conference on Nutrition and Human Development, East Lansing, Michigan, 1969.

[29]H. P. Chase and H. P. Martin, "Undernutrition and Child Development," Paper presented at Conference on Neuropsychological Methods for the Assessment of Impaired Functioning in the Malnourished Child, Palo Alto, California, June, 1969.

The study was carried out in a sample of 20 children who had been hospitalized for malnutrition before the age of one year. These children had a mean Developmental Quotient of 82 when examined several years later. This, they found, was significantly lower than the mean Developmental Quotient of 99 found in a carefully matched control group of non-malnourished children. They concluded from their work, however, that even though the study was carefully designed and controlled, it was virtually impossible to completely separate malnutrition from environmental influences which may have had some effect on the results. There have been other studies reported which have attempted to show a relationship between the effects of poor nutrition on intellectual performance.[30,31,32] Evidence seems to be that adequate nutrition is one important variable related to the intellectual functioning of the child.

There seem to be few studies on the relation between nutrition and behavior in school children. Birch and Gussow[33] report on several studies which associate early malnutrition with psychological disturbance but suggest that this is confined to the time they are

---

[30] Rita Bakan, "Malnutrition and Learning," Phi Delta Kappan, June, 1960, pp. 527-530.

[31] Scrimshaw and Gordon, eds., op. cit., pp. 250-310.

[32] Birch and Gussow, op. cit., pp. 177-220.

[33] Ibid., pp. 186-187.

clinically ill. The authors report that once malnourished children have recovered, relatively normal responsiveness is restored. Further discussion in relation to nutrition and behavior in school children will be discussed when consideration is given to studies related to the effect of breakfast and between meal feeding on behavior of school children.

There are several studies which report the positive effect of nutritional therapy or remediation on the improvement of intellectual performance. Kugelmass et al[34] demonstrated an increase in the I.Q. scores of children as a result of dietary improvement. However, there was no way to be sure if the increase in I.Q. change was in fact due to the presumed nutritional change or due to other social and environmental variables which were impossible to control. Harrell[35] reported that orphanage children who were given thiamine over a year period, scored higher in school learning than a carefully matched group of children who were given placebo tablets. In more recent investigations, Coursin[36] has demonstrated that children who show abnormal mental functioning as a result of

---

[34] I. N. Kugelmass, L. E. Paull, and E. L. Samuel, "Nutritional Improvement of Child Mentality," American Journal of Medical Science, November, 1944, p. 631.

[35] R. F. Harrell, "Mental Response to Added Thiamine," Journal of Nutrition, March, 1946, p. 283.

[36] D. B. Coursin, "Effects on Central Nervous System Function," Nutrition Review, March, 1965, p. 65.

deficiencies in the B-complex vitamins and in Vitamin C can be helped with vitamin therapy. Monro[37] recently conducted a study to learn whether or not poor nutrition, as indicated by low hemoglobin levels, affected the intelligence and behavior of 113 Head Start children in Missoula, Montana. An experimental group of children were given iron tablets at school and another control group was given placebos. Blood tests were taken at intervals during the year, and teachers rated behavior. I.Q. tests were given prior to the study. Results of the data indicated that the iron pills did not significantly affect hemoglobin levels. However, for those with low hemoglobin levels, increases in the levels were associated with increases in intelligence scores.

On the basis of those studies that have been reported in the literature and which have been reviewed, one would have to conclude that adverse effects on the mental development of the child are likely to occur and will be significant and irreversible if malnutrition occurs during the fetal development and/or during the first few months of life, if the malnutrition is severe and long lasting, e.g., goes without remediation for any length of time. It seems necessary to make qualitative statements even with this basic conclusion. The direct

---

[37] Nancy Monro, The Relationship Between Hemoglobin Level and Intellectual Function (Missoula: Montana University, Missoula Foundation, 1967).

evidence related to age of onset and duration of malnutrition still seems quite limited. There does not seem to be conclusive evidence on the extent to which various types of remediation programs will improve the effects of early malnutrition on mental development. As Ricciuti states,

> . . . as scientists and as practitioners or program planners, we need to be careful not to be drawn prematurely into inferring from our research, the general conclusion that . . . malnutrition is of itself a major determinate of severe and permanent impairment of intellectual function of children.[38]

Finally, it seems the question that has the greatest implication for curriculum still remains unanswered. That is, what role does moderate or mild malnutrition, undernutrition, and/or hunger play on the child's intellectual development and school learning? Ricciuti[39] and Wagner[40] suggest that it may not be significant, in comparison with the influences of other social, environmental and genetic factors. Birch and Gussow[41] seem to suggest that it may be significant to learning. In any case, the issue seems to be important enough for further study.

---

[38] Ricciuti, op. cit., p. 24.

[39] Ibid., p. 25.

[40] Muriel G. Wagner, "Nutrition and Mental Development," Research Report No. 5, 1969 (Detroit: Merrill Palmer Institute; East Lansing: Michigan State University, Head Start Evaluation Center).

[41] Birch and Gussow, op. cit., p. 262.

Performance and Behavior in School Children in Relation to Frequency, Type and Amount of Breakfast Eaten

It was stated in Chapter I that the actual number of children who come to school without an adequate breakfast is hard to determine due to the difficulty in getting accurate survey data. A review of the literature has revealed several studies[42,43,44,45,46] which have tried to provide data related to the extent to which school children eat breakfast. The results of these nationwide and local surveys reveal that a significant number of children go to school without an adequate dietary intake. The results are consistant with one survey that seems to be most closely related to this study. Pearce[47] reported on a survey into the breakfast habits of 800 seventh graders in Oxnard, California. He found that 33% ate what could be considered a good breakfast, 35% had a fair breakfast, and 30% of the seventh graders had no breakfast at all. The investigator did not report the criteria used for the

---

[42] Gill, op. cit.

[43] Fellers, op. cit.

[44] Spindler, op. cit.

[45] Monteleone, op. cit.

[46] Cereal Institute, Breakfast Source Book (Chicago: Cereal Institute, Inc., 1957), p. 4.

[47] Galen L. Pearce, "A Better Breakfast Campaign," Journal of School Health, Vol. 31, No. 9 (November, 1961), p. 317.

classification of subjects into these three groups, which is the difficulty in interpreting many of these surveys, e.g., the reports do not define what is an adequate breakfast.

As Fellers[48] has concluded, the notion that eating breakfast will have a favorable effect on school performance seems to be a common one.

A substantial number of studies related to performance and behavior in school children in relation to type and amount of breakfast eaten are reported in the literature. Some were carefully controlled investigations, others were no more than statements and conclusions based wholly on subjective attitudes and opinions. Consider the statement made by Mayor Walter Washington of the District of Columbia at the White House Conference on Foods, Nutrition and Health: "the child who wakes up hungry, goes to school hungry, cannot develop into a good citizen."[49] Considering the implications, should not educators want to be quite sure there is a scientific basis for this statement?

---

[48] Fellers, op. cit., p. 30.

[49] Walter Washington, Opening statement at the White House Conference on Foods, Nutrition and Health, Final Report (Washington, D.C.: Superintendent of Documents, United States Government Printing Office, 1970).

A considerable number of published investigations related to the question of breakfast and performance have been a result of the Iowa Breakfast Studies. Most of these studies were concerned with the physiologic effects of omitting breakfast and breakfast containing various amounts and kinds of nutrients. Some of the most significant of these studies will be reviewed.

Several experiments were reported which deal with the effects of omission of breakfast on efficiency in late morning hours.[50,51,52] The general conclusion that seems warranted from these studies is that the omission of breakfast resulted in decreased efficiency in the late morning hours, as reflected in decreased physiologic performances.

---

[50] W. W. Tuttle, M. Wilson, and K. Daum, "Effects of Altered Breakfast Habits on Physiologic Response," Journal of Applied Physiology, Vol. 1 (1949), 545.

[51] W. W. Tuttle, et al., "Effects of Omitting Breakfast on the Physiologic Response of Men," Journal of the American Dietetic Association, Vol. 26 (1950), 332.

[52] K. Daum, et al., "Effect of Various Types of Breakfast on Physiologic Response," Journal of the American Dietetic Association, Vol. 26 (1950), 503.

Several experiments were reported[53,54,55,56] which had as their main objective a comparison of the effectiveness of various types of breakfast on efficiency in late morning hours. These studies seemed to show that the type of breakfast is not a major determining factor in the efficiency of performance so long as the morning meal is basically adequate in its nutritional content. The importance of protein in the breakfast was studied[57,58,59,60]

[53] Ibid.

[54] W. W. Tuttle, et al., "Effects of Breakfast of Different Size and Content on Physiologic Response of Men," Journal of the American Dietetic Association, Vol. 27 (1951), 190.

[55] W. W. Tuttle, et al., "Physiologic Response to Size Content of Breakfast by Men over 60," Journal of the American Dietetic Association, Vol. 29 (1953), 34.

[56] K. Daum, et al., "Physiologic Response of Boys 12-14 Years Old to Different Breakfasts," Journal of the American Dietetic Association, Vol. 31 (1955), 359.

[57] V. E. Addison, et al., "Effects of Amount and Type of Protein in Breakfasts on Blood Sugar Levels," Journal of the American Dietetic Association, Vol. 29 (1953), 674.

[58] M. C. Coleman, W. W. Tuttle, and K. Daum, "Effects of Protein Source on Maintaining Blood Sugar Levels After Breakfast," Journal of the American Dietetic Association, Vol. 29 (1953), 239.

[59] E. B. Forbes and R. W. Swift, "Associative Dynamic Effects of Protein, Carbohydrate and Fat," Journal of Nutrition, Vol. 27 (1964), 453.

[60] C. M. Karl, W. W. Tuttle, and K. Daum, "Effects of Protein Source and Specific Dynamic Action," Journal of the American Dietetic Association, Vol. 29 (1953), 1208.

in relation to the effect it had on maintaining blood sugar levels above the fasting levels in the late morning hours. These investigations indicate that 20 to 25 grams of protein were adequate in this regard, where 10 grams seemed to be inadequate to maintain blood sugar significantly above fasting levels. These conclusions have special significance to this study, if we accept the conclusions of Van Itallie et al.[61] which suggests a relationship between the blood sugar level, hunger and efficiency. Again, these investigations indicate clearly that when breakfast is omitted, or when adequate amounts of food are not included in the morning meal, a condition of hypoglycemia (low blood sugar) is almost sure to exist throughout the late morning hours.

The study which seems to have most significance to curriculum planning was the relation of omission of breakfast to attitudes and scholastic attainments.[62] In an experiment involving junior high school boys, teachers made careful observations and records of the attitudes and scholastic attainments of the boys during a period of time when their total daily food allowances were rigidly

---

[61] T. B. Van Itallie, R. Beaudoin, and J. Mayer, "Arteriovenous Glucose Differences, Metabolic Hypoglycemia and Food Intake in Man," American Journal of Clinical Nutrition, Vol. 1 (1953), 208.

[62] W. W. Tuttle, et al., "Effect on School Boys of Omitting Breakfast. Physiological Responses, Attitudes, and Scholastic Attainments," Journal of the American Dietetic Association, Vol. 30 (1954), 674.

controlled. The report concluded that the majority of the boys had a definitely better attitude and a better scholastic record during the period when breakfast was eaten than when it was omitted. The study also reported that some of the boys became careless and inattentive when breakfast was omitted. As in the studies that will be reviewed below, however, the conclusions were primarily made on the basis of subjective assessments of performance, e.g., it was the opinion of the school principal and of the teacher that breakfast was a material asset to the boys in the matter of attitude and scholastic attainment.

Other studies have been reported in the literature which have attempted to show the relation of breakfast to school performance. Kaiser[63] reported on a breakfast program that was conducted in the Nicholson Elementary School in Richmond, Indiana. The school was concerned with so many children coming to school listless, drowsy, apathetic and tardy. Juice, toast, and milk were offered to the students with the hope that it would improve the situation. Although it was recognized that qualitative programs are hard to measure, tardiness was reduced by 50% and faculty felt students were more interested in attending regularly and seemed more interested in learning. They also reported the students as more alert, receptive and cooperative.

---

[63]Kaiser, op. cit.

Under the Child Nutrition Act of 1966, the New Dotmond School in North Carolina authorized a two-year test of breakfasts in schools with high percentages of needy children or with pupils who traveled long distances to school. The program reported by Gill[64] provided breakfasts which met minimum requirements under nutrition standards set by the U.S.D.A. Council on Foods and Nutrition. The breakfast provided one-half pint of milk, one-half cup of fruit or full strength fruit or vegetable juice, either enriched bread, rolls, muffins, or three-fourths cup of whole grain cereal. The program was flexible enough to allow for regular or occasional participation by the students. In an initial survey, it was found that 30% of the students did not eat breakfast before coming to school; there was frequent reporting of headaches, stomach aches, inattentiveness, tardiness, dullness, and irritability. An evaluation of the program showed an increase in attendance, greater class participation, some improvement in hemoglobin levels and increased performance on achievement tests. It was impossible to relate these improvements to the breakfast program, however, since the school decided to make the breakfast program one part of a unified effort in instruction, child health and nutrition.

---

[64]Gill, op. cit.

Bramwyche[65] reported on the results of a breakfast program in Cleveland, Ohio. The program involved 24,695 children attending 29 inner city schools, and was part of a complex program which attempted to deal with the intolerable conditions brought about by poverty. The program's aim was to improve nutrition and help reorient the children's attitudes toward school. The reported results of the program were an increase in attendance, improvement in marks, increase in attention span, improvement in reading rate and arithmetic; and where teachers had breakfast with the students, better teacher-pupil relationships.

Monteleone[66] reported that children were more alert, had better study habits, and had fewer discipline problems after a breakfast program was initiated in the Teague Elementary School in Fresno, California.

Carter[67] reported similar results in a breakfast program following calesthenics in the J. F. Bundy School in Washington, D.C.

Fellers[68] conducted an investigation to determine if an adequate breakfast may have an effect on the

---

[65]Bramwyche, op. cit.

[66]Monteleone, op. cit.

[67]Charles E. Carter, "Breakfast Follows Pushups-Showers," Nation's Schools, Vol. 78 (S' 1966), 96.

[68]Fellers, op. cit.

scholastic attainment, rate of absenteeism, and drop out rate of high school sophomores in New Bedford, Massachusetts. His findings indicated there was no significant difference in the final yearly grades, deportment, rate of absenteeism, rate of tardiness, and drop out rate in the groups of 10th grade students who ate breakfast, compared with 10th grade students who did not eat breakfast.

It can be concluded from these breakfast studies that the relation between omission of breakfast and physiologic response seems to be well documented. There are also a substantial number of reports which point to school breakfast programs as having a positive effect on school performance, but as Ricciuti points out: "The possible influence of . . . breakfast programs on school performance has apparently been scientifically investigated only rarely, with little or no evidence of effectiveness in this regard."[69] It appears from these reports that the relation of breakfast to school performance has been established, but only in a most general way due to the lack of controlled experimentation.

---

[69]Ricciuti, op. cit., p. 27.

Performance and Behavior in School Children in Relation to Between Meal Snacks

Just as Ricciuti[70] points out the inadequacy of research into the relation of school breakfast programs to school performance, a review of the literature reveals this appears also to be the case for what has become the traditional "mid-morning snack" program in many of our schools. Several reported investigations related to the positive effects of mid-morning snacks seem related to this study.

As early as 1927, Haggard[71] pointed out that decreased performance occurring in the late morning might arise from low blood sugar levels.

In 1935, Haggard and Greenberg published the results of their research in the problem of frequency of meals in a book entitled, Diet and Physical Efficiency.[72] Their conclusions were that the common practice of eating the day's supply of food in three meals did not promote greatest efficiency and vigor. Of importance in this study are their findings related to the rise and fall of efficiency as it relates to mealtime interval. They

---

[70] Ibid.

[71] H. W. Haggard, Science of Health and Disease, 1st ed. (New York: Harper and Brothers, 1927), pp. 421-422.

[72] Howard Haggard and Leon E. Greenberg, Diet and Physical Efficiency (New Haven: Yale University Press, 1935).

observed that blood sugar levels and muscular efficiency rise sharply after breakfast; they both fall again to the before breakfast level within a period of 2 1/2 to 4 hours unless another meal is eaten. The authors maintain that this decrease in efficiency is not due to subjective feelings of fatigue. In their studies, they were able to provide an increase in performance in the late hours of the morning by changing from three to five meals per day (with no change in total food intake). The authors summed up their work with the following statement:

> Our conception of the five meal/day schedule calls for the conventional three meals with the addition of two smaller meals: mid-morning and mid-afternoon lunches. But on such a schedule, as on any other, no one meal stands alone in the diet; each is merely a part of the total daily intake of food and should be planned with the total view. From the dietetic point of view the food eaten at the two extra meals is not to be added to that of the regular meals, but subtracted from them; it is merely eaten at another time. Due provision must be made that the selection of food for the smaller meals is properly supplementary to the larger meals.
>
> With reasonable caution in this regard it is entirely possible to obtain freedom from the feeling of fatigue, irritability, and from muscular inefficiency by frequent feeding and at the same time to satisfy all the requirements of a fully balanced diet.[73]

Their studies made no attempt to control all the factors which might have influenced increased performance in their study subjects.

---

[73] Ibid., p. 155.

Studies[74,75] of absenteeism among factory workers and among clerical workers also suggest a positive effect to be gained from snacks. An improvement of morale seems to be another benefit of these supplementary feedings.[76,77] Other earlier investigations[78,79,80] have suggested that a mid-morning snack may be desirable in helping to relieve fatigue, nervousness, or irritability in children.

Of particular interest is a study conducted by Keister,[81] who investigated the common educational practice of serving pre-school children a mid-morning lunch. More

---

[74] L. Comstock, and W. Eddy, "The Effect of a Supplementary Rest Period Luncheon on Industrial Absenteeism," Journal of the American Dietetic Association, Vol. 11 (1935), 239.

[75] H. W. Haggard and L. W. Greenberg, "Between Meal Feeding in Industry: Effects on the Absenteeism and Attitude of Clerical Employees," Journal of the American Dietetic Association, Vol. 15 (1939), 435.

[76] Howard Haggard and Leon E. Greenberg, Diet and Physical Efficiency, op. cit.

[77] H. W. Haggard and L. E. Greenberg, "Selection of Foods for Between-Meal Feeding in Industry," Journal of the American Dietetic Association, Vol. 17 (1941), 753.

[78] F. L. Goodenough, Anger in Young Children (Minneapolis: University of Minnesota Press, 1931).

[79] D. A. Laird, M. Levitan, and U. A. Wilson, "Nervousness in School Children as Related to Hunger and Diet," Medical Journal Record, Vol. 134 (1934), 494.

[80] B. Wait, O. Merrlain, and M. U. Cowing, Supplementary Midmorning Feeding of Rural School Children, Massachusetts Agricultural Experimental Station Bulletin No. 310, 1934.

[81] Keister, op. cit.

specifically, the main aim of the study was to investigate the relation of mid-morning snack to behavior of children.

Trained observers, using time sampling methods, obtained the measures of behavior. Water (control group) or pineapple juice (study group) was served daily at mid-morning. It was the judgment of the investigator that nursery school children who were served a mid-morning snack "did better" in terms of behavior than those who did not receive the mid-morning snack. The investigator states:

> It is our conclusion that mid-morning feeding of fruit juice to children of pre-school age has no detrimental effect and will, in a majority of cases, be beneficial in relieving fatigue, in reducing irritability and tension, and in promoting a feeling of satisfaction and well-being over the next few hours before lunch.[82]

Recognizing the lack of quantitative data on the effects of mid-morning snack on performance, this area was investigated as a part of the Iowa Breakfast Studies.

The object of the main experiment reported[83] was to study the effect that the mid-morning break had on maximum work output. Data were secured over a two year period from 20 subjects who worked in industry. The study results seemed to warrant the following conclusions:

---

[82] Ibid., p. 29.

[83] W. W. Tuttle, and E. Herbert, "Work Capacity With No Breakfast and a Mid-Morning Break," Journal of the American Dietetic Association, Vol. 37 (1960), 137.

1. The study subjects did significantly more work when an adequate breakfast was eaten than when it was omitted.
2. When an adequate breakfast was eaten, the addition of a mid-morning break (including snack foods) resulted in no increase in work performance.
3. If an adequate breakfast was not eaten, the addition of a mid-morning break resulted in an increase in work performance for 45% of the study subjects.

Recent studies[84] have indicated that eating frequency may affect lypogenesis, serum cholesterol levels, enzyme activity of tissues, and metabolic pathways. Even so, it seems frequency of feeding is a dietary parameter that seems to have received little attention.[85]

Overview

The purpose of Chapter II was to review the most pertinent literature dealing with the relation between nutrition, learning, and behavior in children. Studies

---

[84] P. Fabry, et al., "Effects of Meal Frequency on School Children," American Journal of Clinical Nutrition, Vol. 18 (1966).

[85] Ercel S. Eppright, "The North Central Regional Study of Diets of Pre-school Children. Frequency of Eating," Journal of Home Economics, Vol. 62 (1970), 407.

dealing with performance and behavior in school children in relation to breakfast and between meal feeding have also been described.

Chapter III describes the procedures used in the conduct of the investigation. The population, sampling, the instruments, methods for collecting, tabulating and analyzing the data are delineated.

CHAPTER III

PROCEDURES

The purpose of this chapter is to describe the procedures employed in examining the research questions. The following sections are included: a description of the study population, selection of the sample, the instruments used for the collection of the data, and the methods used in the analysis of the data.

The Population

Subjects from which the data were collected for the study came from a population comprised of fourth and seventh graders in the Lansing, Michigan school system. There are 49 elementary schools in the district which act as feeder schools to five large junior high schools located throughout the city.

The fourth grade population was limited to those elementary schools that had two regular fourth grade classrooms and which were not participating in a school breakfast program. All of the junior high schools were included in the population.

The population was limited to fourth and seventh graders since these grades were involved in a statewide

assessment program that was conducted by the Michigan Department of Education. There seems to be a growing concern on the part of parents as well as teachers that too much class time is devoted to testing children so it seemed desirable to use tests already scheduled for this investigation.

Those schools in the Lansing school system that were participating in a school breakfast program were also systematically eliminated from the sampling. Including these schools would have made it impossible to establish type of breakfast as a study variable since the study contained a breakfast survey.

The population was limited to schools with two regular fourth grade classes. If only one class was selected from a school, the test scores would less likely be representative of the schools' fourth grade population than would the mean scores of two classes; e.g., the statistical design would be less subject to sampling error.

Sampling

Five elementary schools were used in the investigation, selected from the population through a table of random numbers. The junior high school from which the seventh grade was selected was also picked at random.

Selected data presenting a school "profile" of the fourth grade schools are presented in Table 3.1. With one

TABLE 3.1.--Selected socio-economic and academic characteristics--elementary study schools.*

Characteristic	System Mean	Study Schools				
		1	2	3	4	5
Percentage of parents with an education beyond high school	24	30	23	29	32	13
Percentage of parents without high school diploma	45	45	54	47	53	45
Percentage of working parents with professional and/or managerial jobs	18	19	16	27	26	11
Percentage of working parents with semi-skilled or unskilled jobs	48	57	38	34	32	60
Percentage of children from families where both parents work	32	23	35	33	30	38
Percentage of pupils from families receiving ADC or welfare	6	2	3	4	0	2
Percentage of children from minority or ethnic groups	19	5	4	12	9	5
Average academic aptitude test percentile score for grades 3 and 5 (composite)	47	53	60	50	58	40
Composite stanine scores for grades 2, 4, and 6, 1970						
Reading:	4.5	4.6	4.5	4.8	5.7	4.3
Arithmetic:	4.5	4.4	4.6	4.7	5.3	4.3

*Data provided by the Lansing Board of Education, 1971.

exception, the schools were above the school district average in several selected characteristics related to socio-economic background and academic achievement. This would be expected since those schools that had school breakfast programs were excluded from the study. Most of the schools in low socio-economic areas in the district are participating in breakfast programs.

The junior high school involved in the study was one of the five large junior high schools in the school district. A "school profile" of the school was not available. However, an analysis of the "feeder" elementary schools provided the information presented in Table 3.2.

It can be determined from the composite profile of the feeder elementary schools that the junior high school was typical with the exception that it may have contained somewhat fewer minority and ethnic groups, and low income families than might be expected if the feeder schools were selected at random. As stated earlier, each of the elementary schools selected had two regular fourth grade classrooms. The juice and placebo groups within each of these classrooms were selected by taking class lists and randomly dividing them into two groups.

A total of 286 fourth grade subjects were involved in the study.* A total of 333 seventh grade students in

*Analyses of the data did not require a grouping of fourth grade subjects by sex.

TABLE 3.2.--Selected socio-economic and academic characteristics--junior high study school.*

Characteristics	System Mean	Junior High**
Percentage of parents with education beyond high school	24	20
Percentage of parents without high school diploma	45	50
Percentage of working parents with professional and/or managerial jobs	18	16
Percentage of working parents with semi-skilled or unskilled jobs	48	49
Percentage of children from families where both parents work	32	33
Percentage of pupils from families receiving ADC or welfare	6	3
Percentage of children from minority or ethnic groups	19	10
Average academic aptitude test percentile score for 1970 (average of grades 3 and 5 of the feeder schools)	47	49
Composite stanine scores for grades 2, 4 and 6, 1970 (average of the feeder schools in reading and arithmetic)	4.5	4.5

*Data provided by the Lansing Board of Education

**Composite scores of the feeder school.

the junior high school that was selected served as subjects for the investigation (162 males, 171 females).

The Instruments

The instruments used in the investigation were a breakfast survey form and a five part assessment battery. The next two subsections describe these instruments.

Breakfast Survey Form

The breakfast survey form used in the study was a revision of an inquiry form developed for and used in a pilot study conducted by the investigator in October, 1970. The major purpose of the pilot study was to establish more clearly the research questions and basic procedures that were used in the present investigation.

Approximately 200 third grade students in three Title I designated elementary schools in Lansing, Michigan were selected for the study. The students in each class were randomly divided into two groups. One group was given a juice drink at midmorning, the other a placebo drink. A Metropolitan Achievement Test was administered in the late morning. No significant difference was found in test scores between the placebo and juice groups.

It was intended to use breakfast as a variable in this pilot study but the survey form that was developed for this purpose did not seem to produce reliable information. In addition, since these were Title I

schools, some of the classes were participating in a school breakfast program. This made it impossible to establish type of breakfast as a variable. The study did, however, fulfill its basic purpose in helping to establish the procedures for the present study.

The revised breakfast survey form was a simple questionnaire designed to measure basic information related to the following:

1. How often the subjects ate breakfast.
2. Whether or not they got hungry or tired during the morning.
3. Whether or not they ate anything before they came to school on the testing day.
4. If anything was eaten, what and how much.

The first two questions attempted to gather information which could be used for a general descriptive analysis of the breakfast eating habits of the subjects and provide information which could be used to help interpret the results of the study.

The last two questions were directly related to the aspect of the study which attempted to investigate the relation between breakfast and midmorning snack on the performance of the subjects on an achievement test administered in the late morning.

Assessment Battery

The instrument used to measure the possible effects of midmorning snack on school performance was the Michigan Assessment of Basic Skills Battery, which consisted of five measures--pupil background and attitude, vocabulary, reading, mechanics of written English and mathematics. Test procedures recommended that the battery be administered in three consecutive morning sessions; the pupil background and attitude measure in the first session, vocabulary and reading in the second session and mechanics of written English and mathematics in the third session.

Test scores obtained from the reading and mathematic measures were used as the "achievement tests" for this investigation. The study procedures required that the achievement test be administered in late morning and these tests were scheduled to be administered during the last thirty minutes of the assessment days.

The reading test consisted of 50 questions which assessed paragraph comprehension, ability to understand words from the context in which they are encountered, and ability to identify the correct synonym for a word. The reliability coefficients and standard errors of measurement for these two measures are presented in Tables 3.3 and 3.4.

It was decided that the reliability coefficients were adequately high and the standard errors of measurement

TABLE 3.3.--Reliability coefficients and standard errors of measurement for a sample of 1000 4th graders on the Michigan Assessment of Basic Skills Battery.

Measure	Reliability Coefficient	Standard Error of Measurement	
		Raw Score Units	Standard Score Units
Reading	.925	2.9	2.7
Mathematics	.859	2.7	3.7

TABLE 3.4.--Reliability coefficients and standard errors of measurement for a sample of 1000 7th graders on the Michigan Assessment of Basic Skills Battery.

Measure	Reliability Coefficient	Standard Error of Measurement	
		Raw Score Units	Standard Score Units
Reading	.908	3.0	3.0
Mathematics	.872	2.7	3.5

were adequately low to justify the use of the reading and mathematics measures in this investigation.*

Collection of the Data

The data used as the basis for answering the research questions were obtained from the responses to the breakfast survey form and from the administration of the assessment tests. The following subsections describe the procedures by which these instruments were administered and the information tabulated.

Administration of the Instruments

Prior to the first testing day, the teachers who were to be involved in the study were informed of the purposes of the study and were given instructions as to the procedures that would be followed in administering the liquid snack and breakfast survey form. The general directions were as follows:

1. Between 9:15 and 9:30 on the pupil attitude assessment day, at least 4 ounces of juice was given to each of the subjects. This test day was used to familiarize the teacher and the students with the general procedures that would be followed on the next two testing days. The test results could not be used in the

*Further information related to the reliability and validity of the assessment battery is available from the Michigan Department of Education, Lansing, Michigan.

study since the names of the students were not recorded on the answer form.

2. At 9:00-9:30 on the second testing day, each subject was asked to fill out a short breakfast survey form. On the last question, which asked the subjects to list the type and amount of food eaten for breakfast, the teacher was asked to give assistance by stressing that the subjects should write down everything they ate and drank, including candy, potato chips, cookies, etc.
3. Immediately after administering the breakfast survey form, the teachers were asked to administer the pineapple juice and the placebo drink. They were asked to make a note if any subject did not drink the liquid snack.
4. On the third testing day, these same procedures were repeated except the groups were reversed, e.g., the subjects who received the juice drink on the first day received the placebo drink on the second day. The main reason for this procedure was to minimize any effect which might have resulted from the subjects' recognizing that they were receiving different drinks. In this case, it could be

explained that on the next day the groups would be reversed. This however, did not present a problem. Although the students did recognize a difference between the drinks, they seemed to enjoy the "placebo" drink equally as well as the juice drink.

5. The administration of the achievement tests was standardized through procedures outlined by the Michigan Department of Education. These procedures were similar to those used in administering any standardized test.

Tabulation of the Results

The results obtained from the administration of the instruments were tabulated for the fourth grade subjects on the basis of school, class within school, treatment within class, type of breakfast eaten and test score.

The grouping of subjects on the basis of type of breakfast eaten was as follows:

Adequate Breakfast Group.--Subjects were classified into this group if it could be determined from their response on the breakfast survey form that their breakfast contained at least 10 grams of protein.

Inadequate Breakfast Group.--Subjects were classified into this group if they ate less than 10 grams of protein before coming to school.

No Breakfast Group.--Those subjects who did not eat or drink anything at all (with the exception of water) before coming to school.

For part of the statistical treatment of the study data the few subjects in the "no breakfast" group will be included with the "inadequate breakfast" group. The rationale for dividing the groups on the basis of amount of protein eaten at breakfast relates to the research reviewed in Chapter II which shows that when 15 grams or more of protein are consumed at the morning meal, the individual is less likely to experience fatigue in the late morning hours.

It was decided to use 10 grams of protein instead of 15 grams as a dividing point between "adequate" and "inadequate" breakfast groups for two main reasons: (a) a preliminary breakdown and analysis of the breakfasts eaten by the subjects showed that very few ate as much or more than 15 grams of protein for breakfast, and (b) a breakdown on the basis of 10 grams yielded two groups that more closely approximated a two-group breakdown on the basis of whether or not the subjects ate a breakfast meeting the minimum standards set by the U.S.D.A. Council on Foods and Nutrition (breakfast defined in Chapter 1).

Since the diets of the subjects were not rigidly controlled on the mornings the tests were administered, it was impossible to determine with complete accuracy the

exact amount of protein eaten in the morning meal. With the assistance of a U.S.D.A. registered dietician from the Lansing Food Service Program of the Lansing Board of Education, however, a reasonably accurate determination could be made.

It was originally hoped that it would be possible to divide the subjects into two groups on the basis of "breakfast-no breakfast." However, since so few fourth grade subjects came to school without anything to eat, this was not possible. This was not the case for the seventh grade subjects, however. It was then thought the subjects could be divided on the basis of whether they ate a "basic breakfast" or not. Basic breakfast in this case was defined as meeting minimum standards set by the U.S.D.A. Council on Foods and Nutrition. It was found that so few of the subjects had a "better than basic breakfast," by this definition, that statistical analysis would not be possible. A descriptive analysis of the number of "U.S.D.A. approved" breakfasts eaten by the subjects on the testing days will be given in Chapter IV.

Methods of Data Analyses

The procedures that were used in the analysis of the data were recommended by the Office of Research Consultation in the College of Education at Michigan State University. The subsections deal with the analysis

of the research questions and the analysis of the auxillary questions on the breakfast survey form.

Analyses of the Research Questions

To test for significance, the following analyses were performed: (a) univariate and multivariate analysis of variance; and (b) multivariate analysis of covariance with each of the covariables considered individually. If the results of these analyses yielded an F ratio which would occur by chance less than five times in 100 (P .05) they were considered statistically significant.

If the F ratio for the multivariate test proved significant at or beyond the .05 level, the Scheffe' post hoc procedure[1] was applied to the means and to the combinations of means. Scheffe' procedure provided exact information as to where the differences exist, while the multivariate and univariate F values merely indicated that a difference(s) exist somewhere between the levels of the particular dependent or independent variables. The statistical formula for this procedure is as follows:

[1]William Hays, Statistics (New York: Holt, Rinehart and Winston, 1963), pp. 483-487.

$$\psi - S\sqrt{v\psi g} = \psi g \leq \psi g + S\sqrt{v(\psi g)}$$

where: $\sqrt{v(\psi g)} = \sqrt{(\text{ms error})}\ \omega g = \sqrt{\text{est. var } (\psi)}$

and: $S = \sqrt{(J-1)\ F\ \alpha}$

Responses from the questionnaire sheets and test score data were coded and punched on data control cards for statistical treatment by the Michigan State University CDC 6500 and CDC 3600 computors.

The Finn Fortran Program for Univariate and Multivariate Analysis of Variance and Covariance[2] was used in analyzing the data.

The Finn program was a discriminatory analysis program in which all dependent variables were analyzed at one time to determine what single derived value best reflected the differences between the population variables. It was assumed that for each population the characteristics have a multivariate normal distribution, with different means, but common variances and covariances. The Finn program allowed for a determination of what characteristics, or combination of characteristics, best reflected the population differences being studied.

Jeromy D. Finn, "Multivariance: Fortran Program For Univariate and Multivariate Analysis of Variance and Covariance" (Buffalo: Department of Educational Psychology, State University of New York at Buffalo, May, 1967 (mimeographed).

Analysis of Auxillary Questions

A descriptive analysis of the auxillary questions will be made on the basis of a tabulation of all frequencies and test score means.

CHAPTER IV

ANALYSES OF DATA AND FINDINGS

Introduction

This chapter is divided into three parts. In the first part, data are presented which will provide the basis for answering the following study questions:

a. Will there be a relationship between the performance of fourth and seventh grade students on an academic achievement test administered in the late morning, and the type and amount of breakfast eaten that same morning?

b. Will there be a significant difference in the scores on an academic achievement test administered in late morning, between fourth grade students who receive a liquid mid-morning snack of pineapple juice and fourth grade students who receive a "placebo" drink, when type and amount of breakfast is considered a variable?

In the first section of Part 1, findings are based on test score means of the fourth grade subjects grouped

by treatment (juice vs placebo) and type of breakfast (adequate vs inadequate).

The second section of Part 1 presents more sophisticated statistical analyses of these data, considering the additional factors of school and classes nested within school, as they may interact significantly with the study variables.

A third section presents findings based on the test scores of the seventh grade study subjects grouped by sex and type of breakfast eaten on the test day. An analysis of the data will provide the basis for an additional examination of the first study question, which deals with the relationship between breakfast and test performance. The findings related to the research questions will then be summarized.

Part 2 of this chapter deals with the data tabulated and analyzed from responses to the two ancillary questions, which were included in the breakfast survey form.

The first section of Part 2 presents the responses to the following question:

*How often do you eat breakfast?
once in a while
not too often
every day
almost every day

---

*Since the first and second choices were so similar they were grouped in some of the analyses. This was also the case for the third and fourth choices.

The second section presents the data tabulated from the following question:

> Do you get tired or hungry at school during the morning?
> yes
> no

In Part 3 of this chapter supplemental data are provided related to the type of breakfast eaten by the study subjects as compared to the U.S.D.A. approved breakfast accepted in the Lansing, Michigan School District breakfast program.

Analyses of the Research Questions

Findings Related to Test Score Means of the Fourth Grade Subjects Grouped by Treatment and Type of Breakfast

Findings for Test 1*.--Table 4.1 presents the Test 1 raw data for the fourth grade subjects classified by treatment and type of breakfast eaten. A visual analysis of this table indicates differences in test score means in the direction supporting a general conclusion that breakfast and midmorning snack had a positive effect on the test performance. A more graphic presentation of the test score means for Test 1 is presented in Charts 4.1 and 4.2. The following additional conclusions seem warranted from the analysis of these test score means:

---

*Reading (test described in Chapter III).

TABLE 4.1.--Cell frequency and test score means--4th grade subjects grouped by treatment and adequate vs. inadequate breakfast--Test 1.

	Number	Test Score Mean
Juice Group		
Adequate Breakfast	60	30.4
Inadequate Breakfast	90	28.5
Placebo Group		
Adequate Breakfast	48	29.9
Inadequate Breakfast	88	25.0

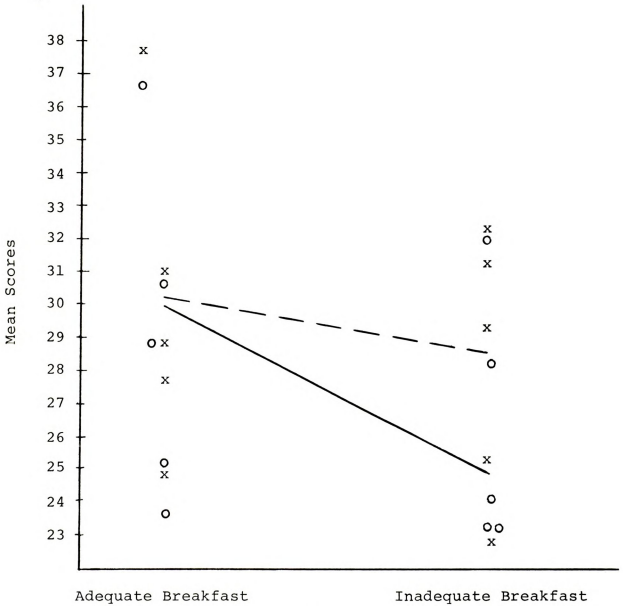

Chart 4.1. Placebo versus juice as midmorning snack--Mean scores of schools by type of treatment, 4th grade, Test 1.

x = Mean scores of juice group by schools
o = Mean scores of placebo group by schools
- - - = Difference within juice group by type of breakfast
——— = Difference in placebo group by type of breakfast

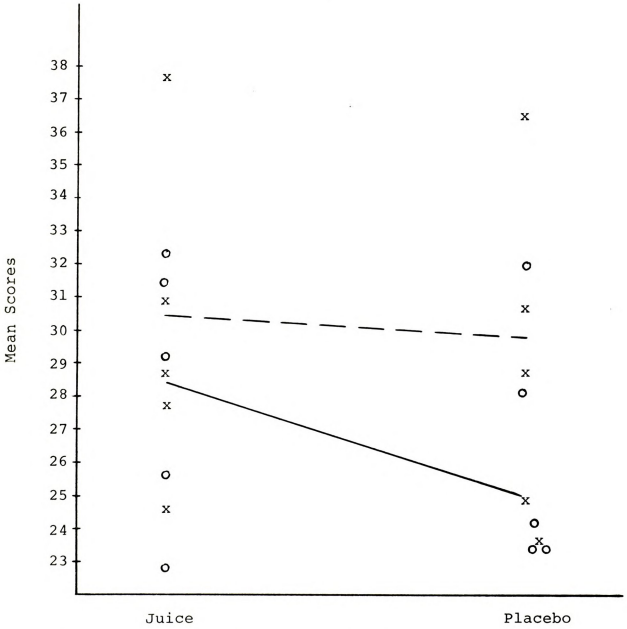

Chart 4.2. Adequate breakfast versus inadequate breakfast--Mean scores of schools by type of treatment, 4th grade, Test 1.

x = Mean scores of adequate breakfast group by schools
o = Mean scores of inadequate breakfast group by schools
- - - = Difference within adequate breakfast group by treatment
——— = Difference within inadequate breakfast group by treatment

1. The inadequate breakfast + juice group ($\bar{x}$28.5) scored lower than the adequate breakfast + placebo group ($\bar{x}$29.9).

2. The adequate breakfast + juice group ($\bar{x}$30.4) scored slightly higher than the adequate breakfast + placebo group ($\bar{x}$29.9).

3. The inadequate breakfast + juice group ($\bar{x}$28.5) scored higher than the inadequate breakfast + placebo group ($\bar{x}$25.0).

4. The adequate breakfast + juice group ($\bar{x}$30.4) scored higher than the inadequate breakfast + juice group ($\bar{x}$28.5).

5. The adequate breakfast + juice group ($\bar{x}$30.4) scored higher than the inadequate breakfast + placebo group ($\bar{x}$25.0).

6. The adequate breakfast + placebo group ($\bar{x}$29.9) scored higher than the inadequate breakfast + placebo group ($\bar{x}$25.0).

It is apparent from the data that the difference between some of the combinations of variables is greater than for others. For example, the difference between mean test scores of the "inadequate breakfast + placebo" group ($\bar{x}$25.0) vs. the "adequate breakfast + placebo" group ($\bar{x}$29.9), is greater than the difference between the "adequate breakfast group + placebo" group ($\bar{x}$29.9) vs. the "inadequate breakfast + juice" group ($\bar{x}$28.5). It is difficult to be certain what factors or combination of factors produced these differences. These differences were tested for significance using procedures outlined in Chapter III.

The data obtained from the univariate analyses of Test 1 are presented in Table 4.2. An examination of

TABLE 4.2.--Between mean squares, univariate F scores and probability for the study variables based on a grouping of 4th grade subjects by treatment and type of breakfast--Test 1.

Variables	Between Mean Square	Univariate F Score	Probability Less Than
Breakfast Effect	194.3318	2.4998	0.0840
Treatment Effect	0.5319	0.0068	0.9342
Interaction	60.1992	0.7744	0.4620

the table does not show significant differences within or between any of the variables tested. Breakfast as a variable does approach significance ($P < .0840$ with significance established at the $< .05$ level).

Findings for Test 2*.--Table 4.3 presents the Test 2 raw data for the fourth grade subjects classified by treatment and type of breakfast eaten. A visual analysis of the test score means again supports a positive effect of breakfast on test performance but does not support the conclusion that the treatment had a positive effect on test performance. A graphic presentation of the test score means for Test 2 is presented in Charts 4.3 and 4.4.

The following conclusions seem warranted from analysis of the test score means.

1. The inadequate breakfast + juice group scored lower ($\bar{x}$19.2) than the adequate breakfast + placebo group ($\bar{x}$22.5).

2. The adequate breakfast + juice group scored lower ($\bar{x}$20.9) than the adequate breakfast + placebo group ($\bar{x}$22.5).

3. The inadequate breakfast + juice group scored virtually the same as the inadequate breakfast + placebo group ($\bar{x}$19.2) vs. ($\bar{x}$19.5).

4. The adequate breakfast + juice group scored higher ($\bar{x}$20.9) than the inadequate breakfast + juice group ($\bar{x}$19.2).

---

*Arithmetic (test described in Chapter III).

TABLE 4.3.--Cell frequency and test score means--4th grade subjects grouped by treatment and adequate vs. inadequate breakfast--Test 2.

	Number	Test Score Mean
Juice Group		
Adequate Breakfast	40	20.9
Inadequate Breakfast	78	19.2
Placebo Group		
Adequate Breakfast	51	22.5
Inadequate Breakfast	111	19.5

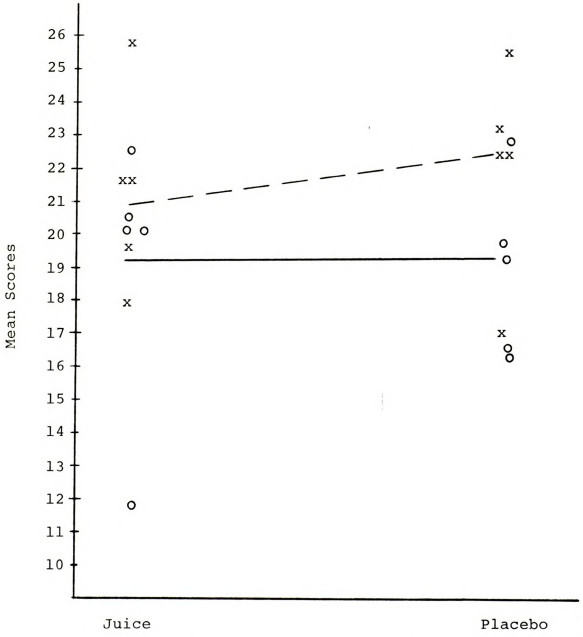

Chart 4.3. Adequate breakfast versus inadequate breakfast--Mean scores of schools by type of treatment, 4th grade, Test 2.

x = Mean scores of the juice group by schools
o = Mean scores of the placebo group by schools
- - - = Difference within adequate breakfast group by treatment
——— = Difference within inadequate breakfast group by treatment

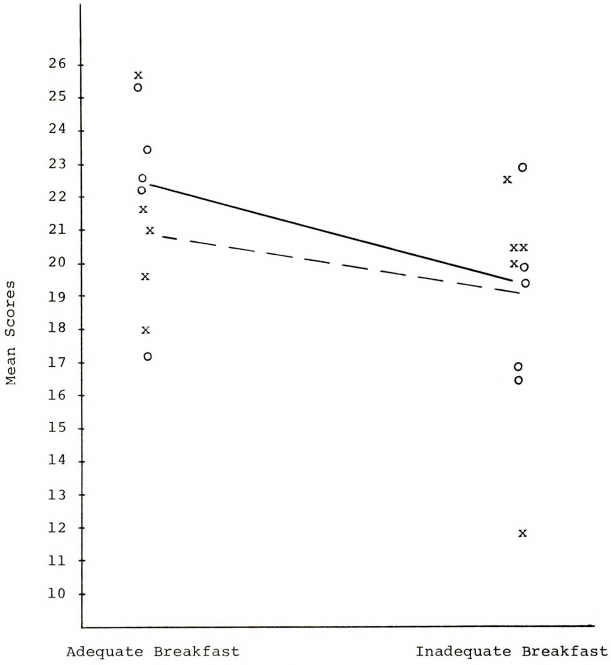

Chart 4.4. Placebo versus juice as midmorning snack--Mean scores of schools by type of breakfast, 4th grade, Test 2.

x = Mean scores of adequate breakfast group by schools
o = Mean scores of inadequate breakfast group by schools
- - - = Difference within juice group by type of breakfast
——— = Difference within placebo group by type of breakfast

5. The adequate breakfast + juice group scored higher ($\bar{x}$20.9) than the inadequate breakfast + placebo group ($\bar{x}$19.5).

6. The adequate breakfast + placebo group scored higher ($\bar{x}$22.5) than the inadequate breakfast + placebo group ($\bar{x}$19.5).

As in Test 1, these means can be reported and compared but the differences are difficult to explain; e.g., such questions as why the placebo group would score higher on this test than the juice group when breakfast is considered as a variable, remain unanswered.

A univariate analysis of significance for the Test 2 data is presented in Table 4.4. The analyses do not produce significant differences within or between any of the variables tested. The results confirm the findings of Test 1, e.g., there was no significant positive effect of breakfast and/or midmorning snack on the test performance of the subjects.

The analyses procedures that were used in this investigation did not permit a statistical analysis of the data with a three way breakdown of breakfast, e.g., "adequate breakfast," "inadequate breakfast" and "no breakfast." Tables 6.1 and 6.2 and Charts 6.1 and 6.2 in Appendix A attempt to present, both visually and graphically, a comparison of test score means when no breakfast is considered as a variable. The conclusions that seem warranted from the data are also presented in Appendix A.

TABLE 4.4.--Between mean squares, univariate F scores and probability for the study variables based on a grouping of 4th grade subjects by treatment and type of breakfast--Test 2.

Variables	Between Mean Square	Univariate F Score	Probability Less Than
Breakfast Effect	346.1102	2.0188	0.1348
Treatment Effect	145.4732	0.8485	0.3578
Interaction	87.9205	0.5128	0.5994

Findings Related to Test Score Means of the Fourth Grade Subjects Grouped by Treatment and Type of Breakfast, Considering the Interaction of Schools and Classes on the Study Variables

As stated in the introduction to this chapter, it was decided to conduct an additional, more sophisticated analysis of the raw data tabulated from the responses on the breakfast survey form and from the results of the assessment tests. This additional analysis considered the possible significant influence of the interaction of schools and classes on the study variables.

Findings for Test 1.--The data collected were organized initially into tables of cell frequencies and test score means. The Test 1 raw data, classified by school, class, type of breakfast eaten and type of treatment administered are presented in Table 4.5. An initial visual analysis of this table shows that with one exception, the "adequate breakfast + placebo" groups scored higher than "inadequate breakfast + placebo" groups; again supporting a positive effect of breakfast on the test scores of the fourth grade study subjects. In the juice treatment category, the "inadequate breakfast" group scored lower than the "adequate breakfast" group in two schools. Considering the small number of subjects within these cells, however, it was difficult to assign any significance to this initial visual analysis.

TABLE 4.5.--Cell frequencies and test score means considering the interaction of schools and classes within schools on the study variables, 4th grade, Test 1.

	School 1				School 2				School 3				School 4				School 5			
	C^1		C^2		C^1		C^2		C^1		C^2		C^1		C^2		C^1		C^2	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Placebo Group																				
B^1	5	36.8	3	36.7	4	23.8	3	23.7	5	32.4	4	18.0	6	25.8	6	35.8	8	35.4	4	22.3
B^2	14	19.4	9	29.2	6	27.7	9	36.3	9	29.7	9	27.1	7	18.6	7	28.4	9	26.0	9	20.9
Juice Group																				
B^1	6	28.2	5	21.8	4	14.0	8	41.8	7	25.0	7	32.6	8	30.5	7	31.7	6	33.8	2	42.0
B^2	5	31.2	13	31.6	9	30.8	8	28.0	11	20.0	8	31.4	8	30.4	8	34.5	8	20.9	12	24.8

C = Class

B^1 = Adequate breakfast

B^2 = Inadequate breakfast

N = Cell frequency

$\bar{X}$ = Cell mean

The between mean squares, univariate F scores and probability for the study variables based on Test 1 scores are presented in Table 4.6. Again the interaction of schools and classes within schools is considered in this second, more sophisticated statistical analyses.

An examination of this table shows no significant interaction between or within any of the study variables, e.g., the findings again, do not support a statistically significant relationship between breakfast and/or midmorning snack and the test scores of the fourth grade subjects.

Findings for Test 2.--The Test 2 raw data considering the interaction of schools and classes on the study variables are presented in Table 4.7. An initial visual analysis of this table would once again seem to support a positive relationship between breakfast and midmorning snack on test performance. The univariate analyses procedure, however, could not support a statistically significant relationship. The between mean squares, univariate F scores, and probability for the study variables based on Test scores are presented in Table 4.8.

An initial observation of this table would indicate a significant relationship between breakfast and the scores of the fourth grade subjects on this test. However, the apparent significance cannot be fully and

TABLE 4.6.--Between mean squares, univariate F scores and probability for the study variables based on 4th grade test score means and considering the interaction of schools and classes on the study variables--Test 1.

Variable	Between Mean Square	Univariate F Score	Probability Less Than*
B	548.2790	3.4983	0.6270
T	106.1248	0.6771	0.4114
B x T	75.7541	0.4833	0.4876

*Significance = $p < .05$

B = Breakfast

T = Treatment

TABLE 4.7.--Cell frequencies and test score means considering the interaction of schools and classes within schools on the study variables, 4th grade, Test 2.

		School 1				School 2				School 3				School 4				School 5			
		C^1		C^2		C^1		C^2		C^1		C^2		C^1		C^2		C^1		C^2	
		N	X	N	X	N	X	N	X	N	X	N	X	N	X	N	X	N	X	N	X
Placebo Group																					
	B^1	5	25.2	5	19.6	2	19.0	8	28.1	4	20.0	6	25.1	8	16.0	7	18.4	7	24.6	2	25.5
	B^2	12	18.2	15	21.5	12	17.6	6	21.3	13	15.2	7	18.4	9	24.4	11	21.5	12	18.0	12	15.2
Juice Group																					
	B^1	2	21.0	4	21.8	5	26.4	6	25.3	4	22.5	3	20.7	6	14.5	4	21.5	2	21.0	3	18.0
	B^2	12	20.2	8	20.4	4	16.5	5	28.8	9	24.3	11	17.0	4	11.5	6	12.3	9	21.9	10	19.3

C = Class

B^1 = Adequate breakfast

B^2 = Inadequate breakfast

N = Cell frequency

$\overline{X}$ = Cell mean

TABLE 4.8.--Between mean squares, univariate F scores and probability for the study variables based on 4th grade test scores and considering the interaction of schools and classes on the study variables--Test 2.

Variable	Between Mean Square	Univariate F Score	Probability Less Than*
B	317.9765	4.3087	0.0386**
T	2.3369	0.0318	0.8586
B x T	24.6724	0.3359	0.5628

*Significance = P < .05

**Due to analysis procedure, significance is uncertain for the reasons discussed on page 80.

only attributed to the breakfast variable. The Finn program is based on nonorthoginal step wise testing, where each successive test is dependent upon earlier tests. In the analysis procedure the significance of the interaction of schools and classes on the study variables was tested first. In the univariate analysis of these factors a significant triple order interaction occurred when a grouping of treatment, breakfast and schools was considered ($P < .0251$). This significance intrinsically became a part of subsequent analyses; thus the inability to assign significance to the study variable, even though it fell below the .05 level of significance. A presentation of the between mean square, univariate F scores and probability for all of the Test 1 and Test 2 study factors is made in Appendix B. An additional visual and graphic presentation of the interaction between these factors based on test score mean by school is made in Appendix C.

In summary, the statistical analyses in this section, which considered the interaction of schools and classes on the study variables, could not support a statistically significant relationship between breakfast and midmorning snack on the test performance of the study subjects. There may have been a relationship between breakfast and test performance, however.

Findings Related to the Test Score Means of the Seventh Grade Subjects Grouped by Sex and Type of Breakfast

A presentation of the seventh grade cell frequencies and test score means by type of breakfast is made in Table 4.9. Of a total of 333 seventh grade subjects, 107 did not eat breakfast on the test day. This group had a test score mean of 23.6. Of the seventh grade subjects, 163 ate some breakfast, but less than 10 gm of protein. This group had a test score mean of 27.6. Only 63 subjects ate at least 10 gm of protein on the morning of the test. This group had a test score mean of 28.5.

A univariate analysis of variance for type of breakfast for the seventh grade testing indicated that significant differences existed but did not indicate where the differences were. The between mean square for this univariate analyses of variance was 676.6740 with a F score of 3.8929 and a probability of less than .0214. The group means were subjected to further analyses using the Scheffe' procedure to identify which groups differed significantly and contributed to the overall significant F value. The results of the comparison of all pair-wise means and their significance are reported in Table 4.10. Analysis of this table indicates a significant difference in test score means between the "no breakfast group" and "adequate breakfast" group, no significant difference between the "adequate breakfast" group and "inadequate

TABLE 4.9.--Cell frequencies and test score means by type of breakfast--7th grade.

	Number	Test Score Mean
B^1	107	23.6
B^2	163	27.6
B^3	63	28.5
TOTAL N	333	

B^1 = No breakfast

B^2 = Inadequate breakfast

B^3 = Adequate breakfast.

TABLE 4.10.--Comparison of the difference in test score means of 7th grade subjects by type of breakfast using Scheffé procedure.

Means Compared	Difference	Level of Significance
$B^3 - B^1$	4.93	.05*
$B^3 - B^2$	.98	NS**
$B^2 - B^1$	3.976	NS**

*Significant at the .05 level

**Not significant at or above the .05 level

B^1 = No breakfast

B^2 = Inadequate breakfast

B^3 = Adequate breakfast.

breakfast" group and no significant difference in mean test scores between the "no breakfast group" and "inadequate breakfast" group.

The data from the seventh grade results support an affirmative answer to the first research question, e.g., there was a relationship between the performance of the subjects on the test, and the type and amount of breakfast eaten on the testing day.

In summary, from an analysis of the data presented in the first part of this chapter, it would seem the responses to the research questions should be as follows:

1. There seems to be a difference in the performance on an achievement test administered in late morning between the 4th grade subjects who ate an "adequate breakfast" and those who do not eat breakfast on the study day. The difference, however, was not proved to be statistically significant at the .05 level.
2. There was a significant difference in the performance on an achievement test administered in late morning between 7th grade subjects who ate an "adequate breakfast" and those who did not eat breakfast on the study day. Since all of the variables could not be controlled, this significance cannot be attributed to breakfast alone.

3. There was no difference in test scores between those subjects who received a juice drink at midmorning and those subjects who received a placebo drink.
4. There was no significant difference in test scores between those subjects who received the placebo drink and those who received the juice drink when breakfast was considered as a variable.

Supplemental Data From the Breakfast Survey

Findings Related to Frequency of Breakfast Eaten by the Study Subjects

In addition to the essential data related to type and amount of breakfast eaten by the subjects, two ancillary questions were asked on the breakfast survey form. The major purpose of these questions was to provide additional information about the general breakfast habits of the subjects and whether or not they got tired or hungry during school in the morning. It was thought that this information would be helpful in the interpretation of the results of the study and/or in raising questions related to existing or proposed breakfast and/or midmorning snack programs.

Fourth Grade Subjects.--Table 4.11 presents a summary of frequency of breakfast eaten by the fourth grade subjects.

The same survey form was administered to the subjects on both testing days. Since there was a slight difference in response between the two days, a mean frequency number was assigned to each of the question options. An analysis of this table shows that of the 279 subjects responding to this question, 232 subjects responded that they ate breakfast either "every day" or "almost every day" and only 47 responded that they ate breakfast only "once in a while" or "not too often." Table 4.12 analyzes the responses to this survey question by school and test. It was originally thought desirable to analyze this table in terms of differences in mean per cent of both parents working in each of the schools (Table 3.1, Chapter III). Even a cursory look at Table 4.12, however, reveals very little, if any, difference between the schools in the per cent of subjects responding to the question options.

Seventh Grade Subjects.--Table 4.13 presents data related to frequency of breakfasts eaten by the seventh grade subjects by sex, and the percentage of subjects within each of these classifications that responded to each of the question options. As indicated in this table, five "never" write in responses in the female category were placed in the "not too often" category. An analysis

TABLE 4.11.--Frequency of breakfast eaten by 4th grade subjects.

Test	Frequency			
	F^1	F^2	F^3	F^4
Test 1	28	23	188	37
Test 2	24	19	195	42
Mean	26	21	192	40

F^1 = Breakfast eaten "once in a while"

F^2 = Breakfast eaten "not too often"

F^3 = Breakfast eaten "every day"

F^4 = Breakfast eaten "almost every day"

TABLE 4.12.--Frequency of breakfasts eaten by 4th grade subjects by test and school.

	School 1				School 2				School 3				School 4				School 5			
	F^1	F^2	F^3	F^4	F^1	F^2	F^3	F^4	F^1	F^2	F^3	F^4	F^1	F^2	F^3	F^4	F^1	F^2	F^3	F^4
Test 1	7	6	35	13	5	4	35	5	2	10	40	6	8	1	43	4	6	2	36	9
Test 2	6	6	36	13	2	3	37	6	3	6	42	6	6	1	43	5	7	3	35	10

F^1 = Breakfast eaten "once in a while"

F^2 = Breakfast eaten "not too often"

F^3 = Breakfast eaten "every day"

F^4 = Breakfast eaten "almost every day."

TABLE 4.13.--Frequency of breakfasts eaten by 7th grade subjects by sex.

Sex	Frequency							
	F^1		F^2		F^3		F^4	
	No.	%	No.	%	No.	%	No.	%
Male	28	17.2	19	11.8	77	47.6	38	23.4
Female	46	26.9	49	28.6	54	31.6	22	12.9

*Includes 5 "never" write in responses in the male category and 12 "never" write in responses in the female category.

F^1 = Breakfast eaten "once in a while"

F^2 = Breakfast eaten "not too often"

F^3 = Breakfast eaten "every day"

F^4 = Breakfast eaten "almost every day."

of this table shows a wide difference between the male group and female group in their responses. In the male group 47 out of 164 subjects who responded to the question, or approximately 30%, indicated that they ate breakfast "once in a while" or "not too often." This compares to 95 out of 169, or approximately 56%, of the female group who checked these question options. In response to the same question, 115 out of 164, or approximately 70% of the male subjects, indicated that they ate breakfast "every day" or "almost every day." This compares to 76 out of 169, or approximately 44% of the female group, who responded that they ate breakfast every day or almost every day.

Frequency of Breakfasts Eaten--Fourth and Seventh Grade Subjects Compared.--A presentation of the data which compare frequency of breakfast eaten by the fourth grade and seventh grade study subjects is made in Table 4.14. As indicated on this table, there is a wide difference between fourth and seventh grade in frequency of breakfast eaten. Seventeen per cent of the fourth grade subjects indicated that they ate breakfast only "once in a while" or "not too often," as compared to 42% of the seventh graders who answered in the same way. Eighty-three per cent of fourth graders indicated that they ate breakfast "every day" or "almost every day" while only 58% of the seventh graders indicated that they ate breakfast "every day" or "almost every day."

TABLE 4.14.--Frequency of breakfasts eaten--comparison between 4th and 7th grade subjects by percentages in each group.

Grade	Frequency			
	F^1	F^2	F^3	F^4
4th Grade*	9.4	7.6	68.6	14.4
7th Grade**	26.7	15.0	39.5	18.2

*Mean % of tests land 2

**Mean % of male and female

F^1 = Breakfast eaten "once in a while"

F^2 = Breakfast eaten "not too often"

F^3 = Breakfast eaten "every day"

F^4 = Breakfast eaten "almost every day"

Supplemental Data Related to Subjects' Reported Feelings of Hunger and/or Fatigue at School During the Morning

Fourth Grade Subjects.--In question 2 on the breakfast survey form, the study subjects were asked if they got tired or hungry at school during the morning. It was hoped that an analysis of the responses to this question would help to raise questions related to the need for midmorning snack programs. The information from the breakfast survey sheets of the fourth grade study group is presented in Table 4.15. Of the 283 subjects who responded on Test 1, 163, or 57.5% indicated that they got hungry or tired at school during the morning; as opposed to 120, or 42.5% who indicated that they did not get tired or hungry at school during the morning. For Test 2, 155 (54.5%) reported that they got hungry or tired at school as opposed to 129, or 44.5% who did not. Of the 163 students who indicated that they got hungry or tired at school during the morning 140 or 85.9% reported eating breakfast "once in a while" or "not too often." Of the 120 students who reported that they did not get hungry or tired at school, 102 or 85.0% reported eating breakfast only "irregularly."

Similar data are presented for Test 2. The results of this survey seem to indicate that the eating of breakfast was not a significant factor in the prevention

TABLE 4.15.--Number and per cent of 4th grade subjects that report hunger and/or fatigue at school in the morning--related to frequency of breakfast eaten.

Response to Question of Fatigue and/or Hunger	Test 1				Test 2			
	F^1		F^2		F^1		F^2	
	No.	%	No.	%	No.	%	No.	%
"Yes" Responses	140	85.9	23	14.1	130	83.9	25	16.1
"No" Responses	120	85.0	18	15.0	109	86.0	20	14.0

TOTALS: Test 1--Yes = 163
No = 120

Test 2--Yes = 155
No = 129

F^1 = Group of subjects who report eating breakfast "every day" or "almost every day"

F^2 = Subjects who report eating breakfast "once in a while" or "not too often."

of subjective veelings of fatigue and/or hunger at school during the morning in the fourth grade group.

Seventh Grade Subjects.--Seventh grade subjects' data related to the breakfast survey question dealing with hunger and fatigue at school during the morning is presented in Table 4.16. It can be observed from the table that 100 out of 164 males or 61% report that they get tired or hungry at school during the morning, as opposed to 106 of the 169 in the female group (62%). Of the male subjects who reported hunger and/or fatigue, 30 or 30%, eat breakfast "once in a while" or "not too often." This is in contrast to 70% of the males who responded "yes" who eat breakfast "every day" or "almost every day."

Of the male subjects who do not get hungry or tired at school, 28.2% do not eat breakfast regularly, opposed to 71.8% who reported that they were regular breakfast eaters. Apparently it makes no difference whether the male group eats breakfast regularly or not--they get tired and hungry at school during the morning. This does not seem to be the case for the female group. Of the 106 female subjects who report hunger and fatigue at school during the morning, 68.8% fall into the "irregular" breakfast category as opposed to 33 or 31.2% falling into the "regular" breakfast pattern group.

TEST 4.16.--Number and per cent of 7th grade subjects that report hunger or fatigue at school in the morning--related to frequency of breakfast eaten and grouped by sex.

Response to question of fatigue and/or hunger	F^1		F^2	
	No.	%	No.	%
Male group				
"Yes" response	30	30.0	70	70.0
"No" response	18	28.2	45	71.8
Female group				
"Yes" response	73	68.8	33	31.2
"No" response	22	35.0	41	65.0

F^1 = Number of subjects who reported eating breakfast "once in a while" or "not too often."

F^2 = Number of subjects who reported eating breakfast "every day" or "almost every day."

Of the female subjects who responded that they do not get tired or hungry at school in the morning, 65% fall into the "regular" breakfast pattern group. The results seem to indicate that the females had a greater need for breakfast in preventing hunger and fatigue at school than did the males.

Supplemental Data Related to the Type of Breakfast Eaten by the Study Subjects Compared with U.S.D.A. Recommended Breakfast

As stated in Chapter III, it was planned originally to divide the groups into "adequate breakfast," "inadequate breakfast," "no breakfast," on the basis of comparison with the "U.S.D.A. approved breakfast" accepted in the Lansing School District breakfast programs. It was not possible to do the desired statistical analyses on this type of breakdown, due to inadequate cell size. It was decided, therefore, to do a descriptive analysis of the breakdown. These data are presented in Tables 4.17-4.19.

Fourth Grade Subjects.--Test 1 data related to the fourth grade subjects is presented in Table 4.17. The data presented in the table show that 13 out of 286 fourth grade subjects, or only 4.5% ate a breakfast that could be considered better than the U.S.D.A. recommended breakfast; 40 out of 286, or 14.0%, ate a breakfast equal to the U.S.D.A. recommended breakfast; 201 out of 286, or

TABLE 4.17.--Breakfasts eaten by 4th grade subjects equivalent to USDA approved breakfast, Test 1, by school.

	B^1	B^2	B^3	B^4
School 1	1	6	46	7
School 2	1	8	41	4
School 3	0	6	52	10
School 4	8	14	28	3
School 5	3	6	34	7
TOTAL N	13	40	201	31
%	4.5	14.0	70.5	10.9

B^1 = Breakfast better than USDA approved breakfast

B^2 = Breakfast equal to USDA approved breakfast

B^3 = Breakfast less than USDA approved breakfast

B^4 = No breakfast.

TABLE 4.18.--Breakfasts eaten by 4th grade subjects equivalent to USDA approved breakfast, Test 2, by school.

	B^1	B^2	B^3	B^4
School 1	0	7	42	6
School 2	0	5	42	5
School 3	2	7	48	8
School 4	4	9	33	1
School 5	6	8	37	10
TOTAL N	12	36	202	30
%	4.4	12.6	72.2	10.8

B^1 = Breakfast better than USDA approved breakfast.

B^2 = Breakfast equal to USDA approved breakfast

B^3 = Breakfast less than USDA approved breakfast

B^4 = No breakfast.

TABLE 4.19.--Breakfasts eaten by 7th grade subjects equivalent to USDA approved breakfast.

B^1		B^2		B^3		B^4	
N	%	N	%	N	%	N	%
24	7.2	32	9.6	170	51.1	107	32.1

B^1 = Breakfast better than USDA approved breakfast

B^2 = Breakfast equal to USDA approved breakfast

B^3 = Breakfast less than USDA approved breakfast

B^4 = No breakfast.

70.5%, ate less than the recommended breakfast; and 31 out of 286, or 10.9%, ate no breakfast.

The data presented in Table 4.18 show very similar results related to the type of breakfast eaten by the subjects on the Test 2 day. A seemingly significant number of the study subjects did not eat a breakfast that could be considered equal to the recommended U.S.D.A. approved breakfast.

Seventh Grade Subjects.--A presentation of the data related to a breakdown of the breakfasts eaten by the seventh grade subjects according to the "U.S.D.A. approved" type breakfast is made in Table 4.19. Again as indicated in this table, only 16.8% of the study subjects ate a breakfast that could be considered equal to or better than the U.S.D.A. approved breakfast, with 32% eating no breakfast at all.

Summary

The study data was presented and analyzed in this chapter, in an attempt to answer the research questions. An attempt was also made to provide information related to the ancillary questions that were included on the breakfast survey form. Chapter V will be used to summarize the findings, draw conclusions, raise questions, and discuss the implications of the study results.

CHAPTER V

SUMMARY AND CONCLUSIONS

Introduction

The general intent of this study was to investigate a relationship between breakfast and midmorning snack and school performance. The more specific purposes were to: (a) examine the relationship between the performance of students on an academic achievement test administered in late morning and the type and amount of breakfast eaten that same morning; (b) examine the effect of a liquid midmorning snack on the performance of students on an academic achievement test administered in late morning.

Subjects were fourth and seventh grade students enrolled in the Lansing, Michigan School District. Five elementary schools, each having two regular fourth grade classrooms, and one junior high school, were selected randomly for the study.

The data needed to answer the research questions were collected by administering a breakfast survey form and by conducting a field experiment in which midmorning snack (treatment) was varied in the target population in which juice and placebo drinks were provided.

The experimental procedures were conducted on two days in January, 1971. At midmorning of the first test day the subjects were asked to fill out a breakfast survey form. The fourth grade subjects, within classes, were then randomly divided into two groups. One group was given a liquid snack of pineapple juice; the other group was given a placebo drink. Later that same morning, an academic achievement test was administered to all of the subjects. The seventh grade subjects did not receive the placebo or juice midmorning snack. They were only asked to fill out the breakfast survey form on the morning the achievement test was administered.

The test score results and the information obtained from the breakfast survey form were used as the basis for answering the following research questions:

a. Will there be a relationship between the performance of fourth and seventh grade students on an academic achievement test administered in the late morning, and the type and amount of breakfast eaten that same morning?

b. Will there be a significant difference in the scores on an academic achievement test administered in late morning, between fourth grade students who receive a liquid mid-morning snack of pineapple juice and fourth

grade students who receive a "placebo" drink, when type and amount of breakfast is considered a variable?

The data from the fourth grade subjects were tabulated according to school, class within school, type of breakfast and type of treatment administered (juice vs placebo). The seventh grade subjects were classified according to sex and type of breakfast eaten.

The research questions were analyzed with the following statistical procedures: (a) univariate analysis of variance and multivariate analysis of covariance with each of the covariables considered individually, and (b) Scheffe' post hoc procedure for analysis of difference between means. All study questions were tested at the .05 level of significance.

In addition to the statistical analyses, graphic and descriptive analyses were presented for the study questions, and for two ancillary questions which were included on the breakfast survey form.

Presented also was a descriptive analysis of the breakfasts eaten by the study subjects on test days, compared with the "U.S.D.A. approved breakfast" accepted by the Lansing, Michigan School District breakfast program.

Summary of Findings

Findings Related to the Study Questions

The following findings were established on the basis of the data analyzed and presented in this investigation.

1. There was no significant difference in the performance on the achievement test administered in late morning between the fourth grade subjects who ate an "adequate breakfast" on the test day and those who did not.
2. There was a significant difference in the test performances between the seventh grade subjects who ate an "adequate breakfast" on the test day and those who did not eat breakfast on that same day.
3. There was no significant difference in the test scores between those subjects who received a placebo drink at midmorning and those who received a juice drink when breakfast was considered as a variable.

Findings Related to the Ancillary Question

Frequency of Breakfasts Eaten.--

1. Of the fourth grade subjects, 83% ate breakfast regularly; 17% did not.

2. Little if any difference existed between schools in frequency of breakfasts eaten by the subjects.
3. Approximately 58% of the seventh grade subjects were regular breakfast eaters; 42% were not.
4. Of the male seventh grade subjects, 71% were regular breakfast eaters while only 44.5% of the seventh grade females reported eating breakfast regularly.

Reported Feelings of Hunger and Fatigue at School During the Morning.--

*1. Approximately 57% of the fourth grade subjects reported that they get hungry or tired at school during the morning; 43% indicated that they did not.
2. Of the fourth grade subjects who reported feeling hungry or tired at school, 86% were regular breakfast eaters.
3. Of the fourth grade subjects who indicated that they did not get hungry or tired at school 85% were regular breakfast eaters.

*Mean responses of the two testing days.

4. Of the seventh grade male subjects, 61% reported getting hungry or tired at school during the morning; 62% of the female subjects reported the same.
5. Of the male subjects who reported getting tired or hungry at school, 70% were regular breakfast eaters; 30% were not.
6. Of the males who reported that they did not get tired or hungry at school 72% were regular breakfast eaters; 28% were not.
7. Of the female subjects who reported getting tired or hungry at school 31% were regular breakfast eaters; approximately 69% were not.
8. Of the female subjects who reported that they did not get tired or hungry at school, 65% were regular breakfast eaters; 35% were not.

Type of Breakfasts Eaten by the Study Subjects Compared with U.S.D.A. Approved Breakfast.--

1. Of the fourth grade subjects, 4.5% ate a breakfast that was determined to be better than the U.S.D.A. approved breakfast.
2. Of the fourth grade study subjects, 14% ate a breakfast that was judged to be nutritionally equal to the U.S.D.A. approved breakfast.

3. Of the fourth grade subjects, 70.5% ate a breakfast that was not as adequate as the U.S.D.A. approved breakfast.
4. Of the fourth grade subjects, 11% ate no breakfast on the study days.
5. Approximately 17% of the seventh grade subjects ate a breakfast equal to or better than the U.S.D.A. approved breakfast.
6. Of the seventh grade subjects, 51% ate a breakfast that was judged to be less than adequate as compared with the U.S.D.A. approved breakfast.
7. Of the seventh grade subjects, 32% did not eat breakfast on the test day.

Conclusions

On the basis of the findings, the following conclusions appear warranted:

Conclusions Related to the Study Questions

1. Although a statistically significant relationship between breakfast and test performance could not be proven in the investigation, the findings did not disprove the suggestion that breakfast is an important factor in influencing school performance. On the contrary, the study offers grounds for support of the belief

that students do better over the late morning hours at school if they eat an adequate breakfast.

2. The study did not offer any grounds for support of the belief that a midmorning snack has a positive effect on school performance. There was virtually no difference between the juice treatment and placebo treatment study groups in test performance. This was the case when treatment was independently considered and when breakfast was considered as a variable.

Conclusions Related to the Ancillary Questions

1. It can be stated on the basis of the findings that the fourth grade subjects were generally regular breakfast eaters; approximately 83% reported eating breakfast on a regular basis.
2. The seventh graders did not eat breakfast as regularly as the fourth grade subjects. This was especially true for the female group; less than half (approximately 45%) reported eating breakfast on a regular basis.
3. Over half (approximately 60%) of the fourth and seventh grade subjects reported getting tired or hungry at school during the morning.

4. There was little difference in reported feelings of hunger and/or fatigue between those fourth grade subjects who ate breakfast on a regular basis and those who did not. This also appeared to be the case for the seventh grade male subjects. Apparently, in these groups, breakfast was not a major factor in contributing to these subjective feelings of hunger and/or fatigue.
5. The findings seem to indicate that breakfast may be a factor in the percentage of female seventh grade subjects who report hunger or fatigue at school. Over twice as many female subjects who reported feeling hungry or tired at school were not eating breakfast on a regular basis as opposed to the group that was eating breakfast regularly.
6. Although the fourth grade subjects were generally regular breakfast eaters, few (18%) appeared to be eating a breakfast that was judged to be equal to or better than the breakfasts served by the Lansing, Michigan School District food service program (U.S.D.A. approved breakfasts). This was also true for the seventh grade subjects; approximately 17% ate an adequate breakfast, using this criterion for grouping.

7. There was a substantially greater percentage of seventh grade subjects who did not eat breakfast on the study days as compared with the fourth grade subjects (32% vs 11%).

Reflections

In the preceding sections of this chapter, the research findings and major conclusions of this investigation have been stated. In this section, some of the main implications are stated; first as they may relate to assumptions about the effect of breakfast and midmorning snack on school performance, and second as they may relate to school feeding programs and finally how they may relate to nutrition education.

First, can the assumption be made that eating breakfast is important to school performance? On the basis of this investigation it seems this assumption cannot be made. The results seem to support a positive relationship between the two, especially in the seventh grade group. Unfortunately, as in other studies of this nature, the breakfast effect on test performance could not be attributed to this factor alone. It was uncertain how the breakfast eating practices of the study subjects might have been interacting with other associated variables which may have been significant to the study results. The uncertainty, however, does not justify or carry with it the suggestion that efforts to improve the

breakfast eating habits of school children should not be made. To the contrary, not withstanding the nutritional importance of breakfast in providing a substantial proportion of the day's recommended nutrients, this study did not disprove its importance in making a more immediate contribution to school performance and to the total well being of the school child.

What can be expected as the contribution of a midmorning snack to school performance? The findings of this investigation clearly would not support a conviction that providing a midmorning snack to school children will increase their academic performance. Based on this conclusion, is there a justification for the midmorning feeding programs that are being conducted in schools throughout the country? In the opinion of the writer they are questionable if they are primarily based on the assumption that the snack will increase academic performance of the type measured in this study. But there are questions that remain. Does the midmorning snack contribute to an increase in performance towards other educational objectives, for example, socialization? Does a midmorning snack program have an effect on performance if provided over an extended period of time? Was there in fact a total treatment effect in this investigation? The differences between the placebo juice and juice group

were measured. The effect of the placebo and juice group compared with a control group was not measured.

In summary, what are some major implications from this investigation for program planning, based on the study findings and the opinions and impressions developed by the writer in the conduct of the investigation?

First, are there not practical as well as scientific reasons for avoiding the broad and sweeping claims attesting to the educational benefits to be derived from breakfast and midmorning snack programs?

Are not schools more likely to be successful in the long run in developing and maintaining support for these programs if they are more certain of the assumptions underlying such programs?

Consider the concern of one parent:

> After providing three meals a day for seven days a week for the needy, will someone argue this is now a part of free public education and everyone must be given a free lunch? Are we going to see further erosion of the local school budget by welfare programs whereby the schools feed, clothe, supervise and sleep everyone and educate no one.[1]

How will schools respond to this growing type of parent concern? With our present knowledge base, is it wise for schools to initiate large scale feeding programs on the principal assumption that the program will enhance learning and in general make a significant contribution to

---

[1]Van Ness, op. cit.

the educational goals of school? What effect will large scale school feeding programs have on the family eating patterns? Finally, what contribution can these programs make to nutrition education? Since their relatively widespread acceptance, school lunch programs have at least partially been justified on the basis of their nutrition education objective. Has this objective been realized? What can be learned in this regard from experiences with the school lunch program?

A significant number of the study subjects did not eat breakfast on the testing days. If the breakfasts that were eaten on the study day give some indication of the type of breakfasts usually eaten by the subjects, it can be concluded that a significant number are not adequate according to current recommendations of the U.S.D.A. Council on Foods and Nutrition. It was also concluded that few study subjects ate a breakfast that contained the minimum of 15 grams of protein recommended in Iowa Breakfast Studies.[2]

If breakfast is important, for whatever reason, it is clear, at least to the writer, that the major implications of the breakfast survey findings are related to the need for more effective nutrition education. This must be done with full recognition that past efforts have apparently not been too successful. The day of the pure

---

[2]Cereal Institute, op. cit.

health lecture is past; for example, the memorizing of the names of vitamins. To students this is viewed as much to do about nothing and has only resulted in an apparent gap between knowledge and action. The differences that were found in this investigation between the percentage of fourth and seventh graders who ate breakfast was probably not due to differences in the amount of nutrition information each group possessed, since we can reasonably assume that the seventh graders had more nutrition information than the fourth graders. Why then the difference? Why did so many of the study subjects feel tired and hungry at school during the morning even though they were regular breakfast eaters? Was this related to the type of food eaten? There was a difference in the relationship between breakfast eating habits and reported feelings of hunger and fatigue between the seventh grade male and female student groups. Why? Unless nutrition education programs are based on insightful answers to these types of questions and nutrition education becomes entangled with the personal values of students, the gap between what students know and what they do will continue to exist.

In summary, this study did not seem to provide data which would clarify the relationships between breakfast, midmorning snack and school performance in any significant way. In fact, a number of additional questions

have been raised which seem to warrant additional study.

Recommendations for Future Research

A significant gap seems to exist between many assumptions educators make regarding the relation of nutrition and hunger to learning and the knowledge base supporting these assumptions. Additional research can narrow this gap and provide the basis needed for community support of school feeding and nutrition education programs. The following recommendations for future research are offered.

1. Although a growing body of data is becoming available which points to the effect of early and severe malnutrition on school learning, more research is needed to measure the effect of less severe malnutrition and hunger (immediate and over a period of time) on school performance. Controlled research of this type was not evident in the literature.

   Significant additional information may be gathered by a careful analysis and comparison of existing longitudinal measures of growth patterns with selected measures of school performance. In addition, if these analyses and comparisons are combined with more direct clinical measures of nutritional status, it

may be possible to establish more clearly the relationships between nutrition and learning.

2. The specific immediate and long term effect of not eating breakfast on school performance needs further investigation. This must be done using adequate controls. More specific answers are needed to questions related to the effect of missed breakfast on the regular breakfast eaters vs. the individual who is not a regular breakfast eater, differences in effect related to sex, socioeconomic factors, and general health status.
3. The reasons why students don't eat breakfast need further investigation. Is there a difference by socioeconomic status, race, and age? How important do students feel breakfast is in relation to other meals? What conflicting values influence decisions to skip breakfast? These questions need further exploration; the answers are important as the basis for effective nutrition education.
4. Further investigation is needed concerning the effects of between meal feeding on school performance. This study was concerned with the possible effect of midmorning snack on an

academic achievement test. Would the study results have been different if other measures of school performance were used? Would the use of other types of "snacks" made any difference in the study results? Would providing a midafternoon snack make any difference in school performance? These are questions that need further study.

5. Further research is needed into the total impact of school feeding programs on the child, on the curriculum, on the family and on parent attitudes toward the role of the school in the community. This type of research has apparently been very limited. Studies that have been done seem poorly controlled. Schools, particularly, have to work more closely with nutritionists in developing, through research, a knowledge base that would clearly support a rationale for school feeding programs which will stand up to the growing criticism of programs which are often viewed as not the function of schools.
6. Further research is needed concerning the status of nutrition education in our schools, what impact this education has on the food selection and consumption patterns of school children, and the effect of teachers' nutrition

attitudes and knowledge and misconceptions on the status of nutrition education in our schools.

7. Finally the relationships between nutrition and learning must be investigated using a multidisciplinary approach in which the skills of the nutritionist, educator, family ecologist and physician are effectively combined.

BIBLIOGRAPHY

BIBLIOGRAPHY

Books

Birch, Herbert G., and Gusson, Joan D. Disadvantaged Children. New York: Harcourt, Brace and World, Inc., 1970.

Cereal Institute Inc. A Complete Summary of the Iowa Breakfast Studies. Chicago: 1962.

_____. Breakfast Source Book. Chicago: Cereal Institute, Inc., 1957.

Finn, Jeremy D. Multivariance: Fortran Program for Univariate and Multivariate Analysis of Variance and Covariance. Buffalo: Department of Educational Psychology, State University of New York at Buffalo, 1967. (Mimeographed.)

Goodenough, F. L. Anger in Young Children. Minneapolis: University of Minnesota Press, 1931.

Haggard, Howard W. Science of Health and Disease. 1st ed. New York: Harper and Bros., 1937.

Haggard, Howard W., and Greenberg, Leon E. Diet and Physical Efficiency. New Haven: Hale University Press, 1935.

Hays, William. Statistics. New York: Holt, Rinehart and Winston, 1963.

Keys, A.; Brozek, J.; Henschel, A.; Michelsen, O.; and Taylor, H. L. The Biology of Human Starvation. Minneapolis: University of Minnesota Press, 1950.

Monro, H. N., and Allison, J. B., eds. Mammalian Protein Metabolism. Vol. 2. New York: Academic Press, 1960.

Monro, Nancy. The Relationship Between Hemoglobin Level and Intellectual Function. Montana University: Missoula Foundation, 1967.

Oberteuffer, Delbert, and Beyer, Mary K. School Health Education. New York: Harper and Row Publishers, 1966.

Scrimshaw, Nevin S., and Gorden, John E., eds. Malnutrition Learning and Behavior. Cambridge: The M.I.T. Press, 1968.

Wohl, M. G., and Goodhart, R. S., eds. Modern Nutrition in Health and Disease. 4th ed. Philadelphia: Lea and Febinger, 1968.

Newspapers, Journals and Periodicals

Addison, V. E.; Tuttle, W. W.; Daum, K.; and Larsen, R. "Effects of Amount and Type of Protein in Breakfasts on Blood Sugar Levels." Journal of the American Dietetic Association, 29:674 (1953).

Bakan, Rita. "Malnutrition and Learning." Phi Delta Kappan (June, 1970), 527-530.

Bramyche, April. "Two Million Free School Breakfasts." The Times Education Supplement, November 15, 1968.

Bundy, J. F. "Breakfast Follows A.M. Calesthetics." Nation's Schools, Vol. LXXVIII, No. 3 (September, 1966), 20.

Carter, Charles E. "Breakfast Follows Pushups-Showers." Nation's Schools, Vol. LXXVIII (September, 1966), 96.

Coleman, M. C.; Tuttle, W. W.; and Daum, K. "Effects of Protein Source on Maintaining Blood Sugar Levels After Breakfast." Journal of the American Dietetic Association, 29:239 (1953).

Comstock, L., and Eddy, W. "The Effect of a Supplementary Rest Period Luncheon on Industrial Absenteeism." Journal of the American Dietetic Association, 11:239 (1935).

Coursin, D. B. "Effects on Central Nervous System Function." Nutrition Review (March, 1965), 65.

Daum, K.; Tuttle, W. W.; Larsen, R.; Raloff, L.; and Salzano, J. "Physiologic Response of Boys 12-14 Years Old to Different Breakfasts." Journal of the American Dietetic Association, 31:359 (1955).

Daum, K.; Tuttle, W. W.; Martin, C.; and Myers, L. "Effect of Various Types of Breakfast on Physiologic Response." Journal of the American Dietetic Association, 26:503 (1950).

Eichenwald, H. F., and Fry, P. C. "Nutrition and Learning." Science (February, 1969), 664.

Eppright, Ercel S. "The North Central Regional Study of Diets of Pre-school Children. Frequency of Eating." Journal of Home Economics, 62:407 (1970).

Erickson, M. T. "Intelligence: Prenatal and Preconception Environmental Influences." Science (September, 1967), 1210.

Fabry, P.; Hejda, S.; Gerney, K.; Osancara, K.; and Pechar, J. "Effects of Meal Frequency on School Children." American Journal of Clinical Nutrition, Vol. XVIII (1966), 358-361.

Forbes, E. B., and Swift, R. W. "Associative Dynamic Effects of Protein, Carbohydrate and Fat." Journal of Nutrition, 27:453 (1964).

Gill, James N. "A Breakfast Survey." The Instructor (August-September, 1964), 38.

Graham, G. G., and Morales, E. "Studies in Infantile Malnutrition. 1. Nature of the Problem in Peru." Journal of Nutrition, 79:479-487 (1963).

Haggard, H. W., and Greenberg, L. E. "Between Meal Feeding in Industry: Effects on the Absenteeism and Attitude of Clerical Employees." Journal of the American Dietetic Association, 15:435 (1939).

_____. "Selection of Foods for Between-Meal Feeding in Industry." Journal of the American Dietetic Association, XVII (1941), 753-758.

Harrell, R. F. "Mental Response to Added Thiamine." Journal of Nutrition (March, 1946), 283.

Kaiser, Margaret. "Breakfast Program Combats Pupil Apathy." Instructor (August-September, 1970), 114.

Karl, C. M.; Tuttle, W. W.; and Daum, K. "Effects of Protein Source and Specific Synamic Action." Journal of the American Dietetic Association, 29:1208 (1953).

Keister, Mary C. "Relation of Mid-Morning Feeding to Behavior of Nursery School Children." Journal of the American Dietetic Association, Vol. XXVI (January, 1950), 256-259.

Kugelmass, I. N.; Paull, L. E.; and Samuel, E. L. "Nutritional Improvement of Child Mentality." American Journal of Medical Science (November, 1944), 631.

Laird, D. A.; Levitan, M.; and Wilson, U. A. "Nervousness in School Children as Related to Hunger and Diet." Medical Journal Record, 135:494 (1934).

Monteleone, Louis. "Report of Breakfast Program." Nation's Schools, Vol. LXXII, No. 1 (July, 1963).

Pearce, Galen L. "A Better Breakfast Campaign." Journal of School Health, Vol. XXXI, No. 9 (November, 1961), 317.

"School Food Service: New Laws Can Help You Provide It." Nation's Schools, Vol. LXXXVI, No. 5 (November, 1970), 61.

Scott, J. P. "Critical Periods in Behavioral Development." Science, 138:949-958 (1962).

Scrimshaw, N. S. "Malnutrition and the Health of Children." Journal of the American Dietetic Association, 42:203-208 (1963).

Spindler, Evelyn B. "Eating Habits of Teenagers." Food and Nutrition News, Vol. XXXIX, No. 8 (May, 1968), 1.

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." Journal of the American Dietetic Association, 27:190 (1951).

Tuttle, W. W.; Daum, K.; Imig, C. J.; Randall, B.; and Schumacher, M. T. "Effect on School Boys of Omitting Breakfast. Physiologic Responses, Attitudes and Scholastic Attainments." Journal of the American Dietetic Association, 30:674 (1954).

Tuttle, W. W., Daum, K.; Larsen, R.; Salzano, J.; and Roloff, L. "Effect on School Boys of Omitting Breakfast. Physiological Responses, Attitudes, and Scholastic Attainments." Journal of the American Dietetic Association, 30:674 (1954).

Tuttle, W. W.; Daum, K.; Myers, L.; and Martin C. "Effects of Omitting Breakfast on the Physiologic Response of Men." Journal of the American Dietetic Association, 26:332 (1950).

Tuttle, W. W.; Daum, K.; Roberts, H.; and Randall, B. "Physiologic Response to Size and Content of Breakfast by Men over 60." Journal of the American Dietetic Association, 29:34 (1953).

Tuttle, W. W., and Herbert, E. "Work Capacity with No Breakfast and a Mid-Morning Break." Journal of the American Dietetic Association, 37:137 (1960).

Tuttle, W. W.; Wilson, M.; and Daum, K. "Effects of Altered Breakfast Habits on Physiologic Response." Journal of Applied Physiology, 1:545 (1949).

Van Itallie, T. B.; Beaudoin, R.; and Mayer, J. "Arteriovenous Glucose Differences, Metabolic Hypoglycemia and Food Intake in Man." American Journal of Clinical Nutrition, 1:208 (1953).

Van Ness, Marcia. "Simple Lunch Issue." Lansing State Journal, May 26, 1971.

Winick, M. "Malnutrition and Brain Development." Journal of Pediatrics (May, 1969), 667.

Winick, M., and Rasso, P. "Head Circumference and Cellular Growth of the Brain in Normal and Marasmic Children." Journal of Pediatrics (May, 1969), 774.

Other Sources

Barnes, R. H. "Developmental Consequences of Malnutrition: Experimental Studies in Animals." Paper read at Conference on Nutrition, Growth and Development of North American Indian Children, Oklahoma City, May, 1969.

Chase, H. P., and Martin, H. P. "Undernutrition and Child Development." Paper presented at Conference on Neuropsychological Methods for the Assessment of Impaired Functioning in the Malnourished Child, Palo Alto, California, June, 1969.

Cravioto, J. "Malnutrition and Behavioral Development in the Pre School Child." In Pre School Child Malnutrition: Primary Deterrent to Human Progress. An International Conference on Prevention of Malnutrition in the Pre School Child, Washington, D.C., December 7-11, 1964. Washington, D.C.: National Academy of Sciences National Research Council Publication No. 1282, 1966.

Monekeberg, F. "Nutrition and Mental Development." Paper presented at the Conference on Nutrition and Human Development, East Lansing, Michigan, 1969.

Ricciuti, Henry N. Malnutrition, Learning and Intellectual Development. Cornell University, Ithaca, New York, Cornell Research Program in Early Childhood Education, September, 1969.

Scrimshaw, N. S.; Taylor, C. E.; and Gordon, J. E. "Interactions of Nutrition and Infection." WHO Monograph Series, No. 57, 1968.

Wagner, Muriel G. Nutrition and Mental Development, Research Report No. 5, 1969, Merrill Palmer Institute. Detroit: Michigan State University, East Lansing, Michigan, Head Start Evaluation Center.

Wait, B.; Merrlain, O.; and Cowing, M. U. Supplementary Midmorning Feeding of Rural School Children. Massachusetts Agricultural Experimental Station Bulletin No. 310, 1934.

Washington, Walter. Opening statement at the White House Conference on Foods, Nutrition and Health, Final Report, Superintendent of Documents. Washington, D.C.: Government Printing Office, 1970.

White House Conference on Food, Nutrition, and Health, Final Report, Superintendent of Documents. Washington, D.C.: Government Printing Office, 1970.

Unpublished Material

Fellers, Stanford. "A Study of the Effects of Breakfast on Scholastic Attainment, Dropout Rate, and Knowledge of Nutrition Among High School Sophomores." Unpublished Ph.D. dissertation, Boston University School of Education, 1967.

APPENDICES

APPENDIX A

PRESENTATION OF SUPPLEMENTAL DATA RELATED TO TEST SCORE MEANS OF THE 4th GRADE SUBJECTS WITH A THREE WAY BREAKDOWN OF THE BREAKFAST VARIABLE

TABLE 6.1.--Cell frequencies and test score means--4th grade subjects grouped by treatment and a three way breakdown of the breakfast variable--Test 1.

Variable	Number	Test Score Mean
Placebo Group		
adequate breakfast	48	29.9
inadequate breakfast	72	26.6
no breakfast	16	23.4
Juice Group		
adequate breakfast	60	30.4
inadequate breakfast	75	27.8
no breakfast	15	29.3

TABLE 6.2.--Test score means of the 4th grade subjects--comparison of the various combinations of study variables for Test 1.

1. The adequate breakfast + juice group (ABJ) scored higher ($\bar{x}$30.4) than the adequate breakfast + placebo group ($\bar{x}$29.9).

2. The ABJ group scored higher ($\bar{x}$30.4) than the inadequate breakfast + juice group (IBJ) ($\bar{x}$27.8).

3. The ABJ group scored higher ($\bar{x}$30.4) than the inadequate breakfast + placebo (IBP) group ($\bar{x}$26.6).

4. The ABJ group scored higher ($\bar{x}$30.4) than the no breakfast + juice (NBJ) group ($\bar{x}$29.3).

5. The ABJ group scored higher ($\bar{x}$30.4) than the no breakfast + placebo (NBP) group ($\bar{x}$23.4).

6. The adequate breakfast + placebo (ABP) group scored higher ($\bar{x}$29.9) than the IBJ group ($\bar{x}$27.8).

7. The ABP group scored higher ($\bar{x}$29.9) than the IBP group ($\bar{x}$26.6).

8. The ABP group scored higher ($\bar{x}$30.4) than the NBJ group ($\bar{x}$29.3).

9. The ABP group scored higher ($\bar{x}$29.9) than the NBP group ($\bar{x}$23.4).

10. The IBJ group scored higher ($\bar{x}$27.8) than the IBP ($\bar{x}$26.6) group.

11. The IBJ group scored lower ($\bar{x}$27.8) than the NBJ group ($\bar{x}$29.3).

12. The IBJ group scored higher ($\bar{x}$27.8) than the NBP group ($\bar{x}$23.4).

13. The IBP group scored lower ($\bar{x}$26.6) than the NBJ group ($\bar{x}$29.30).

14. The NBJ group scored higher ($\bar{x}$29.3) than the NBP group ($\bar{x}$23.4).

TABLE 6.3.--Cell frequencies and test score means--4th grade subjects grouped by treatment and a three way breakdown of the breakfast variable--Test 2.

Variable	Number	Test Score Means
Placebo Group		
adequate breakfast	51	22.5
inadequate breakfast	98	18.9
no breakfast	13	20.0
Juice Group		
adequate breakfast	40	20.9
inadequate breakfast	60	20.0
no breakfast	18	18.4

TABLE 6.4.--Comparison of means between Test 1 and Test 2 4th grade subjects grouped by treatment and a three way breakdown of the breakfast variable.

Variables*	Test 1 Means	Test 2 Means
ABJ vs ABP	29.9 vs 30.4	22.5 vs 20.9
ABJ vs IBJ	29.9 vs 26.6	22.5 vs 18.9
ABJ vs IBP	29.9 vs 27.8	22.5 vs 20.0
ABJ vs NBJ	29.9 vs 23.4	22.5 vs 20.0
ABJ vs NBP	29.9 vs 29.3	22.5 vs 18.4
ABP vs IBJ	30.4 vs 26.6	20.9 vs 18.9
ABP vs IBP	30.4 vs 27.8	20.9 vs 20.0
ABP vs NBJ	30.4 vs 23.4	20.9 vs 20.0
ABP vs NBP	30.4 vs 29.3	20.9 vs 18.4
IBJ vs IBP	26.6 vs 27.8	18.9 vs 20.0
IBJ vs NBJ	26.6 vs 23.4	18.9 vs 20.0
IBJ vs NBP	26.6 vs 29.3	18.9 vs 18.4
IBP vs NBJ	27.8 vs 23.4	20.0 vs 20.0
NBJ vs NBP	23.3 vs 29.3	20.0 vs 18.4

*AB = adequate breakfast (more than 10 gm protein)
IB = inadequate breakfast (less than 10 gm protein)
NB = no breakfast
J = juice as treatment
P = placebo as treatment

APPENDIX B

BETWEEN MEAN SQUARES, UNIVARIATE F SCORES AND PROBABILITY FOR ALL OF THE TEST 1 AND TEST 2 STUDY FACTORS

TABLE 6.5.--Between mean squares, univariate F scores, and probability for the study variables based on test scores--4th grade, Test 1.

Hypothesis	Variables*	Between Mean Squares	Univariate F Score	Probability Less Than
H_o1	T x B x C(s)	244.3297	1.5589	0.1724
H_o2	T x B x S	44.7922	2.8380	0.0251
H_o3	B x C(s)	258.9129	1.6520	0.1470
H_o4	T x C(s)	353.7599	2.2572	0.0495
H_o5	B x S	201.6168	1.2864	0.2759
H_o6	T x S	80.5515	0.5140	0.7256
H_o7	T x B	75.7541	0.4833	0.4876
H_o8	T	106.1248	0.6771	0.4114
H_o9	B	548.2790	3.4983	0.6270
H_o10	S	130.4094	0.8321	0.5059
H_o11	C(s)	403.4741	2.5744	0.0272

* T = treatment
B = breakfast
S = school
C(s) = class nested within school

TABLE 6.6.--Between mean squares, univariate F scores, and probability for the study variables based on test scores--4th grade, Test 2.

Hypothesis	Factors*	Between Mean Squares	Univariate F Score	Probability Less Than
H_o1	T x B x C(s)	57.2334	0.7791	0.5656
H_o2	T x B x S	176.4503	2.4020	0.0506
H_o3	B x C(s)	55.0544	0.7495	0.5872
H_o4	T x C(s)	73.2769	0.9974	0.4199
H_o5	B x S	80.8160	1.1002	0.3572
H_o6	T x S	153.0447	2.0834	0.0837
H_o7	T x B	24.6724	0.3359	0.5628
H_o8	T	2.3369	0.0318	0.8586
H_o9	B	317.9765	4.3287	0.0386
H_o10	S	142.2289	1.9362	0.1052
H_o11	C(s)	139.3870	1.8975	0.0955

* T = treatment
B = breakfast
S = school
C(s) = class nested within school

APPENDIX C

VISUAL AND GRAPHIC PRESENTATION OF THE INTERACTION BETWEEN THE STUDY VARIABLES BY SCHOOL BASED ON TEST SCORE MEANS

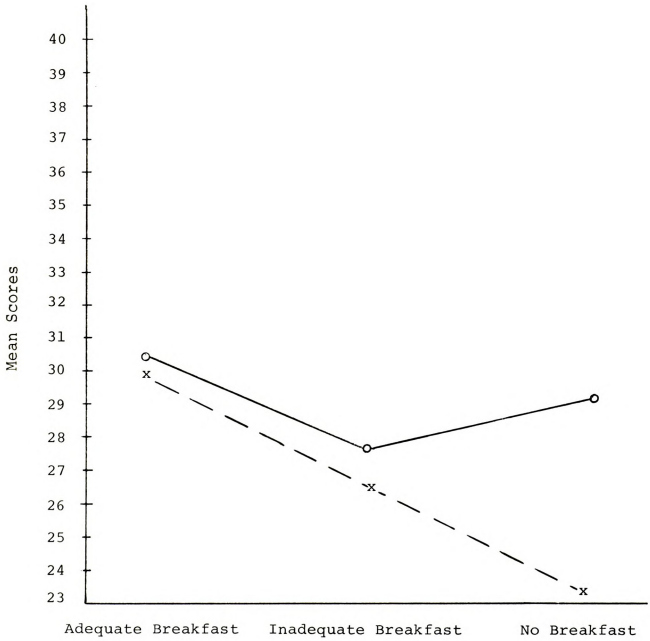

Chart 6.1. Test score means of 4th grade subjects grouped by treatment--Adequate breakfast versus inadequate breakfast versus no breakfast.

x = Mean scores of juice group by type of breakfast
o = Mean scores of placebo group by type of breakfast

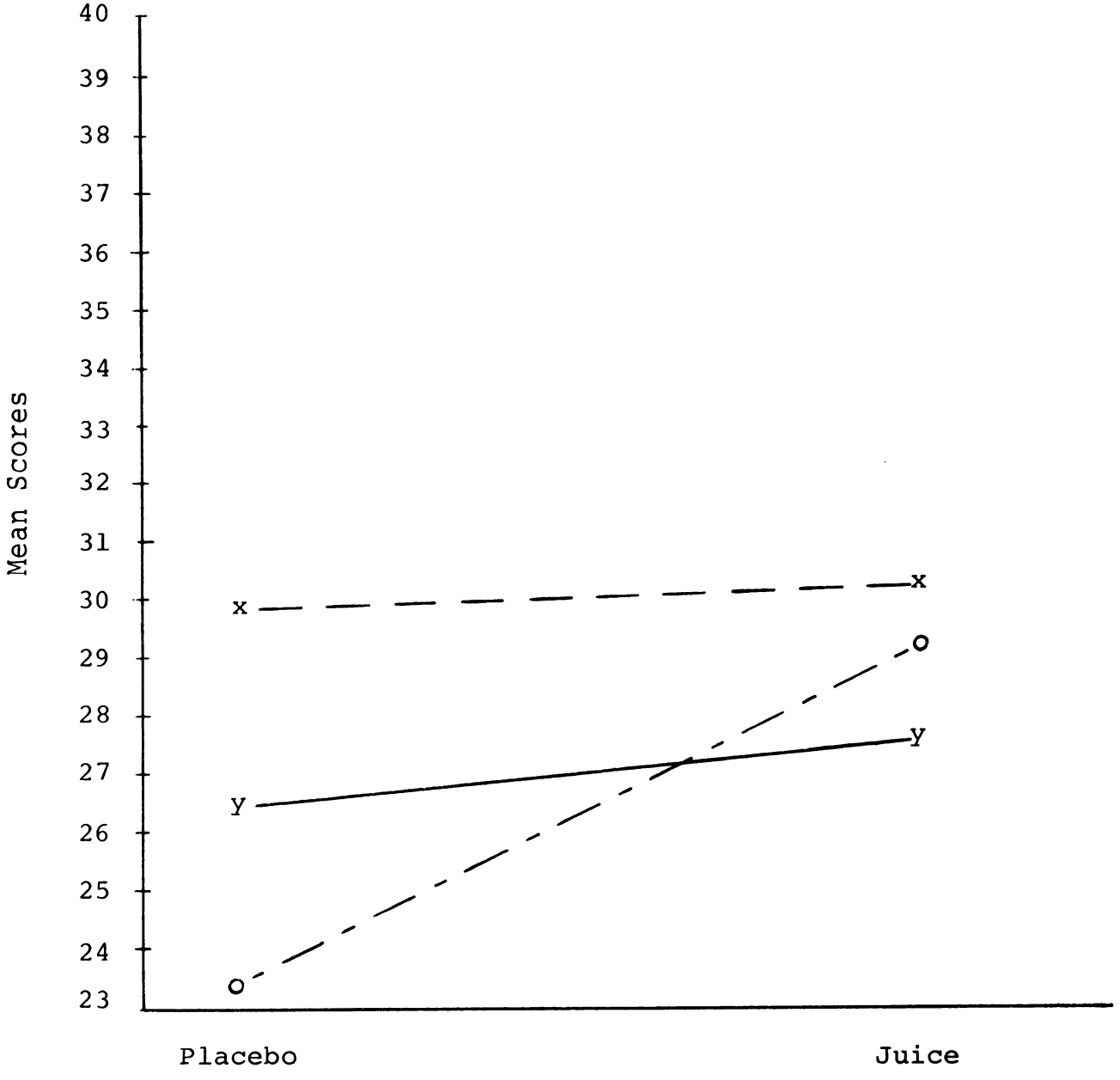

Chart 6.2. Test score means of 4th grade subjects grouped by type of breakfast--Juice versus Placebo, Test 1.

x = Mean scores of adequate breakfast group by treatment
y = Mean scores of inadequate breakfast group by treatment
o = Mean scores of the no breakfast group by treatment

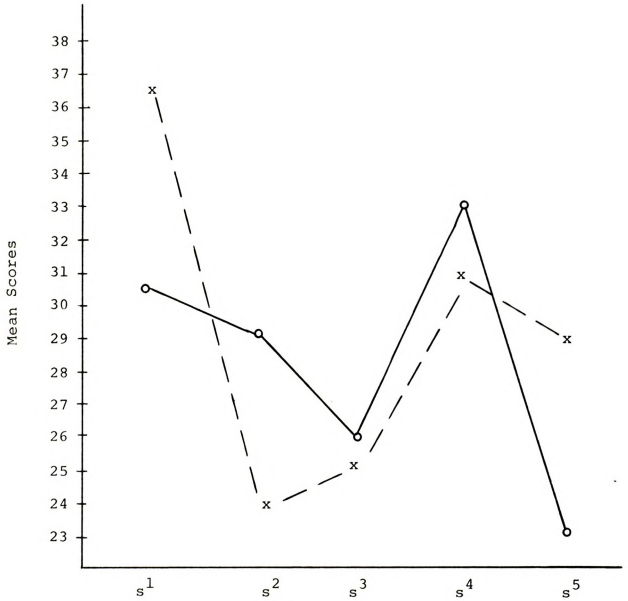

Chart 6.3. Mean scores of adequate breakfast + placebo versus inadequate breakfast + juice by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

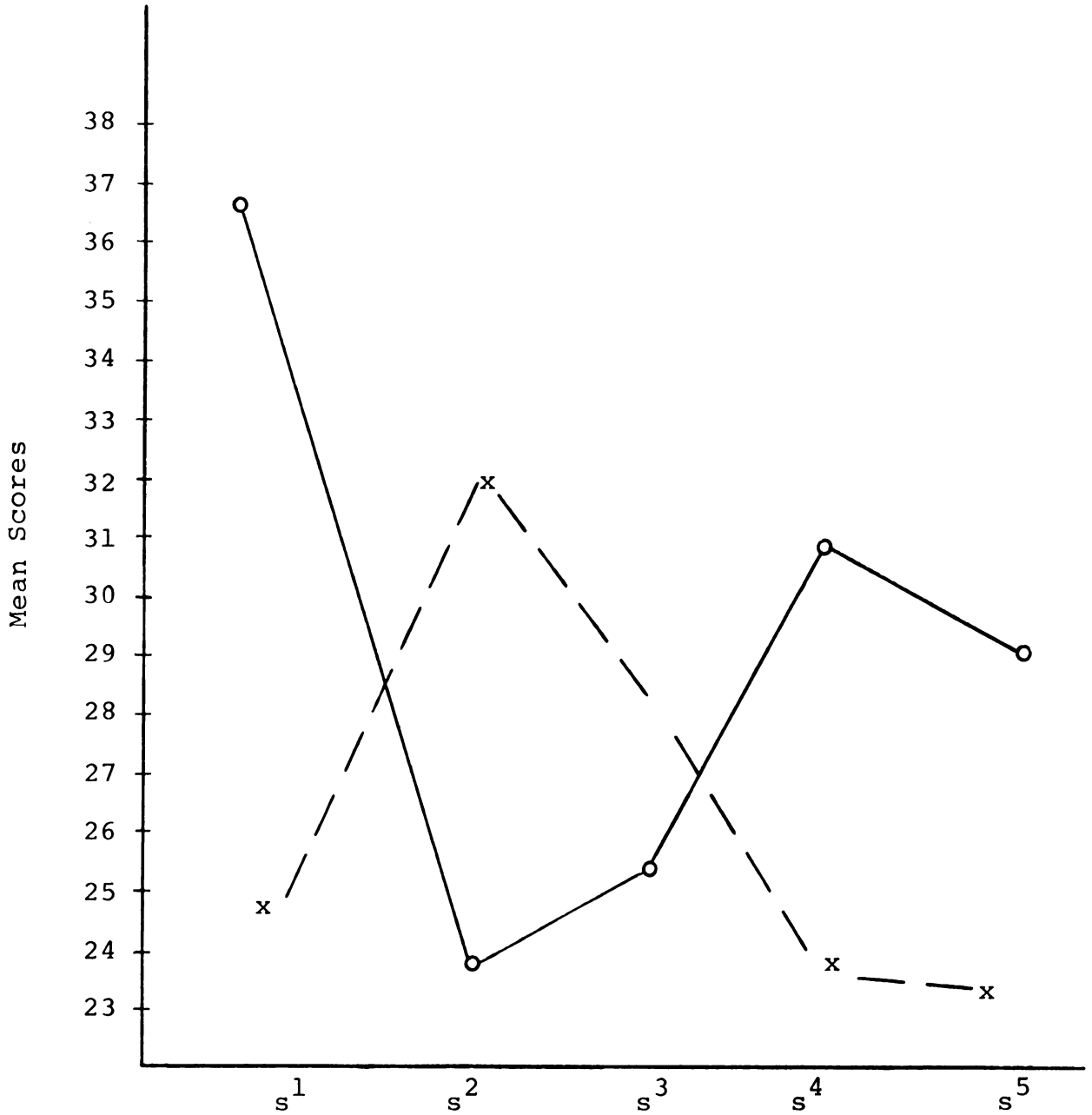

Chart 6.4. Mean scores of adequate breakfast + juice versus adequate breakfast + placebo by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

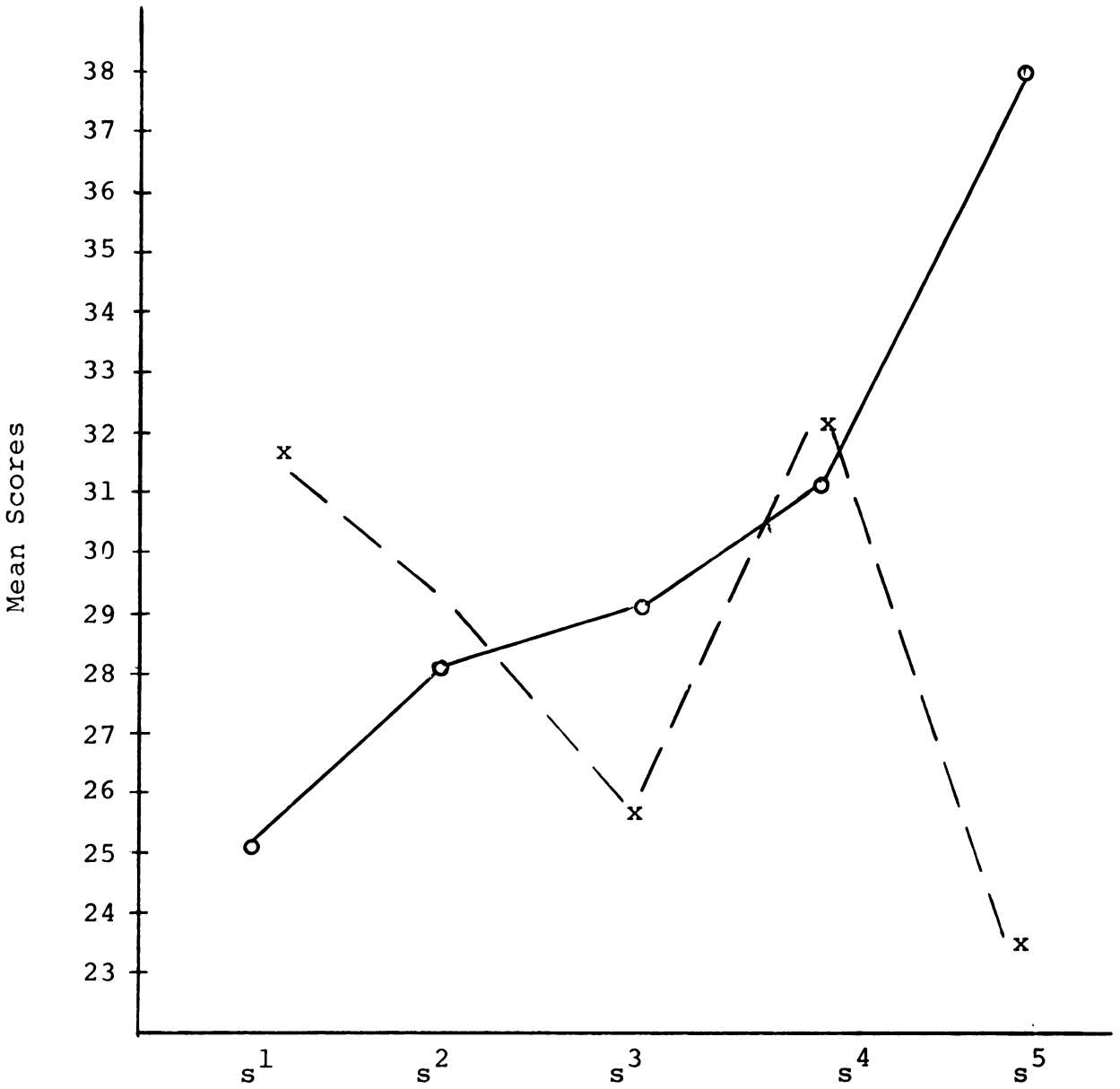

Chart 6.5. Mean scores of inadequate breakfast + juice versus inadequate breakfast + placebo by school, 4th grade, Test 1.

x = Mean scores of adepuate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

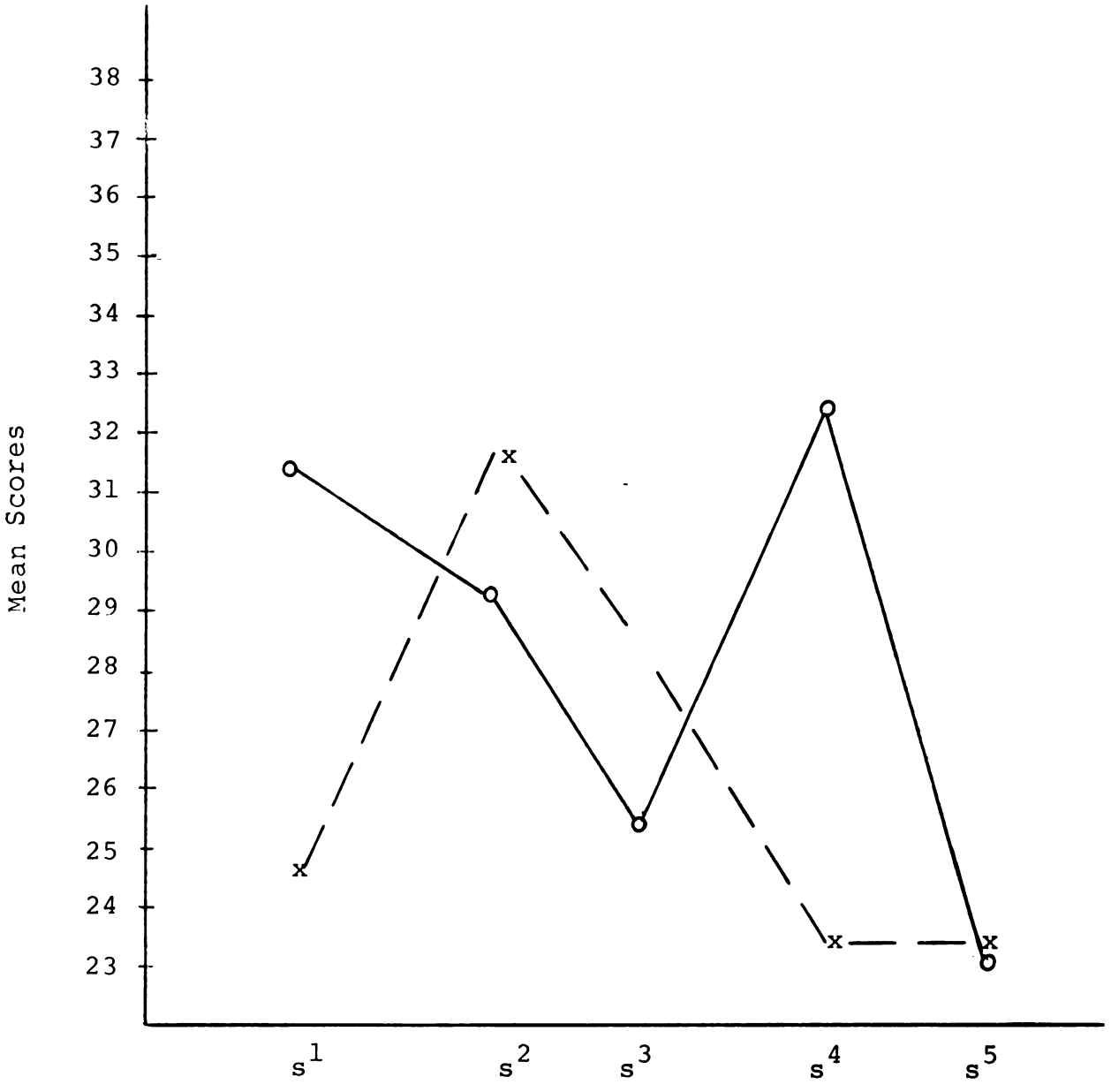

Chart 6.6. Mean scores of adequate breakfast + juice versus inadequate breakfast + juice by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

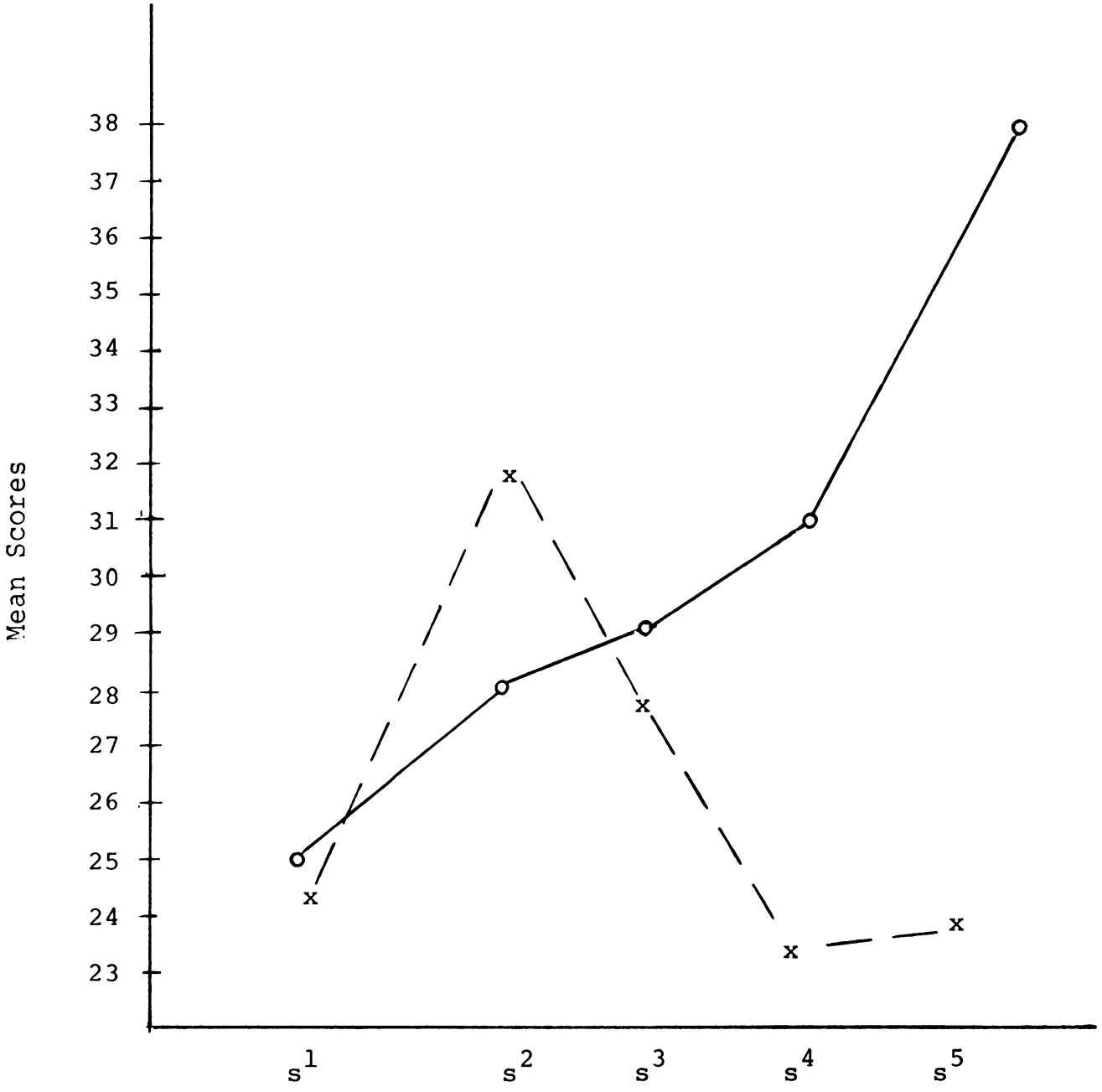

Chart 6.7. Mean scores of adequate breakfast + juice versus inadequate breakfast + placebo by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

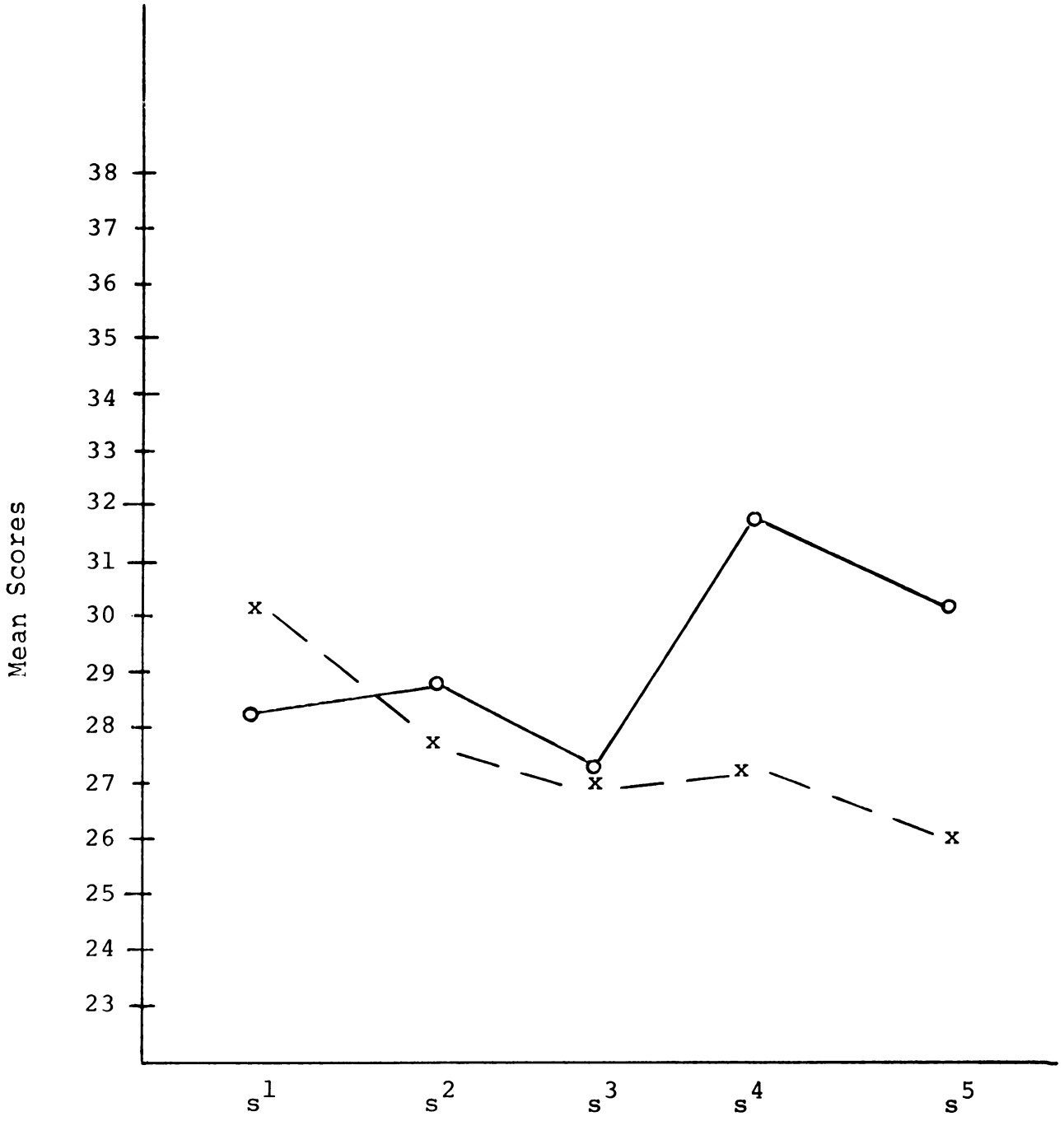

Chart 6.8. Mean scores of adequate breakfast + juice versus inadequate breakfast + juice by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

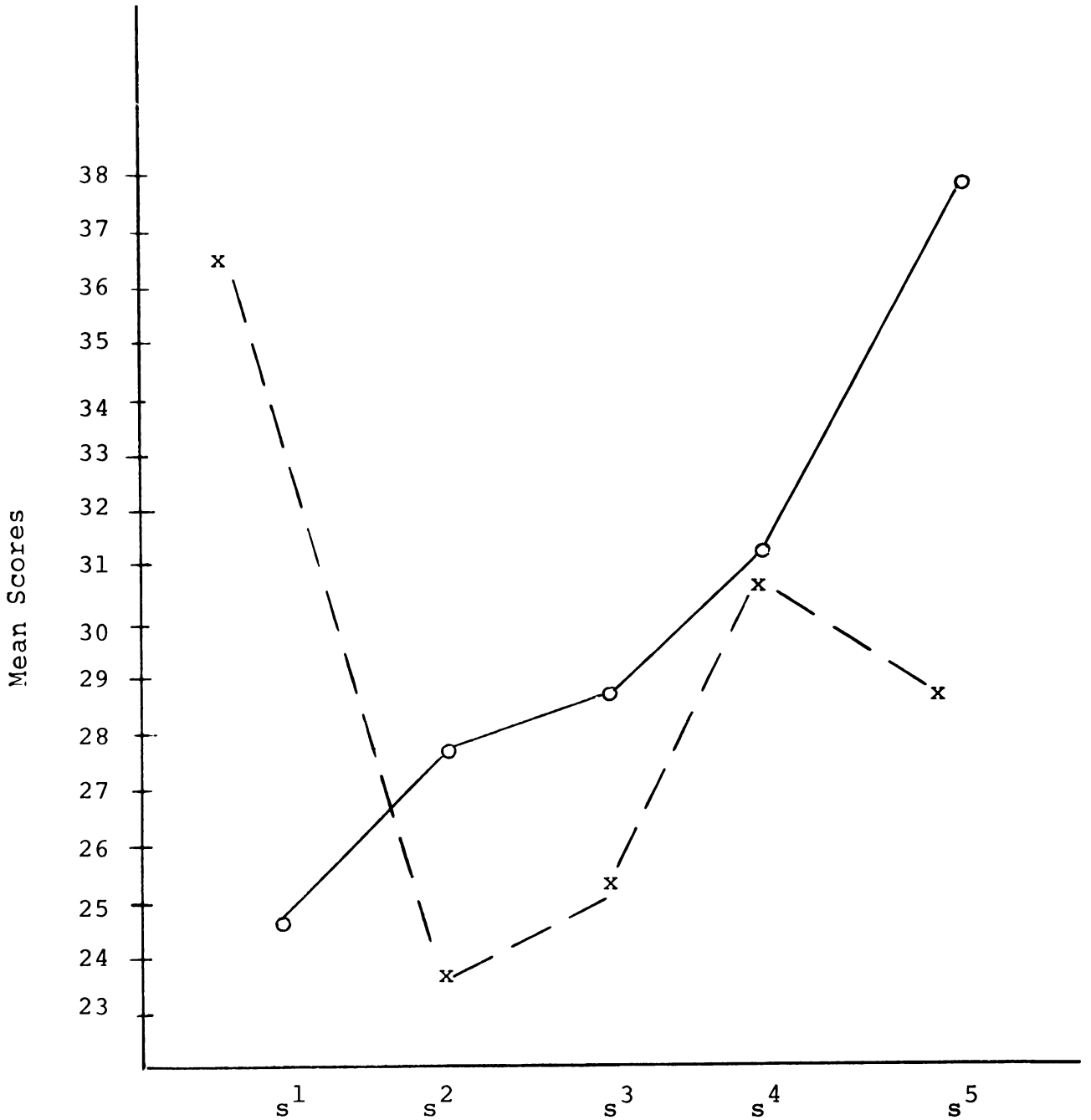

Chart 6.9. Mean scores of adequate breakfast + placebo versus inadequate breakfast + placebo by school, 4th grade, Test 1.

x = Mean scores of adequate breakfast groups
o = Mean scores of inadequate breakfast groups
s = Schools

APPENDIX D

BREAKFAST SURVEY FORM

Please answer the following questions

Name_____

School_____

_____

1. How often do you eat breakfast?

   _____Once in a while

   _____Not too often

   _____Every day

   _____Almost every day

2. Do you get hungry or tired at school during the morning?

   _____Yes

   _____No

   If so, about what time?_____

3. Did you eat anything before you came to school this morning?

   _____Yes

   _____No

4. If you ate something before coming to school this morning, please write down what you ate and how much you ate.

APPENDIX E

COMMUNICATION--DIRECTIONS TO TEACHERS FOR ADMINISTERING THE MIDMORNING SNACK AND BREAKFAST SURVEY FORM

DIRECTIONS FOR TEACHERS ASSISTING IN THE LIQUID SNACK STUDY

First Testing Day

1. Simply administer approximately 4 oz. (cup filled 1/2 inch from top) of the liquid snack to each of the children prior to their taking the test.

Second Testing Day

1. Divide the class into two groups, according to the class lists provided.

2. Hand out the short questionnaire, have them write their name on the top and whether they will have the drink from the "p" or "j" container.

3. Have each child fill out the questionnaire. On the last question, please stress that they should write down anything that they ate, including candy, pop, potato chips, cereal, fruit, toast, sandwich (the kind), etc.

4. Give each child in one of the groups approximately 4 oz. (cup filled to 1/2 inch from the top) of the liquid snack from one of the containers marked with the letter "p".

5. Give each child in the other group the same amount from one of the containers marked with the letter "j".

Third Testing Day

1. Repeat the procedures followed on the second testing day. However, change your groups. Make sure the "j" or "p", depending on what the child had, is recorded on the top of the questionnaire.

Materials

School_____ Class_____

Cups_____

"P" Containers_____

"J" Containers_____

Thank you for your cooperation and assistance.