DOCUMENT RESUME

ED 218 001 PS 012 919

AUTHOR Nelson, Kathryn, Ed.; And Others
TITLE The National Evaluation of School Nutrition Programs. Review of Research: Volume 2.
INSTITUTION System Development Corp., Santa Monica, Calif.
SPONS AGENCY Food and Nutrition Service (DOA), Washington, DC. Office of Policy, Planning and Evaluation.
PUB DATE Apr 81
NOTE 330p.; For related documents, see PS 012 918-920.

EDRS PRICE MF01/PC14 Plus Postage.
DESCRIPTORS *Breakfast Programs; Delivery Systems; Elementary Secondary Education; Federal Legislation; *Federal Programs; Literature Reviews; *Lunch Programs; *Nutrition; Participant Characteristics; Program Effectiveness; *Program Evaluation; Research Methodology
IDENTIFIERS Food Consumption; *Milk Programs

ABSTRACT

Findings of a review of research pertaining to federally subsidized school nutrition programs are presented in this report. The aim of the review of research is to provide guidance for the design of the subsequent parts of the evaluation by describing the school nutrition programs and their operations and by providing baseline information on nutritional status assessment, on the nutritional status of school-age children, on program impact, and on the correspondence between targeting of program benefits and recipients' needs. The review identifies areas that need further investigation and also identifies methodological approaches that lead to increased knowledge of the programs and their effects. Chapter 4 in this second volume of the review describes the few large and several smaller studies which have investigated the impact of school nutrition programs. Much of this chapter is concerned with an analysis of the methodologies used in the reported studies. Chapter 5 first examines how benefits are targeted, next focusing on the correspondence between the nutritional needs of school-age children and the programs' nutritional benefits. Chapter 6 summarizes what is known and not known about the school nutrition programs, describing what kinds of research are needed. All of the studies examined are listed in the bibliography; also appended is the Omnibus Budget Reconciliation Act of 1981 (PL97-35). (RH)

The National Evaluation of School Nutrition Programs

Review of Research–Volume 2

NATIONAL EVALUATION OF
SCHOOL NUTRITION
PROGRAMS

U.S. DEPARTMENT OF AGRICULTURE FOOD AND NUTRITION SERVICE

Jack Radzikowski, Ph.D., Project Officer
Steven K. Gale, Ph.D., Associate Project Officer
Office of Policy, Planning and Evaluation
500 12th Street, S.W.
Washington, D. C 20250
(202) 447-8223

SUBCONTRACTORS

DECIMA RESEARCH
2760 North Main
Santa Ana, CA. 92701
Vincent Breglio, Ph.D., Project Director
Tom Glenn, Senior Research Associate

CASE WESTERN RESERVE UNIVERSITY
Office of Research Administrator
Cleveland, Ohio 44106
James Koppenhaver, Assistant Director
Harold Hower, M.D., Coordinator

CONSULTANTS AND TECHNICAL ADVISORS

Philip Armstrong
Amelia Ariens
George Briggs, Ph.D.
Ruth Carol, Ed.D.
John Coulson, Ph.D.
Joseph Edozien, M.D.
Gail Frank
Ralph Frerichs, Dr. P.H.
Steven Kaplan
Ward Keesling, Ph.D.
Jane Lewis, Dr. P.H.
Robert Levine, Ph.D.
Lillie Parkin, Ph.D.
Grace Petot
Marian Solomon, Ph.D.
Seymour Sudman, Ph.D.
Donald West, Ph.D.
Alfred Zerfas, M.R.C.P.E.

SYSTEM DEVELOPMENT CORPORATION

2500 Colorado Avenue
Santa Monica, CA 90406
(213) 820-4111

Jean Wellisch, Ph.D., Project Manager
Ray Stewart, Ed.D., Associate Manager

Joyce Vermeersch, Dr. P.H.
Project Research Nutritionist

Judit Katona-Apte, Dr. P.H.
Research Nutritionist

Lawrence A. Jordan, Ph.D.
Manager—Sampling, Design and Analysis

Sally D. Hanes
Associate Manager

Kenneth M Maurer
Econometrician

Janet K. Rienbolt
Research Analyst

John R. Shiban
Manager—Field Operations

Mary Macari
Sr. Field Operations Specialist

Beth Minton
Field Operations Specialist

Linda Soriano
Field Nutritionist

Instrument Processing
Aida Bell

Training and Quality Assurance

Lyn Hayes
Sue Hixson
Maria Marvosh
Olga Sanders
Noreen Shanahan
Patricia Sorrells

Gary A. Duck, Ph.D.
Manager—Instrumentation

Doug Longshore
Instrumentation Specialist

Kathryn Nelson
Phase I Coordinator

Jane Green
Research Associate

Project Secretaries

Carol Bundies
Peggy Hobbs
Mieko M. Vale

ADVISORY PANEL

Gertrude Applebaum
Director, Department of Food Services
Corpus Christi Independent School District, Corpus Christi, Texas

Walter F. Colender
Director, Child Nutrition Programs
New Jersey State Department of Education
Trenton, New Jersey

Ross Conner, Ph.D.
Asst. Professor of Social Ecology
University of California at Irvine
Irvine, California

Robert Karp, M.D.
Asst. Professor of Pediatrics and
Director, Nutrition Programs
Department of Pediatrics,
Thomas Jefferson University
Philadelphia, Pennsylvania

Robert Linn, Ph.D
Professor of Psychology
University of Illinois
Urbana, Illinois

Sara Lynn Parker
Nutrition Field Worker
Food Research and Action Center
Washington, D. C.

David Price, Ph.D.
Professor, Agricultural Economics
Washington State University
Pullman, Washington

Richard Reed
Member, Committee on Evaluation and Information Systems, and
Child Nutrition Director
New York State Department of Education
Albany, New York

David Rush, M.D.
School of Public Health
Columbia University
New York, New York

Daniel Stufflebeam, Ph.D.
Director, Evaluation Center, and
Professor of Education
Western Michigan University
Kalamazoo, Michigan

Ann R. Tolman
Director, Child Nutrition Programs
Connecticut State Department of Education
Hartford, Connecticut

Myron Winick, M.D.
Professor of Pediatrics and
Director, Institute of Human Nutrition
Columbia University
New York, New York

THE NATIONAL EVALUATION OF SCHOOL NUTRITION PROGRAMS

REVIEW OF RESEARCH - VOLUME 2

Edited by: Kathryn Nelson
Joyce Vermeersch
Lawrence Jordan
Jean Wellisch
Steven Gale

The research reported herein was performed pursuant to a contract with the Office of Policy, Planning and Evaluation, Food and Nutrition Service, U.S. Department of Agriculture. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Therefore, points of view or opinions stated do not, necessarily, represent official USDA position or policy.

SYSTEM DEVELOPMENT CORPORATION
2500 COLORADO AVENUE
SANTA MONICA, CALIFORNIA 90406

APRIL 1981

ACKNOWLEDGEMENTS

Here, we want to acknowledge the people who made significant contributions during the review process, in addition to those named as authors. Many people contributed to the review of research by searching for relevant studies, abstracting information, composing tables, preparing preliminary drafts, and conducting substantive and editorial reviews. If someone who helped us is not mentioned, it is due to an oversight and we apologize.

First, we want to express our appreciation to the people in the Food and Nutrition Service (FNS) of the Department of Agriculture (USDA). Jack Radzikowski, the USDA Project Officer for the National Evaluation of School Nutrition Programs (NESNP) has been unfailing in his support, patience and good humor. He and Steven Gale, Nutritional Coordinator for the Program Evaluation Staff of the Office of Planning, Policy and Evaluation, critiqued draft materials and coordinated inputs from other members of the FNS staff. They were extremely sensitive to the interests and concerns of the diverse audiences for this report and guided us toward making the report useful to decision-makers, practitioners and researchers.

Among other FNS staff who reviewed drafts of the report, we are especially grateful to Fran Zo[illegible]n and Teresa Trogden for their information and insights concerning nutritional assessment and program operations.

Next, we want to thank the members of the NESNP Advisory Group who reviewed our drafts, provided information on operational procedures, and suggested additional topics to be covered in the review. (The Advisory Group membership is shown on the NESNP organization chart.)

Finally, we want to acknowledge the contributions of NESNP staff. Ruth Bornstein (consultant) wrote the preliminary draft of legislative history in Chapter I, and Ken Maurer (project economist) drafted the section on school

and student participation, also in Chapter I; Lilli Parkin and Fred Zerfas (consultants) wrote the preliminary drafts for Chapter II on dietary measures and anthropometrics, respectively; Jane Green (NESNP research associate) and Linda Marie Collins (FNS summer intern) prepared comprehensive, detailed critical analyses of Chapters II and IV, respectively; Laura Leeb (NESNP research assistant) located research and abstracted data for several of the chapters; Sandra Brighouse located studies and constructed tables for Chapter III; Carol Bundies (project secretary), Frank Tierney, Pam Doherty, and Bruce Severy (SDC editors) patiently and diligently worked on the many iterations needed to complete this report.

TABLE OF CONTENTS

7

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF TABLES (Cont'd)

13

LIST OF FIGURES

SUMMARY OF CHAPTER IV. THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS, FAMILIES, SCHOOLS AND DISTRICTS

This chapter summarizes findings from a review of the research on the effects of the USDA school nutrition programs--the National School Lunch Program (NSLP), School Breakfast Program (SBP), and Special Milk Program (SMP). The review focused on research concerning effects of one or more of the three programs on participating students, on their families, and on schools and school districts. Most of the research assessed program effects on students; only a few studies assessed the effects on families, and fewer still assessed effects on schools and districts.

The chapter is divided into three major sections, addressing effects at the student, family, and institutional levels. Several central questions have guided our review of the literature at each of these levels and have structured the presentation of the findings. The major student-level question is:

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS?

To answer this, several subquestions were identified and the literature pertinent to each was reviewed. The questions and the major findings of the review are summarized below.

A. *What Are the Effects of Participation on Nutritional Status?*

The review of research did not yield consistent evidence of positive program effects on the nutritional status of students. Most of the research focused on the NSLP rather than on the SBP or SMP.

Major conclusions of the review are as follows:

- School lunch participants appear to consume lunches that contain higher percentages of Recommended Dietary Allowances (RDA) for selected nutrients than nonparticipants; however, the impact of this advantage in 24-hour intakes on the students' health is unclear. Comparisons of the mean daily intakes of nutrients or percentages of the RDA achieved by participants and nonparticipants generally do not show significant differences, except for participants' consumption of more vitamin A (Price et al., 1975, 1978), calcium (Howe et al., 1980; Price et al., 1975, 1978), protein, riboflavin and phosphorus (Price et al., 1978).

  When factors that are thought to influence dietary intakes (such as the child's sex, age, height and weight) are taken into account, school lunch participants continue to have increased intakes of calcium, riboflavin, and phosphorus compared with nonparticipants (Price et al., 1978). Milk is a good source of these nutrients, and it is likely that some of the differences between the nutrient intakes of participants and nonparticipants can be attributed to the milk served at lunch.

- There is evidence that the dietary intakes of children who are from low-income families or who are judged to be nutritionally needy may be improved by the NSLP. Some of these children receive substantial portions of their total daily nutrient intake from the School Lunch Program (Emmons et al., 1972; Price et al., 1975; U.S. DHEW, HRA, CDC, 1972).

- One study suggested that breakfast program participants had higher intakes of several nutrients than students to whom the program was not available, but the sample of students participating only in the breakfast program was very small (U.S. Congress, Congressional Budget Office, 1980). Children attending schools with breakfast programs consumed more of their total daily intake before 10:00 a.m. than children in schools without a program, and more children attending schools without a program reported having nothing to eat before 10:00 a.m. (Hunt et al., 1979). One study showed that children who participated in both the NSLP and SBP had higher intakes of nutrients than children who received only school lunch and morning milk (Emmons et al., 1972). Other studies have failed to show this effect (U.S. Congress, Congressional Budget Office, 1980; Lieberman et al., 1976). However, children participating in both the school lunch and breakfast programs were found to have higher indices of nutrient intake than children participating in only the breakfast or the lunch program (U.S. Congress, Congressional Budget Office, 1980).

- The relatively few studies that have attempted to explore the effects of school meal programs on biochemical, anthropometric, and clinical indicators of nutritional status have all encountered technical problems that make it difficult to draw definitive conclusions from the results. The most commonly employed biochemical measures have been hemoglobin or hematocrit values. In most studies (Emmons et al., 1972; Price et al., 1975; Lieberman et al., 1976), there were so few low hemoglobin or hematocrit values that it was difficult to distinguish program effects among the groups studied. Even when the occurrence of low hemoglobin or hematocrit values was more frequent, no discernible effects of program participation could be shown (Paige, 1972). Studies that evaluated other biochemical indices in addition to hemoglobin and hematocrit did not yield meaningful indications of program effects (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975).

- There is some evidence that anthropometric measures can show differences between participants and nonparticipants. For example, Price et al. (1975) found tendencies for participants and nonparticipants to have different weight patterns in some age-sex groups.

B. *What Are the Effects of Participation on Milk Consumption?*

An expressed purpose of the Special Milk Program (SMP) is to encourage the consumption of fluid milk. It is likely that the milk served with school meals also increases milk consumption, and contributes to the higher intakes of specific nutrients by NSLP participants. For these reasons, it is important to look at program effects on milk consumption. Findings of the literature review are as follows:

- Two studies (Anderson & Hoofnagle, 1960; Robinson, 1975) found that children attending schools with the SMP consumed more milk in a 24-hour period than children in schools without the program. Robinson indicated that about 90 percent of schools with the SMP also have the NSLP, but that both programs yield increased levels of student milk consumption.
- Since the milk component of the school lunch pattern* may be responsible in part for increases in the intakes of specific nutrients by participants, the question of milk and lactose intolerance (i.e., metabolic and absorptive disorders associated with milk consumption) is potentially important. Only three studies could be found that explored the relationship between these disorders and milk consumption of children from different racial groups who participated in school nutrition programs. The studies compared milk

*While this chapter contains references to "Type A" meals for analytic purposes, this terminology has been replaced with "school lunch patterns" or "reimbursable meals" as a result of recent changes in the Type A pattern (Federal Register, August 17, 1979 and May 16, 1980).

consumption between black and white children and obtained contradictory results. Paige et al. (1971, 1972, 1974) found that higher percentages of black students, compared to white students, drank less than half of the milk served to them at lunch, whereas Stephenson et al. (1977) found no relationship between race and milk consumption.

- Three studies investigated the effects of offering different types of milk in school nutrition programs. A national study in over 700 schools (Robinson, 1975) showed that milk waste is significantly reduced when children are allowed the choice of flavored milk. A smaller study by Guthrie (1977) also showed this effect; however, this study indicated that increased milk consumption was accompanied by increased food waste among other lunch pattern components. No difference was found in school children's consumption of, or liking for, low-fat or unflavored whole milk (Godfrey et al., 1972).

C. *What Are the Effects of Participation on School Performance, Behavior, and Nutrition Knowledge?*

- Two general approaches have been used to investigate the effects of school nutrition programs on non-nutritional aspects of student behavior. One approach looks at the effects of hunger on short-term behavior, while the other attempts to relate participation in school feeding programs to long-term effects on school achievement and attendance. Studies of short-term effects yield conflicting results, and studies that have investigated the long-term effects of school feeding programs on school achievement and attendance have failed to conclusively demonstrate significant relationships. Whether programs targeted toward malnourished students, per se, could have beneficial effects on school performance has not been resolved.

- It is reasonable to assume that exposing children to the components of nutritious meals through participation in school nutrition programs will improve their attitudes toward nutrition and increase their nutrition knowledge. However, there are no studies to document whether or not simple exposure to nutritious food, rather than specific activities in, for example, nutrition education curricula, has an effect on students' awareness and knowledge of nutrition.

The major family-level question that this chapter addresses is the following:

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON FAMILIES?

The Washington State Study (Price et al., 1975) appears to be the only major research that investigated program effects on families by engaging in primary data collection and analysis. This study looked at the effects of children's participation in school meal programs on their families' food expenditures and food consumption, and found the following:

- Participation in school meals that are provided free was found to have a fairly strong family income supplementation effect. Price et al. (1975) reported that a dollar's worth of free school lunch resulted in an increase of 60 cents in the total value of household food used by eligible and participating families.
- In comparing the food consumption patterns of families participating and not participating in the NSLP, they found few significant differences between groups, and speculated that the observed differences might be due more to regional variations than to program effects.

The major institutional-level question that this chapter addresses is the following:

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS?

The effects of the programs on schools and districts can be examined in various ways. Of greatest interest is the effect of federal subsidies and regulations on the ability of schools and districts to provide nutritious meals to students, and to provide free or reduced-price meals to the economically needy. While there are numerous studies of factors influencing the institutional decision to offer the programs (see Bentley et al., 1980, for a recent review), no studies of the direct effects of the programs on participating institutions could be found. However, there are studies on the effects of planned variations in program operations or procedures on schools and districts. We investigated three such studies, along with a fourth study that examined the effects of the programs on the national economy. Unlike the previous sections of this chapter, which involved an exhaustive review of all relevant studies, this section only illustrates the kinds of problems and issues that arise in studies of schools and school districts. Interpretation of the studies of school program variations (Harper et al., 1978; Lough et al., 1978a, 1978b; USDA, FNS, 1980) is hampered by three general problems: small sample sizes, self-selection of the sample (i.e., all schools were chosen from a relatively small number of schools that volunteered to participate in the studies), and a short time period for the experimental variations to have produced an effect. These problems limit the generality of the results obtained by these studies. The conclusions drawn by these researchers are summarized as follows:

- The labor, equipment, and food costs associated with different delivery systems (such as on-site preparation, central preparation, etc.) were found to vary significantly, even though no significant differences were found in per-meal costs across systems.

- Food and labor costs were reported to be significantly lower when students were allowed free choice in their food selection, compared to the Type A offer-versus-serve menu pattern. However, the effort required for planning and serving meals under free choice was found to be higher.

- In the study comparing schools receiving commodities and schools receiving cash in lieu of commodities, no significant differences were found. However, state administrative costs were lower in Kansas, where all schools received cash in lieu of commodities, than in neighboring Colorado, where no schools received cash in lieu of commodities.

The final study reviewed in this section used input-output analysis to evaluate the effects of the school lunch program on the national economy (Nelson & Perrin, 1976). After describing the limitations on the results, the authors examined the effects of the school lunch as currently defined, and compared its effects with the estimated effects of three alternative lunch programs:

- Universal free lunch to all students;

- Free lunch to all students currently eligible and reduced-price lunch for all other students; and

- Federal subsidies limited to those students currently eligible for free lunches.

The estimated effects of the current lunch program on the national economy were estimated for both calendar year 1972 and fiscal year 1971. These effects included the following:

- An increase in gross national product (GNP) of approximately $348 million in calendar 1972 and $448 million in fiscal 1974;
- An increase in business receipts of approximately $838 million in calendar 1972 and $982 million in fiscal 1974; and
- An increase in total employment for approximately 33,000 jobs in calendar 1972 and 38,000 jobs in fiscal 1974.

The authors estimated that if the universal free lunch alternative had been in operation in fiscal 1974, an additional $1,163 million in business receipts, $809 million in GNP, and 54,000 jobs would have resulted. The universal reduced-price lunch with a free lunch option would have resulted in smaller gains, while the limitation of federal subsidies to the free lunch program would have reduced business receipts, GNP, and employment slightly.

In reviewing research on program effects, particular attention was given to the methods used in the studies. In critiquing methods, we emphasized the areas on which the studies focused, e.g., effects on nutritional status, milk consumption, student behavior, and families. The appropriateness of a particular method can only be evaluated relative to the purpose of the study. As expected, all of the studies exhibit some methodological problems.

Several summary comments regarding sampling, design, measurement and analysis which have implications for future research are:

- Sampling. When selecting subjects for research, the investigator is concerned with whether the sample of subjects is representative of the population under study and whether the comparison groups from the sample are similar. The first concern involves external validity, the extent to which the findings can be generalized to the population; the second concern involves internal validity, the confidence with which any differences obtained between control and experimental groups can be attributed to the treatment. If the purpose of the research is to obtain information regarding the effects of school nutrition programs on a national basis, probability sampling seems an appropriate method by which to select subjects; that is, drawing a large number of students so that each student has an equal chance of being selected in the sample. For example, in the review of program effects on the nutritional status of students, the only study that can be generalized to the U.S. population is the U.S. Congress, Congressional Budget Office (1980) analysis of the HANES data for students. Although the numbers of subjects in some cells used in the analysis were quite small, the strength of HANES is that it is based on a probability sample with a respectable response rate. Price et al. (1975), on the other hand, drew subjects only from Washington State; their results can be generalized to the Washington population, but cannot necessarily be generalized to the national population of students. However, the findings of Price et al. (1975) could be generalized if their results were replicated using samples from locations other than Washington State or if it could be assumed that their parameter estimates do not deviate substantially from the parameters of the national population.

- Design. Among other things, design involves the choice of treatment and the scheduling of observations. In the studies reviewed, the treatment (participation in school nutrition programs) was generally considered a categorical variable: various classification systems were used to place children into discrete, nominal groups, i.e., participants and nonparticipants. For example, several investigators categorized students as participants based on the number of times per week the students ate the school meal: two times or more (U.S. Congress, Congressional Budget Office, 1980); three times or more (U.S. DHEW, HRA, CDC, 1972); and four times or more (Price et al., 1975, 1978). Students who ate the school meal less frequently were categorized as nonparticipants. Such categorization provides only rough estimates of the frequency of participation, resulting in a loss of valuable information and a less sensitive analysis. If a study is intended to make statements about the effects of school nutrition programs, it would be appropriate for participation in the programs to be treated not as a categorical variable but, rather, as a continuous variable that includes the frequency and duration of participation in the school lunch, breakfast and milk programs.

Another design feature of research is the scheduling of observations. Observations may be made at one point in time (cross-sectionally) or repeated observations may be made over an extended period of time (longitudinally). Many investigators believe that more confidence can be placed in causal inferences that are based on longitudinal findings than on those based on cross-sectional findings. If the research is intended to make strong statements of causal attribution, a longitudinal design is desirable. Longitudinal studies are very costly in terms of both time and money. These costs make it difficult to conduct a large longitudinal study on a national basis, but smaller local studies may also be informative. Longitudinal studies are most appropriate for testing hypotheses that are based on a body of past research or a formal theory. In the absence of empirical or theoretical underpinnings, a practical course to follow might be to use less expensive cross-sectional methods initially and then to proceed with a longitudinal study after a theory has been derived.

- Measurement. When selecting an instrument to measure the outcome of a treatment, the researcher is concerned with the instrument's reliability (the extent to which the instrument's measurements are consistent) and validity (the extent to which the instrument assesses what it is intended to assess). These issues have important implications for the findings of research concerning program effects. For example, in cross-sectional studies, it is critical to ensure the comparability of measures used in various schools; in longitudinal studies, it is critical to ensure the comparability of measures for individual children as well as for groups. Chapter II discusses the reliability and validity of the nutritional status measures. Generally, more information is needed about the reliability and validity of most measures used in the studies reviewed in Chapter IV.

- Analysis. Many factors other than the treatment are likely to impinge upon the outcome. If these extraneous factors are not controlled for, they may confound the effect. While a sound research design attempts to control for extraneous factors, statistical techniques are also needed to control for the influence of measured extraneous variables.

  Many of the reviewed studies did not control statistically for extraneous factors. If the purpose of the research is to obtain information regarding the effects of school nutrition programs on the nutritional status of students, it is appropriate to control for factors other than participation that could affect the student's nutritional standing; e.g., nutrients consumed away from school and genetic, metabolic, and other factors. Of all the studies, only two (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975, 1978) controlled for some of these factors in analysis.

26

CHAPTER IV. THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS, FAMILIES, SCHOOLS AND DISTRICTS

Joyce Vermeersch
Jane Green
Kathryn Nelson
Lawrence A. Jordan
Kenneth M. Maurer

INTRODUCTION

This chapter summarizes findings from a review of the research on the effects of the school nutrition programs--the National School Lunch Program (NSLP), School Breakfast Program (SBP), and Special Milk Program (SMP). In conducting the review we searched for studies that had investigated effects on students and their families, who are the direct beneficiaries of the nutrition services. We also searched for studies that had examined the effects of the programs on schools and districts, who are the providers of these nutritional services. Most of the relevant studies assessed program effects on students. Only a few studies examined the effects on families, and fewer still investigated the effects of participation in the programs on schools and districts. Since the major objective of the programs is to safeguard children's health by providing them with nutritious foods, it is reasonable that the existing research emphasizes effects on children, and is mainly concerned with nutritional effects.

Unlike the previous two chapters, which reviewed studies that provided background material on nutritional assessment measures and the nutritional status of school-age children, the material in this chapter focuses directly on the school nutrition programs. The assessment of the measures of nutritional status (Chapter II) will help the reader evaluate the findings that were obtained using one or more of these measures in studies of nutritional effects. Similarly, the discussion of the nutritional problems found in school-age children (Chapter III) will give the reader some appreciation of the difficulties involved in demonstrating nutritional effects for a population in which major nutritional deficiencies are relatively rare.

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS?

Two national surveys (Ten State Nutrition Survey, U.S. DHEW, HRA, CDC, 1972; and Hoagland's report of the HANES data, U.S. Congress, Congressional Budget Office, 1980) provide information about the programs' impact on the nutritional status of students. A number of local studies, the most comprehensive of which was the Washington State Study (Price et al., 1975), also investigated the nutritional impact of the programs. All of the studies compared the nutritional status of students who participated in one or more of the programs with those who did not. All but one of the studies included a 24-hour dietary intake in the battery of measures used to show differences between participants and nonparticipants. Anthropometric measures were also used in studies to show long-range nutritional effects.

In addition to program impacts on nutrient intakes, some research has been done on program impact on consumption of different foods. Of particular interest is the contribution made by Special Milk Program to milk consumption. Milk is also a component of the NSLP, and may be largely responsible for the findings of higher intake of certain nutrients (e.g., calcium) for NSLP participants. On the other hand, the problem of lactose intolerance (see Chapter III) has caused some investigators (e.g., Paige et al., 1971, 1972, 1974) to question the appropriateness of government policies that encourage children to drink milk. In order to identify the effects of program participation on milk consumption, we reviewed the research that examined this question and found several studies that investigated various aspects of milk consumption: two studies compared milk consumption for a 24-hour period in schools with and without the SMP (Anderson & Hoofnagle, 1960; Robinson, 1975); two studies (Paige et al., 1971, 1972, 1974; Stephenson et al., 1977) compared the milk consumption of black and white students; and three studies (Robinson, 1975; Guthrie, 1977; Godfrey et al., 1972) examined the effects of offering different types of milk.

In addition to the nutritional effects, and effects of participation in the programs on milk consumption, we also looked at program effects on school performance, behavior, and nutrition knowledge at the student level. Research on these topics has concentrated mainly on the effects of breakfast. Arguments that have been advanced in support of the SBP stress that many children come to school without breakfast and that hungry and/or inadequately nourished children cannot learn well. Pollitt, Gersovitz, and Garfiulo (1978) reviewed the research that has addressed the short-term behavioral effects of morning feeding, and the long-term effects of the school nutrition programs, on attendance and academic achievement. The studies that looked at short-term effects (hyperactivity, performance on decoding tasks, attention span, neuromuscular tremor, grip strength and physical endurance) used experimental designs. Studies that looked at long-term effects (attendance and academic achievement), in the main, used pretest-posttest designs.

The final student-level effect that we investigated was the effect on nutrition knowledge. The idea here is that constant exposure through participation in the NSLP to well-balanced nutritious meals would have the effect of increasing the child's awareness of and knowledge concerning nutrition. Our review of research on this topic unearthed no studies that examined whether simple exposure to the program, without an explicit educational component, has this effect.

WHAT ARE THE EFFECTS OF PARTICIPATION ON FAMILIES?

Program participation can potentially affect the families of participating children in various ways. The families may be released from the burden of preparing lunch in advance or of having to be home at fixed times in order to provide lunch. If meals of equivalent nutritious quality and appeal cannot be prepared as cheaply at home, families may save money by allowing children to participate in school breakfast or lunch. For families whose children receive meals free or at reduced price, the programs provide an income supplement. In addition, of course, there is the intangible benefit of knowing the child is receiving a nutritious meal.

The issue of program effects on families is an important one since the school nutrition programs probably cannot be justified solely in terms of their nutritional effects for the majority of American school children. In part, justification for the programs may lie in their income supplementation effects for economically needy families, and in the help provided to all households where no adult is at home during the day.

In reviewing the research on the effects of participation on families, we found only one major study that engaged in primary data collection and investigated family food expenditures and food consumption patterns (Price et al., 1975). This study provides a start in the direction of systematic investigation of program effects on families. However, since the study sample was confined to Wasnington State, and many of the potential effects on families were not examined, this aspect of participation needs further investigation.

WHAT ARE THE EFFECTS OF THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS?

The effects of the programs on schools and districts can be examined in various ways. Probably of greatest interest is the effect of federal subsidies and regulations on the ability of schools and districts to provide nutritious meals for all children, and to provide these meals free, or at reduced price, to the economically needy. The particular question that the review of research attempted to answer in this connection was the following: what effect would changes in federal subsidies have on institutional decisions to participate and on the quality of the meals served to students? Our review was not able to identify any studies that dealt with this question even though it is obviously an important one during this period when cutbacks to federal programs are being considered.

We were able to identify studies that provide information on the effects of planned variations in program operations and procedures on schools and districts. Although there are many studies of this kind, we chose to present only three in order to illustrate the kind of research previously conducted on the effects of operational variations. Two studies examine the effects of variations in food services. One study looks at the effects on costs, quality, and acceptability of school lunches that result from alternate food service delivery systems (Lough et al., 1978). The other study examines similar effects that result from alternative meal patterns (Harper et al., 1978). The third study included in this section comes closest to dealing with the question of the impact of federal subsidization, which we originally sought to answer, by looking at the effects of providing cash in lieu of commodities (USDA, FNS, 1980). The study examines effects on food selection and food cost and quality.

The final study that is reviewed here considers the overall role of the school nutrition programs in the national economy, and the effects of major changes in the programs on the economy. While this economic study does not address the question of program effects on schools and districts, it does consider the economic effects of the aggregate expenditures of local schools and districts on food, equipment, and personnel used in the school nutrition programs.

Organization of the Chapter

In the remainder of the chapter, findings from our review of program effects on students, families, schools and districts are presented. Because of the importance of the studies reviewed here for providing guidance to the National Evaluation of School Nutrition Programs, the methodologies employed by the major studies are described and critiqued in considerable detail.

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS?

This section reviews the major studies on the effects of the school nutrition programs and critiques the methods employed. As reflected in the three specific questions that gu ed the review, the discussion covers the effects of programs on the nutritional status of students (in terms of dietary, anthropometric, and biochemical parameters), on milk consumption, and on the performance and behavior of children in school.

A. *What Are the Effects of Participation on Nutritional Status?*

B. *What Are the Effects of Participation on Milk Consumption?*

C. *What Are the Effects of Participation on School Performance, Behavior, and Nutrition Knowledge?*

Findings of studies addressing each of these questions are presented along with descriptions of the methods used. The methods of major studies are critiqued to help the reader evaluate the findings, and to identify strengths and weaknesses that should be taken into account in the design of future studies on program effects.

A. *What Are the Effects of Participation on Nutritional Status?*

The school nutrition programs could make an important contribution to nutritional status if they represent supplements to otherwise inadequate diets of school children. The issues to be addressed in this discussion, therefore, are whether participants and nonparticipants differ significantly* in their nutritional status (i.e., in their dietary intake, biochemical, and anthropometric measurements), and whether these differences can be ascribed to program participation. The various dietary intake, biochemical, and anthropometric measures of nutritional status that are mentioned in the subsequent discussion are described and critiqued in Chapter II.

REVIEW OF STUDIES

Seven studies have attempted to determine the effects of participation in school nutrition programs on the nutritional status of children. Two major studies, discussed below, are based on data for school-age children collected as part of large-scale surveys of the U.S. population. The Ten State Nutrition Survey (U.S. DHEW, HRA, CDC, 1972) compared the nutrient intakes of participants and nonparticipants in school lunch programs and calculated the contribution of the school lunch to the total dietary intake. In the second large-scale study, U.S. Congress, Congressional Budget Office (1980) used

*Statistical significance is a technical term which denotes that observed differences are not due to chance, but does not necessarily imply that the differences are large or important for student nutrition and health.

data gathered during Cycle I of the Health and Nutrition Examination Survey (HANES) to study the relative effects of school lunches, breakfasts, and supplementary milk on the daily nutrient intake.

The other five studies cited used smaller samples from single states or localities. Price et al. (1975) used dietary, biochemical, anthropometric and general health status data to determine the effects of school lunch and school breakfast programs in Washington State. This study also included extensive home interviews to determine household food practices and factors associated with the food preferences of children. Howe and Vaden (1980) analyzed 24-hour dietary intake data for NSLP participants and non-participants from a middle-sized high school in a midwestern city. Paige (1972) obtained biochemical and anthropometric measurements for participants and nonparticipants in the school lunch program in four elementary schools in Baltimore. Lieberman et al. (1976) compared dietary and anthropometric data for children receiving free school breakfasts at an elementary school in Compton, California, with similar data for children from an adjacent school where the program was not available. Finally, Emmons et al. (1972) obtained dietary, biochemical, anthropometric and general health status measures for elementary school children in two school districts in Upper New York State. In one district, a free lunch and milk program was offered to all children. In the other, a free lunch was combined with a free breakfast program.

With respect to study design, four of the studies used data collected cross-sectionally (U.S. DHEW, HRA, CDC, 1972; U.S. Congress, Congressional Budget Office, 1980; Howe et al, 1980; Price et al., 1975) and the remaining three studies used longitudinal designs with measurements of students taken in the fall and spring of one school year (Lieberman et al., 1976; Paige, 1972; and Emmons et al., 1972). The methods and principal findings in each of these studies are described below in the order listed in Table IV-1, which summarizes the features and results of each study. The order of the studies reflects decreasing sample sizes within the cross-sectional and longitudinal categories. Strengths and weaknesses of the methods used in each study are discussed and contrasted.

Before the studies are described further, two issues, which are discussed in more detail later, merit a brief reference. First, the definitions of participation varied from study to study. The bases of these definitions ranged from whether the school (Lieberman et al., 1976) or district (Emmons et al., 1972) offered a school meal program to how often the child ate the school meal (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975; U.S. DHEW, HRA, CDC, 1972). Second, Hoagland (1978) advocated a distinction between students who chose not to participate in available school nutrition programs (nonparticipants) and those students who did not participate because programs were not available to them (non-availables). He asserted that a more valid determination of program effects would be obtained from comparisons between non-availables and participants because a bias exists in participant/nonparticipant comparisons. Because of these issues, the definitions of participation and the composition of the comparison groups used in each study are described as fully as the original investigators' reports permit.

Ten State Nutrition Survey (U.S., DHEW, HRA, CDC, 1972)

As originally mandated by Congress, the Ten State Nutrition Survey (TSNS) (U.S. DHEW, HRA, CDC, 1972) was designed to "determine the extent and location of serious hunger and malnutrition in the United States."

Method. The sample for the survey was drawn from Kentucky, Louisiana, South Carolina, Texas, West Virginia, California, Massachusetts, Michigan, New York and Washington. The first five of these states were designated as low-income-ratio states and the last five of these states were designated as high-income-ratio states, as based on the average poverty income ratio (PIR) for families in each state. (The PIR, an index of income level, is the ratio

Table IV-1. Summary of Studies of Impacts of School Nutrition Programs on Nutrition Status of Students

CROSS-SECTIONAL

Studies	Program(s)[a]	Treatment	Sample	Measures	Analysis	Results
Ten State Nutrition Survey (TSNS), 1972	NSLP[b]	Students did or did not participate in program	Ages 10-16 low-income quartiles of 10 states N = 8,495	24-hour dietary recall	Comparison of mean 24-hour nutrient intakes between participants and non-participants. Contribution of NSLP to nutrient intake of participants.	Daily mean intakes higher for participants than non-participants. Contribution of NSLP to nutrient intake higher for students from low-income-ratio states.
Health Examination and Nutrition Survey (HANES), U.S. Congress, Congressional Budget Office, 1980	NSLP[b] SMP[b] SBP[b]	Students did or did not participate in programs	Ages 6-21 probability sample of U.S. population (HANES) N = 3,155	24-hour dietary recall, hemoglobin, hematocrit, serum protein, serum albumin, serum cholesterol	Comparison of 24-hour nutrient intakes as NAR[c] and MAR[d] of participants and non-availables. Regression analysis with program participation and SES[e] variables. Comparison of proportions of children with abnormal biochemical values (no statistical tests applied).	Intakes of SBP and of SMP participants, but not NSLP participants, were higher than intakes of non-availables. SBP + NSLP participants had higher MARS than either SBP or NSLP participants. Nutrient intakes decreased with increasing age and family size but increased with higher educational level of family head. Children from wealthier homes tended to consume higher MARs overall but fewer calories and less vitamin-A.
Washington State Study (WSS), Price et al., 1975	NSLP SBP	Students did or did not participate in programs	Ages 8-12 participants and non-participants of NSLP in Wash. State stratified by income and ethnicity N = 1,013	24-hour dietary recall, household food habits, height, weight, fatfold and arm and head circumferences, blood pressure, large battery of biochemical tests	Comparisons of mean values of students by income/ethnic participation categories. Regression analysis for nutrient intakes and selected biochemical values using program participation, SES factors and household food habits.	Participants had higher vitamin A intakes and serum calcium levels, lower iron intakes, lower serum phosphorus, serum vitamin C and serum albumin levels and lower albumin/globulin ratios. Contribution of school meals to total intake greater for low-income than high-income NSLP participants. Full SBP participation related to higher vitamin C intakes and serum vitamin C levels. Full NSLP participants had lower intakes of iron than non-participants and higher intakes of energy, protein, calcium and riboflavin than partial-NSLP participants. NSLP non-participation related to higher serum albumin and lower serum carotene levels.
Howe et al., 1980	NSLP	Students did or did not participate in program	Random sample of participants and non-participants from grades 10 and 11 of one high school N = 104	24-hour dietary recall	Comparison of mean nutrient intakes and RDA percentages for total day and for lunch only by participation and gender	24 hour mean intake and consumed RDA percentage of calcium higher for participants. Lunch-only mean intakes and consumed RDA percentages of all nutrients except niacin higher for participants. Participants consumed more than 1/3 of RDA of 6 nutrients at lunch.

Table IV-1. Summary of Studies of Impacts of School Nutrition Programs on Nutrition Status of Students (Cont'd)

LONGITUDINAL

Studies	Program(s)[a]	Treatment	Sample	Measures	Analysis	Results
Emmons et al., 1972	NSLP + SMP NSLP + SBP	Breakfast program implemented in a district that offered NSLP but not in a comparison district that offered SMP and NSLP	Grades 1-3 two school districts in Upstate New York N = 844	24-hour dietary recall, height, weight, hemoglobin or hematocrit	Comparison of fall and spring measure of "nutritionally needy" and "nutritionally adequate" students. Change in measures from fall to spring. Change in "needy" status from fall to spring.	Spring intakes of needy children in both districts were higher than their fall intakes. In District A, 1/4 of increase was from NSLP; in District B, 3/4 of increase was from NSLP + SBP. NSLP + SBP students diets in the spring were higher in calcium, vitamin A, thiamin, riboflavin and vitamin C. No significant differences found for anthropometric measures.
Paige, 1972	NSLP	Students did or did not participate in program	Grades 1, 2 and 6 in 4 low-income schools in Baltimore participating in NSLP N = 751	Height, weight, hemoglobin and hematocrit	Comparison of fall and spring measures for participants and non-participants. Change in measures from fall to spring on participants and non-participants	No significant differences between participants and non-participants.
Lieberman et al., 1976	SBP[b]	Breakfast program implemented at one school but not at control school	Grades 3-6 1 program and 1 no-program school in low-income neighborhood Compton, CA. N = 551	24-hour dietary recall, height, weight, chest and arm circumferences	Comparison of fall measures of program and no-program students. Change in fall to spring measures of program students.	Average intakes similar except for program children's lower intake of vitamin C, iron and thiamin. No significant changes in height and weight of program children after participating 5 months.

[a] NSLP = National School Lunch Program
SBP = School Breakfast Program
SMP = Special Milk Program

[b] May include programs not sponsored by USDA.

[c] NAR = Nutrient Adequacy Ratio, which is consumption expressed as the percentage of the recommended daily intake of a nutrient.

[d] MAR = Mean Adequacy Ratio, which is consumption expressed as a composite of all nutrients and is computed by truncating the NAR values of each studied nutrient at 100 percent and taking their average.

[e] SES = Socioeconomic status.

of family income to a defined poverty level that has been adjusted for family characteristics, e.g., size.) Within each state, enumeration districts were ranked by PIR, and random samples of 30 households per district were drawn from the lowest income quartile in each state. All determinations were based on the 1960 census.

Interviewers visited the households selected in each district and collected information concerning the socioeconomic status, food sources, and educational status of family members. All persons in the household were then invited to participate in clinical examinations at a regional center. The clinical examination to assess nutritional status consisted of a medical history, physical and dental examinations, X-rays, and dietary, biochemical, and anthropometric assessments. Household interviews were completed with 23,846 households, representing 86,352 individuals. Clinical examinations were obtained from 40,847 of these individuals (47.3 percent of the original sample).

The age and ethnic distributions of the clinical sample were as follows:

- Age Distribution

  0-16 years - 53%
  17-44 years - 30%
  45+ years - 17%

- Ethnic Distribution

White	46%
Black	35%
American Indian	10%
Oriental	5%
Other	4%

Clinical, anthropometric and biochemical measures were obtained from all subjects who presented themselves for the examination. Dietary assessments using 24-hour dietary recalls were conducted for all pregnant and lactating women and for all people aged 0 to 3 years, 10 tc 16 years, and more than 59 years. To evaluate the dietary intakes, special standards were devised for the survey.

Only the dietary information was considered in the analysis of the impact of school lunch programs. In this study no distinction was made between USDA-supported programs and programs sponsored by other organizations. Participation was defined as eating the school lunch regularly three or more days per week; however, it is not clear from the report whether the nonparticipation comparison group had access to a school lunch program. Dietary information was obtained from 8,495 children aged 10 to 16, using a 24-hour dietary recall. A computerized system based on food composition tables from Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1963) was used to convert the foods listed on the recall form into values for calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C. Comparisons were made between the average daily intakes of nutrients for participants and nonparticipants in the school lunch program, for students from high- and low-income-ratio states, and for students with varied ethnicity and income. Nutrient contributions of school lunches were compared between children from low- and high-income-ratio states. However, no tests of statistical significance were reported for differences obtained in any of these comparisons.

Results. Although the mean 24-hour intakes of all nutrients except thiamin were higher for students in the high-income-ratio states than in the low-income states, within each income category the daily mean intakes of participants were generally higher than the intakes of nonparticipants. The authors found that school lunch programs made a larger contribution to the daily nutrient intake of children in low-income-ratio states. For each nutrient examined, the school lunch's contribution to the day's total intake was higher for the students in low-income states than in high-income states. For black children in the low-income-ratio states, the school lunch contributed more than one-half of the day's total intake of calcium and one-third or more of the day's total intake of energy (calories), iron and vitamin A.

Although the sample was designed to be probabilistically representative of the poverty population within each state, problems that arose during the collection of data changed its representativeness. Of the 40,847 persons given clinical examinations, 8,400 were "volunteers" who were not contacted during the initial household interviews but who were recruited because of the low participation rate of the original sample. Many people from the original sample refused to participate in either the interview or the examination. Also, interviews could not be completed in a large number of selected households because dwellings no longer existed or were unoccupied when the interviewer arrived. Furthermore, not all the people who resided in these poverty neighborhoods and who agreed to participate had low incomes. As a result of these problems, the TSNS sample is only representative of itself; technically, generalizations cannot be made to the national population of low-income people or even to the low-income segments of the participation states.

Hoagland (1978, 1979); U.S. Congress, Congressional Budget Office (1980)

The National Center for Health Statistics (NCHS) conducted nationwide Health Examination Surveys (HES) in 1959-1962 and 1963-1965. For the scheduled 1971-1974 survey, a substantial nutrition component was added, and the name of the survey was changed to the Health and Nutrition Examination Survey (HANES). HANES used a multi-stage procedure to select a nationally representative probability sample of non-institutionalized persons aged 1 to 74 (NCHS, 1972). Of the 28,043 individuals selected from 65 primary sampling units throughout the United States, 20,749 (74 percent) agreed to the examination. This corresponds to an effective response rate of 75 percent when adjustment is made for the effect of over-sampling among the poor, preschool children, women of childbearing age and the elderly.

Among other things, HANES included a household questionnaire, food programs questionnaire, general medical examination, dental examination, anthropometric assessment, dietary interview, and biochemical tests on samples of whole blood, serum, plasma and urine. The HANES protocol for dietary interviews is described at length in Chapter II.

As in the TSNS, special standards were developed to evaluate the adequacy of dietary intake in HANES. The standards for calcium, iron, vitamin A, and vitamin C were defined for age and sex categories. Standards for thiamin and riboflavin were related to caloric intake. Standards for assessing calories and protein were based on body weight for sex and height. The standards for children used the actual body weights for age, sex, and height derived from the anthropometric measures performed during the survey (NCHS, 1974).

Method. Hoagland (1978, 1979) and U.S. Congress, Congressional Budget Office (1980) used portions of the 1971-74 HANES data base to examine the nutritional impact of three child nutrition programs: the school lunch, breakfast, and milk programs.* The children were classified as participants or nonparticipants on the basis of responses by them or their parents to questions asking whether their school had a "school lunch progr 1, special milk program, or school breakfast program" and how many times per week the

*An exception was made to the criteria for selecting references to be reviewed (i.e., only primary analyses) to include Hoagland's analysis of HANES data since it represents a significant contribution to the analysis of student dietary impacts.

children usually participated. Participants were defined as those children who had the program available to them and who participated a minimum of twice a week. Nonparticipants were defined as those children who participated only once a week or not at all.

Hoagland recognized a problem in the designation of nonparticipants, which was not taken into account in the TSNS analysis. Nonparticipation may occur either because the programs are not offered by the schools or because children or their parents decide not to participate in an available program. The decision against participation represents a self-selection option that cannot be taken by children in schools where the program is not available. To explore the existence of a bias introduced by self-selection, Hoagland divided the nonparticipants into two groups: those to whom a program was available (nonparticipants) and those to whom a program was not available (non-availables). He then attempted to determine the direction of bias in the participant/nonparticipant comparisons by contrasting the nutritional data from the non-available group with the data from the nonparticipating group. He concluded that, for the breakfast and milk programs, the participant/nonparticipant comparisons would be biased toward reducing the apparent impact of the programs and, for the lunch program, the direction of the bias could not be determined. Accordingly, he reasoned that participant/non-available comparisons would provide a more valid estimate of program effects.

Hoagland's three reports (1978, 1979; and U.S. Congress, Congressional Budget Office, 1980) are similar, but they vary in the number of respondents included and the types of nutritional data analyzed. In the 1978 analysis, Hoagland examined data for approximately 3,850 of the respondents between 6 and 21 years of age, who represented about 45 million school children. In the 1979 and 1980 analyses, Hoagland used data for only 3,155 of these respondents (representing about 36 million children), including only those reported as being in school and examined while school was in session and excluding those who reported consuming an "atypical diet" for the 24-hour recall period. Furthermore, unlike the 1978 and 1979 reports, the analysis reported in 1980 includes biochemical data in addition to dietary data. Only the results of the most recent analysis will be discussed here.

The HANES dietary information was obtained by using a 24-hour dietary recall. The recalled food intake was then converted into nutrient values using the Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1963) food composition tables. From these nutrient values, Nutrient Adequacy Ratios (NARs) were computed for each individual for food energy (calories), protein, calcium, iron, vitamin A, vitamin C, niacin, thiamin, riboflavin, and phosphorus. The NAR is the percentage consumed of the recommended daily intake of a nutrient. The recommended daily intake standards developed for HANES by a nutritional advisory panel were used to compute the NARs for energy, protein, calcium, iron, vitamin A and vitamin C. For the other four nutrients, the standards used to compute the NARs were Recommended Dietary Allowances (RDA) (National Research Council, 1974)*. A composite Mean Adequacy Ratio (MAR) for each respondent was computed by truncating the NAR values at 100 percent and taking their average. (The MAR was constructed so that overconsumption of one nutrient would not compensate for underconsumption of another.)

*Two general points should be made concerning the use of RDA. First, in all the studies that assessed nutrient intakes by comparing them to RDA, the RDA were adjusted for each child's age and sex. Second, the RDA have been revised several times over the years (e.g., National Research Council, 1968, 1974, 1980). Researchers who use RDA to assess nutrient intakes employ the most current edition. Because the values for nutrients may fluctuate among the various revisions, it is possible that conclusions may differ according to the revision used, e.g., nutrient intakes that met the 1968 RDA may not meet the 1980 RDA.

Results. Analyses of the dietary data included examinations of the means and standard errors of the NARs and MARs for participants in single nutrition programs and for non-availables. Hoagland interpreted findings as statistically significant if they were at the .10 level (two-tailed). The results indicated that the breakfast program participants had significantly higher NARs for energy, protein, iron, vitamin C, niacin, and phosphorus, and a significantly higher average MAR than the non-availables did. The milk program participants had significantly higher NARs for energy, protein, calcium, riboflavin and phosphorus, and a significantly higher overall MAR then the non-availables. The lunch program participants differed from the non-availables only in their significantly smaller intake of vitamin C. Hoagland concluded that participation in the breakfast or milk programs, but not in the lunch program, increases the nutritional status of students.

Comparisons were also made between the overall MARs of participants in multiple school nutrition programs and participants in only one school nutrition program. Of the comparisons that were made, only one showed significant differences: the average MAR of students who participated in both the breakfast and lunch programs was significantly higher than the average MAR of students who participated in only the breakfast or only the lunch program. Since there were very few subjects who participated only in the breakfast program, in effect this was a comparison of subjects who participated in both programs with those who participated only in the lunch program.

Analyses of the dietary data also included an examination of the contributions of individual variables using multiple regression. Hoagland's regression analyses were based on a generalized least squares (GLS) analysis* with the NARs and MARs for energy, protein, calcium, phosphorus, vitamin A,

*The GLS analysis was used rather than an ordinary least squares (OLS) analysis, since it could not be assumed that the error components of the data were uncorrelated; this assumption is a requirement for OLS analysis.

thiamin, riboflavin and vitamin C for 24-hour intakes as outcome variables. (An analysis of intakes for meals actually consumed at school, which would be possible from the data, was not attempted.) In a first set of equations, the independent variables included household income (log transform), age of head of household, schooling of household head, number of household members, region of the country, and the age, sex and race (white _versus_ other) of the student respondent. Cross-products of these main-effect variables were also included if they reached statistical significance at the .10 level. In a second set of equations, six dummy variables for participation status (participants vs. non-availables and nonparticipants vs. non-availables, defined separately for breakfast, lunch and milk) were added to the equations, so that the effects of the programs could be examined with the other variables controlled.

Among the control variables, Hoagland found higher nutrient intakes with increased education of the family head, and lower intakes with increased family size. There was also a decline in NARs and MARs with increasing age of the students, especially for females. Log family income was positively related to the MAR composite ($p < .10$) and was negatively related to caloric intake and vitamin A intake ($p < .05$). That is, controlling for the other variables, children from wealthier homes tended to have higher MARs overall, but to consume fewer calories and less vitamin A.

By holding constant the socioeconomic factors and participation in other programs, the effects of nutrition programs on poor children were compared to the effects on other children. Three categories of poverty status were used, ranging from low-income to high-income: less than 125 percent of poverty level, 125 percent to 195 percent, and more than 195 percent of poverty level. (The cutoffs correspond to the free and reduced-price meal criteria.) The largest improvement in diet (changes in MAR percentage points) was for the children in the breakfast program: in each income category, breakfast program participants had larger increases in MARs than the participants in the other two programs. The MAR increases for breakfast program participants were greatest for high-income children and smallest for low-income children. The differences in MAR increases between income levels for the lunch and the milk programs were reported as being insignificant.

Hoagland used the results of HANES biochemical assays of hemoglobin, hematocrit, serum protein, serum albumin and serum cholesterol to compare participants, nonparticipants and non-availables in single and multiple school nutrition programs. Computations were made of the proportions of children having abnormal levels of each substance except for serum cholesterol, for which no generally accepted standards currently exist.

Hoagland specified the values used as standards to evaluate hemoglobin, hematocrit and serum protein, but not serum albumin, and he identified only the origin of the hemoglobin standard (HANES). No incidence of low hemoglobin, low hematocrit or low serum protein was found among breakfast program participants and breakfast and milk program participants; the prevalence rates of low values in the breakfast-only, non-available group were 3.8 percent (low hemoglobin), 6.9 percent (low hematocrit) and 2.0 percent (low serum protein). No incidence of low serum albumin occurred for any children regardless of program. It was reported that participation in the programs had neither a positive nor negative effect on serum cholesterol levels, but the findings upon which this conclusion was based were not given. No tests to determine the statistical significance of the biochemical findings were reported.

Several important factors should be noted concerning Hoagland's findings. First, consideration should be given to the meaning of the differences found between NAR intakes. Although the average daily intakes of many nutrients differed significantly between the participant and non-available groups, the average intakes of all nutrients surpassed 100 percent of the RDA with the following exceptions: in the case of the breakfast program, the intakes of energy and iron by non-availables; in the case of the lunch program, the intakes of energy, iron and niacin by participants and non-availables; and, in the case of the milk program, the intakes of energy and iron by both participation groups, and the intakes of niacin by the non-availables. Although the average levels of nutrient intakes were high, there could have been appreciable numbers of children with poor diets. The proportions of children with low intakes in each participation category were not reported.

Second, the school programs can be assumed to be USDA programs in most cases; however, Hoagland reported that the HANES estimates of the numbers of students in programs were higher than the numbers reflected by official NSLP, SBP and SMP statistics, suggesting that some students attended schools having nutrition programs "...other than those regulated and supported by the federal government" (Hoagland, 1978, p. 15).

Finally, Hoagland's conclusions concerning the nutritional increments resulting from breakfast program participation only were actually based on data from three persons who participated in the breakfast program, but not the lunch and milk programs. As Hoagland stated, caution should be taken in drawing conclusions about the effects of exclusive participation in the breakfast program because of the small sample size (p. 65). Although Hoagland's regression analysis also indicated that breakfast program, but not lunch program, participation is beneficial, it should be noted that a large percentage (approximately 90%) of the children who participated in breakfast programs also took part in lunch programs. Based on Hoagland's findings concerning multiple- and single-program comparisons, it appears that the combination of breakfast and lunch participation is more beneficial than lunch participation alone. However, any generalizations made from these findings concerning breakfast programs would be based on extremely slim information, for the number of breakfast program participants is small (approximately 100) in comparison to both the number of lunch program participants (approximately 1,550) and milk program participants (approximately 1,250).

Price et al., 1975

There have been relatively few large-scale studies that have evaluated the effects of school nutrition programs on all parameters of nutritional status, that is, dietary, biochemical, anthronometric and clinical indicators. The Washington State Study (WSS) (Price et al., 1975) is an exception that made measurement of all these parameters a primary objective. In addition, WSS sought to relate food acceptance to ethnic, socioeconomic and psychological variables; to relate socioeconomic and psychological variables to nutritional status and to dietary profiles of children participating and not participating in the school nutrition programs; to determine why some schools do not participate in the school breakfast and school lunch programs; and to develop recommendations based on the results of the study to improve menu and management patterns and to extend participation in school feeding programs.

Method. To accomplish these objectives, a sample design was developed to obtain a total of 1,500 school children aged 8 to 12 years, stratified by ethnic group, poverty level, and participation status, as follows:

	Ethnic Group		
	Mexican-American	Black	White
Below poverty:			
participants	125	125	125
nonparticipants	125	125	125
Above poverty:			
participants	125	125	125
nonparticipants	125	125	125

Below-poverty students were defined as those eligible for free or reduced-price lunches according to Washington State guidelines. In the year of the study (1971-72), the reduced-price criterion level was $4,320 per year for a family of four. The definitions of participation status varied according to the analyses being performed. For the analysis of variance, participants were defined as those students who ate school lunches and/or school breakfasts consistently (four or five times a week); nonparticipants were those children who did not eat the school meals on a consistent basis. For the regression analysis, breakfast program participation was distinguished from lunch program participation. Participation in either program was defined as eating the meal four to five times a week; partial participation was defined as eating the meal two to three times per week; and non-participation was defined as eating the meal once a week or less.

Washington State was divided into eight geographic regions, and lists of school districts with enrollments of 500 or more students were made for each region. To qualify, school districts had to be participating in the NSLP. A two-stage cluster design was used to sample students: school districts within each geographic area were stratified by size; then districts within each region and schools within each district were selected by probability sampling, with higher probabilities assigned to districts and schools having large enrollments of black or Mexican-American children. Once the schools were identified, children were randomly selected within each school from lists representing the 12 sampling cells shown above. During this procedure, it was discovered that only a small number of below-poverty, nonparticipating students was being sampled. To compensate for this shortage, a school district that did not participate in the NSLP was added to the design. Even then, the investigators found that it was difficult to find enough children in some cells, particularly minority children who did not participate in any of the nutrition programs. Consequently, only 1,013 of the original target number of children were studied.

Data were collected by trained interviewers from children and their parents at home and from the same children at school. In addition to socioeconomic information, data were gathered during the home interview concerning household meal preparation and food habits. The school interviews involved the administration of three 24-hour dietary recalls to each child over a two- to three-week period. One of the three interviews was administered on a Monday in order to evaluate weekend consumption. Before the two interviews to determine weekday consumption were administered, what the child ate for lunch at school was recorded, representative portions of served foods were weighed, and amounts of traded or wasted foods were recorded. Therefore, lunch consumption at school was based on actual amounts consumed rather than amounts recalled. The food amounts for each 24-hour dietary recall were converted into gram weights and analyzed for nutrient composition using Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1963). At least one dietary interview was completed for each of 1,008 students; three interviews were obtained from 90 percent of the children. Where two or more recalls were obtained from one child, average intakes of calories and the nine nutrients were computed based on the number of interviews completed.

An extensive battery of biochemical tests was performed on the children. Blood samples were taken at the first of four data-collection visits to the school and were analyzed for hemoglobin, hematocrit, total serum protein, serum albumin, vitamin C, vitamin A, carotene, serum calcium, serum magnesium and serum copper. The children were generally in a non-fasting state when the blood samples were taken, but efforts were made to schedule children at least two hours after their last meal. In total, 54 children (5 percent) refused to submit to the procedure; the highest rate of refusal (15 percent) was among the below-poverty children. During subsequent visits to the school, the other biochemical measurements were made. Blood pressure was taken, hair samples were obtained and analyzed for hair-root protein, and urine samples were collected for determination of protein and glucose. The investigators reported a high rate of refusal to give urine samples among the children, possibly due to lack of privacy in some schools.

Anthropometric measures consisted of height, weight, head and arm circumferences, head length and width, and triceps fatfold. Height was measured without shoes. Subjects wore indoor clothing and were weighed on a balance-beam scale. Head and arm circumferences were measured using a steel tape. Lange calipers were used to measure triceps fatfold at the mid-point of the upper arm.

Results. The biochemical and anthropometric data were first presented in aggregate and compared with other published data in order to determine the proportion of children in Washington State who were at risk for various nutritional problems. Biochemical data were evaluated to determine the percentage of children at high or moderate risk according to the TSNS standards for deficient and low values, respectively. Frequency distributions for the values of hemoglobin, hematocrit, vitamin C, vitamin A, calcium, hair-root protein and diastolic blood pressure were presented for subjects in each combination of income, participation, and ethnic group. Finally, mean differences (classified by ethnic group, income, program participation, and sex) were tested for significance.

All anthropometric measures were expressed as mean values by sex and age for each of the income/program participation groups. Separate analyses were made for each ethnic group. Means at each age for the various groups were also compared with standards derived from a variety of published data (e.g., TSNS). Anthropometric data were also presented as frequency distributions by sex, by age, and for some measures, by income group. No statistical tests of significance of differences in means or frequencies are described in the report; however, observation was apparently used to detect patterns among the variables.

Dietary data were subjected to more extensive analysis than either the biochemical or anthropometric information. First, average 24-hour intakes for energy and nine nutrients, expressed as percentages of the RDA (National Research Council, 1974), were shown for children in the various age, sex, ethnic, income and program participation categories. Tests were made to identify mean differences and possible interactions among the variables. Next, nutrient contributions made by school lunches to the 24-hour intakes were compared among children grouped according to ethnic background, age, sex, and income. These data showed the proportion of selected total dietary nutrients that were supplied by school lunch and how much of the RDA for these nutrients came from foods eaten in the school lunch. Dietary data collected during the household interviews were analyzed in order to determine food preferences and psychological attributes of the children along with food and home management patterns of their families.

A final step in the analysis of the Washington State data was the construction of regression models to explain the nutrient intake and biochemical status of the children. The models were constructed for ten nutrients and nine biochemical indicators. The nutrient values were expressed as percentages of the RDA, and excluded intake values from vitamin and mineral supplements, which were not considered part of the regular food intake.

A total of 41 independent variables was hypothesized to affect the dietary and biochemical values. This included two sets of dummy variables representing school food program participation. Separate variables were set up for lunch and breakfast participation, with the frequency of participation expressed at four to five times per week (full participant), two to three times per week (partial participant), or zero to one time per week (nonparticipant). Other variables included in the model were socioeconomic and demographic factors; anthropometric measurements for triceps fatfold, weight and height; food expenditures; use of food stamps; free lunch status;

frequency of serving selected foods; factor-scores for four food factors from the analysis of food frequency; indexes relating a child's food preference to the intake of each of the nutrients; kinds of food rejected by the child; and dummy variables for management styles and psychological needs of mothers.

The Automatic Interaction Detector program (Sonquist & Morgan, 1964) was used as a preliminary step to determine the existence of interactions or non-linearities that should be specified in regression analysis. The main statistical treatments were simple correlations followed by regression analysis, using the part of the sample for which complete data were available. In generalizing results to the State of Washington, regression coefficients were assumed to be equal among ethnic groups, between children from above-poverty and below-poverty households, and between participants and nonparticipants in the programs. It was also assumed that the variance of the error terms was equal among classifications of important variables. None of these assumptions was formally tested, due to lack of time and monetary constraints.

Two sets of regression models were formulated for the biochemical values. In the first set, variables were included if they had significant correlations with the dependent variables or if they were theoretically important. In the second set of models, there was an effort to reduce problems of multi-collinearity by eliminating variables having little theoretical justification or low significance levels.

Only one set of models was formulated for the nutrient intakes. These models included variables with theoretical justification and significant simple correlations. Results were reported in terms of the standardized regression coefficients for each variable and the percentage of variation explained by each dependent variable.

For the total daily intakes, there were no significant differences between the above- and below-poverty groups. Participants in the school meal programs averaged significantly more dietary vitamin A for a 24-hour period than nonparticipants. The mean total daily intakes of the other nutrients were higher among nonparticipants, but the difference was significant only for iron. White children consumed significantly more energy, protein, calcium, phosphorus, iron, thiamin, riboflavin and niacin during 24-hour periods than black or Mexican-American children. Although the text of Price's report (p. 60) states that blacks had significantly higher intakes of vitamin A and vitamin C than whites, the tables on pages 121 and 145 of that report show that the differences were only significant for the percentage of RDA consumed of vitamin C. Mexican-American students had significantly lower intakes of the RDA percentages of calcium, phosphorus, vitamin A and vitamin C than black students. On the average, each ethnic group consumed more than 100 percent of the RDA for protein, phosphorus, riboflavin and vitamin C; white and black children exceeded 100 percent of the RDA for vitamin A; and white children exceeded 100 percent of the RDA for calcium.

The contribution of the school lunch to the total nutrient intake and to the percentage of the RDA consumed was also examined for the various groups. School lunch participants living below poverty levels obtained a significantly higher proportion of their daily total intakes of calories and seven nutrients (protein, calcium, phosphorus, iron, vitamin A, thiamin and riboflavin) from school-provided meals than participants from non-poverty households. For below-poverty students, the contributions of the school lunch to total daily intake ranged from 32 percent for iron to 45 percent for calcium. In this study, Mexican-American children benefited significantly more than white or black children in terms of the percentage of the total intake and RDA provided by school lunches. Mexican-American children received significantly higher percentages of the RDA for energy, protein, phosphorus, niacin, and vitamin C than either of the other ethnic groups. Although Mexican-American and white children did not differ significantly in the RDA percentages of calcium, iron, vitamin A and riboflavin obtained from lunch, both ethnic groups obtained significantly more of these nutrients than black children. Mexican-American students received 72 percent of their RDA for protein from the school lunch, 39 percent of calcium, 50 percent of phosphorus, 29 percent of iron, 45 percent of vitamin A, 28 percent of thiamin, 53 percent of riboflavin, 32 percent of niacin, 40 percent of vitamin C and 29 percent of energy.

In the regression analysis, full breakfast program participants had significantly higher intakes of vitamin C for the total day than nonparticipants. Full lunch program participants had significantly lower 24-hour intakes of iron ($p < .05$) but higher intakes of vitamin A ($p < .10$) and calcium ($p < .06$) than nonparticipants. Full lunch program participants had significantly higher intakes of energy, protein, calcium and riboflavin for the total day than did partial lunch program participants. In comparison to the analysis of variance results, the only significant ethnic differences that arose in the regression analysis were black children's significantly lower intakes of calcium and riboflavin. The authors suggested, based on the regression results, that rather than ethnicity, other variables common to blacks and Mexican-Americans, such as geographic area, origin of parents, size of household and household food patterns, could better explain group differences.

In a later analysis of the dietary intake data, Price et.al. (1978) excluded those children from the one nonparticipating district. When these data were subjected to regression analysis, full participation in the school lunch program was associated with higher intakes of protein, calcium, riboflavin, phosphorus and vitamin A. The authors note that "milk is a good source of three of these nutrients, which suggests that milk consumption is higher among full participants than among partial- and non-participants" (p. 612). They also found in this analysis that 11 percent of the WSS children came to school without breakfast. The authors estimated that on a statewide basis, 7 percent of the white children, 12 percent of the black children and 13 percent of the Mexican-American children came to school without breakfast. Daily intakes of calcium, phosphorus, thiamin, and riboflavin were significantly lower among children who came to school without breakfast than for children who ate breakfast in the morning. Only 20 children of approximately 1,000 students in the study participated regularly in the school breakfast program (i.e., four to five times per week). For these children, daily intakes of vitamin C were significantly greater than for nonparticipants. In 7 to 13 percent of the cases, breakfast did not replace a meal at home but supplied a meal where none was usually served.

In general, the biochemical measures failed to show evidence of severe nutrition problems for either participants or nonparticipants, although the prevalence of low values for hemoglobin, hematocrit, total serum protein, serum calcium, serum vitamin C and serum vitamin A ranged from 1 percent to 4 percent and varied by the incomes and ethnic backgrounds of the students. The analysis of variance of the biochemical data indicated that, across income and ethnic groups, participants had significantly lower levels of serum phosphorus ($p < .05$), serum vitamin C ($p < .01$), and serum albumin ($p < .01$), and significantly lower albumin/globulin ratios ($p < .01$) than nonparticipants. The authors also found that, across ethnic and income groups, participants had a significantly higher level of serum calcium than nonparticipants.

When biochemical measures were treated as the dependent variables in a regression analysis, more of the variation was explained by socioeconomic and geographic variables than by participation status in either the school lunch or breakfast programs. There were some exceptions, however. For example, full participation in school breakfast resulted in significantly higher serum levels of vitamin C. Some biochemical variables had significant negative coefficients with participation status; for example, children who were partial participants in school breakfast had lower levels of serum copper.

For others, the significant relationship was with nonparticipation; nonparticipants in school lunch programs had higher levels of serum albumin and lower levels of carotene. The meaning of the biochemical results for both types of analyses is difficult to interpret. The authors note that while the differences may be significant, the absolute values are rather small and do not suggest a major effect on the health of the subgroups.

Price et al. (1975) found that, among the anthropometric measures, triceps fatfold thickness "was shown to be a reliable index of obesity in children" (Chapter XV, p. 1). This measure was found to be significantly correlated with height, weight, age, sex, total family assets and ethnic background. The incidence of obesity was determined by classifying students as obese if their triceps fatfold measure fell one standard deviation above the mean for their age and sex. Using this criterion, 14 percent of black males and 12 percent of black females were obese, while 16 percent of white males and 15 percent of white females were obese. For Mexican-Americans, 17 percent of males and 15 percent of the females were obese. No relationships were shown between obesity and school nutrition program participation. Neither was there a consistent pattern relating program participation to height or head circumference. However, there was a trend for weight, considered as a percentage of the standard (e.g., Ten State Nutrition Survey), to be greater among school meal participants, with the greatest difference between below-poverty male participants and nonparticipants. A similar trend was shown for males and to a lesser extent for females in some age categories of the above-poverty groups.

As would be expected, manifestations of malnutrition, such as abnormal tongue coloration, were infrequent and did not prove useful in the evaluation of program effects. The majority of children reported one or two colds per year, but about one-third reported more than three colds per year. There were no significant differences in reported colds attributable to program status.

As mentioned earlier, problems were encountered during the sampling phase of this study. Because of the small number of low-income nonparticipating students, the original plan was changed to include a nonparticipating school district. Even with the addition of this district, the cell sizes of nonparticipating students were considerably smaller than planned and the sample of nonparticipating blacks who were from below-poverty households included only three students.

Howe et al., 1980

Howe and Vaden (1980) investigated whether NSLP participation improved the nutrient intakes of students from a high school in a middle-sized Midwestern city. The school offered three Type A meal alternatives (regular lunch line, salad bar, or Type A combination at the snack bar), and students also had the option to leave campus for lunch.

Method. Students were identified as participating or not participating in the school lunch program based on their responses to a questionnaire. (Neither the method of classification nor the number of participants selecting each Type A alternative were described by the authors.) Subsequently, a random sample of 104 tenth- and eleventh-grade boys and girls (26 participants and 26 nonparticipants from each grade) were interviewed and administered a 24-hour dietary recall to assess their nutrient intake. From the 24-hour dietary recall data, food intakes were converted by computer into nutrient intakes using Home and Garden Bulletin No. 72 (USDA, ARS, CFEI, 1970) and other sources. The mean nutrient intakes and the percentages of RDA (National Research Council, 1974) consumed for the 24-hour period and for lunch only were computed for calories, protein, iron, calcium, riboflavin, niacin, thiamin, vitamin A and vitamin C.

Results. A two-way analysis of variance performed on the means and the percentages of RDA revealed dietary differences associated with two factors:

school lunch participation and gender. For the entire 24-hour period, participants consumed significantly more calcium than did nonparticipants in terms of both mean intake and percentage of RDA. Although the girls had lower mean daily intakes than boys for all nutrients except vitamin C, the girls had significantly lower percentages of the RDA for protein, calcium, iron, and riboflavin. All mean daily intakes of nutrients exceeded the RDA, except that iron intakes were less than the RDA for all students (although the boys' iron intake was only slightly less than the RDA), and thiamin and calcium intakes were below the RDA for girls and for all nonparticipants.

The consumption of nutrients at lunch only were also compared. For all nutrients except niacin, participants had a significantly higher mean nutrient intake and percentage of RDA at lunch than nonparticipants did. Girls and boys differed in that the girls' average intakes for all nutrients, except niacin and vitamin C, were significantly lower than the boys', and the girls consumed significantly less of the RDA for calcium and iron than the boys. The percentages of RDA consumed at lunch were considered in relation to the NSLP goal to contribute one-third of the RDA for each nutrient. The percentages of RDA of the nutrients received at lunch ranged from 27 percent to 74 percent for participants and 17 percent to 45 percent for nonparticipants. Participants consumed one-third or more of the RDA for energy*, protein, calcium, vitamin A, riboflavin and vitamin C, while only the intake of protein exceeded this value for nonparticipants. The RDA percentages of the studied nutrients received at lunch ranged from 19 percent to 52 percent for girls and from 27 percent to 63 percent for boys. Girls

*Although the goal of one-third RDA for school lunches does not include energy, most of the studies measuring the success of school lunches in meeting this goal have analyzed energy as well as vitamin C, calcium, etc. These findings are reported here.

received at least one-third of the RDA for four nutrients (protein, riboflavin, niacin and vitamin C) and boys received at least one-third of the RDA for five nutrients (protein, calcium, vitamin A, riboflavin and vitamin C).

In addition to these analyses, a procedure developed by Cosper (1972) was used to rate students' diets as excellent, good, fair or poor, based on the percentages of RDA achieved for the eight nutrients: protein, iron, calcium, riboflavin, niacin, thiamin, vitamin A and vitamin C. The percentages of students with dietary ratings falling into each category were calculated for the 24-hour intakes and the lunch intakes. Although no statistical tests for differences were reported, these ratings were compared graphically for male and female participants and nonparticipants. Proportionally, male and female participants had better diets than did male and female nonparticipants for both the entire day and lunch only.

The authors concluded that participation has a positive effect on the diet of students, i.e., participants had better diets than nonparticipants. Although no explanation was offered for the sex differences found, the authors did cite other studies that obtained similar findings: lower mean intakes of nutrients by girls than boys (Schorr et al., 1972); and lower percentages of the RDA for calcium and iron consumed by girls than by boys (Hampton et al., 1967).

Lieberman et al., 1976

The study by Lieberman et al. (1976) is the first of three longitudinal studies that we reviewed. The purpose of the study was to document the effect of a breakfast program instituted in a ghetto school on the nutrition, health, and education of participating children in grades three through six.

Method. Two elementary schools in a low-income area of Los Angeles County were selected to be in the study. All children in the third through sixth grades in both schools could participate in the study if their parents gave consent. A free breakfast program was instituted in one school at the beginning of the school year and was offered to the third- through sixth-grade children. No breakfast program was offered at the other school, which served as a control. Both schools offered the NSLP. Most of the students at both schools were black. The educational level of parents, size of family, percent of children in families receiving welfare, and average number of years the families had lived in the Los Angeles area were well matched for students in the two schools, but the estimated monthly family income was significantly higher in the breakfast school than in the control school.

Students at the breakfast school who cooperated in the study were offered a free breakfast on five school days a week for eight months. The menu followed the "basic breakfast" required by the USDA School Breakfast Program, which is designed to provide one-fourth of the RDA for a nine- to ten-year-old child, but additional eggs, meat, or meat alternates supplying three to five grams of protein were served each day. A record was kept of each child's attendance at breakfast each day. Attendance was highly variable: on the average, students ate on 60 percent of the days that breakfast was served; nearly 20 percent of the students ate on fewer than 10 percent of the days that breakfast was served, while only about 10 percent of the students ate on 90 percent or more of the days.

The evaluation of health and nutrition effects was based on (1) clinical examinations that included an evaluation of skin, ears, throat and extremities for signs of poor nutrition; (2) anthropometry, including measures of height, weight, and head, arm and chest circumferences; and (3) 24-hour dietary intakes. The clinical examinations and anthropometry were performed by personnel at the breakfast school on 282 students during November and December, 1970, and at the no-breakfast control school on 301 students from January to March, 1971. In May and June, 1971, the anthropometric measures were repeated on 252 of the breakfast school children who had been examined in the fall; the anthropometric measures were not repeated for the children at the control school. The 24-hour dietary intake was obtained in a home interview with the children and their parents, using local interviewers who had been trained by project nutritionists. It is not clear whether the interviewers were aware of the study's purpose or of the school attended by the child. The home interviews for both groups were conducted throughout the year (i.e., October to June). A total of 551 home interviews were completed.

The authors reported that if abnormalities were found in the physical examination or if a child's height was below the 16th percentile or weight exceeded the 84th percentile of the Iowa growth curves, parents were notified and invited to take the child to a neighborhood health clinic for follow-up. Blood samples for the analyses of hemoglobin, serum transferrin, serum protein, serum vitamin A and serum vitamin C were drawn for all children who went to the clinic (Lieberman et al., 1972).

Results. The dietary recalls were converted to intakes for calories, protein, vitamin A, vitamin C, niacin, riboflavin, thiamin, calcium, iron, fat and carbohydrates by computer,* and the averages of these intakes were calculated. The average nutrient intakes were compared between the two schools and with the "recommended allowance for 10-year-olds."** The average heights and weights obtained in the fall for the breakfast school children and control school children were compared for differences. These anthropometric measures for the black children from both schools were combined and compared with height and weight data from the Iowa growth

*The nutrient conversion methods were not specifically identified.
**The source of this standard was not reported.

curves, TSNS, HANES and other sources. The effect of the breakfast program on participating children was determined by comparing the anthropometric measures of the breakfast school children obtained in the fall and in the spring, after adjustment for expected growth.

Although no statistical tests of significance for dietary measures were reported, comparisons of the nutrient intakes of breakfast-school and control-school children indicated that the average intakes of children in the two schools were similar and met the recommended allowance for all nutrients, except calcium and energy. No significant differences between the two schools were found for the children's average height and weight by age and sex. Also, comparisons of the anthropometric measures taken from the breakfast school children at the beginning of the year and after the program had been operating for five months revealed no significant changes when adjusted for the five months' expected growth.

Sixty-one children at the breakfast school and 56 children at the control school were found to have physical abnormalities, but no unequivocal signs of malnutrition were found. The height of 19 percent of the students in the breakfast school and 11 percent of students in the control school fell below 16th percentile of the Iowa growth curves. Weight exceeded the 84th percentile of the Iowa growth curves in 17 percent of the students at the breakfast school and 14 percent of the students at the control school. Of these children who qualified for follow-up, only 18 took advantage of the referrals to the health clinic (Lieberman et al., 1972). There were too few students with low hemoglobin values for meaningful analysis: of the 18 children from whom blood samples were drawn, only three had hemoglobin values that were below the norm.

These findings suggest that children at both schools were in generally good nutritional status at the beginning of the study, in spite of the fact that most children came from low-income families. Therefore, it is not surprising that no significant shift in height and weight for any age or sex group was found when measurements were repeated on breakfast participants five months after initiation of the program. The authors point out that these results cannot be generalized to malnourished or older students; that is, "...it cannot be concluded that school breakfast programs would not benefit malnourished children or teenagers who must often go without breakfast" (p. 137).

The authors encountered two obstacles in conducting this study. First, the original research design of the study called for the random assignment of half the children at the selected elementary school to a breakfast group with the other half serving as controls. However, when the assignment of students to non-treatment groups met with objections from community leaders and parents, it was decided that all children in the designated grades would be served breakfast and that a second school with a similar student population would be used as the no-program control. The difficulties experienced by the investigators in attempting to implement this design illustrate some of the practical aspects of using an experimental approach to determine program benefits in schools. Second, the original menu, consisting of a fortified beverage and an "engineered" cake, had to be abandoned when community leaders insisted on foods that would be better examples of good nutrition and would be more familiar to the children.

In a separate report of this study, Hunt et al. (1979) examined the effects of the free breakfast program on the 24-hour dietary intakes of children. The food intakes were converted by computer into nutrient intakes using Home and Garden Bulletin No. 72 (USDA, ARS, CFEI, 1971) and other sources. The mean intakes and mean percentages of RDA (National Research Council, 1974) consumed that were computed from the 24-hour dietary recalls of children at the two schools were compared. Frequency distributions were presented for children at the breakfast and control schools whose diets were below two-thirds RDA, between two-thirds and one-and-one-third RDA, and above one-and-one-third RDA, separately for vitamin A, iron, calcium, niacin, calories, thiamin, ascorbic acid, riboflavin and protein. Diets that provided less than two-thirds of the RDA for one or more of the studied nutrients (except energy) were classified as "poor." The contribution of the school breakfast was determined by comparing program and control students for the mean nutrient intakes consumed before 10:00 a.m.

Hunt et al. found that the mean intake of children at both schools was close to, or greater than, 100 percent of the RDA for all nutrients studied; however, 48 percent of the children had poor diets, defined as intakes below two-thirds of the RDA for one or more nutrients. Although the total mean intakes of vitamin C, iron and thiamin were significantly lower for breakfast school children, these children consumed significantly more of their total daily nutrient intake before 10:00 a.m. than children at the non-breakfast school. The differences were greatest for children with poor diets. In addition, a significantly greater number of children from the non-breakfast school reported that they had nothing to eat before 10:00 a.m.

Many of the data gathered were not analyzed in relation to program effects by either Lieberman et al., or Hunt et al. For example, the frequency of participation in the breakfast program was recorded for each child, but these data were not entered into the analysis. Also, measures of chest and arm circumference were taken in fall and spring for children in the breakfast program, but changes in these measures adjusted for expected growth were not reported.

<u>Paige, 1972</u>

The objective of Paige (1972) was to determine "the results of the 'Type A' school feeding program in attempting to upgrade the status of nutritionally disadvantaged school children" (p. 392).

Method. The population studied was drawn from four elementary schools in Baltimore. Two of the schools had a predominantly black student population; the other two schools were predominantly white. The investigators reported that all four schools drew their students from "...the lowest socioeconomic decentiles" (p. 392), but gave no further information concerning the income levels of the families. The Type A lunch was served at all four schools.

Assessments of height, weight and hematocrit were made for all children in the first, second, and sixth grades at the four schools during September, and were repeated in May. Although students were classified as participants or nonparticipants, it is not clear on what basis this classification was made. It is possible that either eligibility for free or reduced-price lunch or program records were used. Whatever the criteria selected, there does not appear to have been any determination of how regularly the children in the participant group actually ate the USDA lunch. In the four schools, a total of 453 children were designated as participants and a total of 298 children were designated as nonparticipants in the Type A program.

Results. Generally, data analysis consisted of comparisons between participants and nonparticipants within each grade level for changes over the school year in height, weight and hematocrit, singly and combined. More specifically, first-, second-, and sixth-grade participants were compared to their same-grade nonparticipant counterparts in terms of the percentage change in mean height and mean weight that occurred between the pretest measures in September and the posttest measures in May. The effects on hematocrits were determined by comparing the percentage of all children in the participating and nonparticipating groups whose hematocrit measure was low (below 36 percent) in September but was not low in May. The authors also used height, weight and hematocrit in various combinations as additional indices of nutritional deficits. These combinations were: (a) height equal to or below the 10th percentile of the Boston-Stuart Anthropometric Charts and a hematocrit below 36 percent; (b) weight equal to or below the 10th percentile of the Boston-Stuart charts and a hematocrit below 36 percent; or (c) height equal to or below the 25th percentile and weight equal to or below the 10th percentile of the Boston-Stuart charts. Although differences resulting from comparisons of all the single and combined measures were reported as non-significant, the statistical tests were not identified.

Analysis of these anthropometric and biochemical measures independently and in combination with one another over the school year showed no significant differences between participants and nonparticipants. The comparisons of same-grade participants and nonparticipants indicated there were no advantages in height and weight that could be attributed to the program. The mean increases in height and weight during the school year were actually greater among nonparticipants than participants, but the differences were not statistically significant. Of the 93 participating children and 38 nonparticipating children who began the school year with low hematocrits, 65 percent of the participants and 63 percent of the nonparticipants had equally low hematocrits at the end of the school year. Furthermore, nearly 10 percent of the children with initially normal hematocrits had lower hematocrits after eating the school lunch for a year. Although the findings were not fully reported, it appears that no significant differences were found between participants and nonparticipants in changes over the year in the combined measures of low height and hematocrit, of low weight and hematocrit and of low height and weight. The authors concluded that the "Type A school feeding program does not appear to be improving the nutritional status of school children as judged by anthropometrics and hematocrit" (p. 394).

Paige was not explicit about the criteria used to identify participants and nonparticipants. Participants and nonparticipants were described as "similarly matched, the only difference being that participants were fed the school lunch while nonparticipants were left to fend for themselves over the lunch period." It is not clear from this whether the nonparticipants had the option of eating the school lunch. On the other hand, if participation was determined by eligibility for free or reduced-price lunch, then the participants and nonparticipants would have differed in family income and possibly in other characteristics that could have been used by school officials to identify children in need. Without clarification as to which children constituted the participant and nonparticipant groups, it cannot be assumed that they were similarly matched or that valid comparisons could have been made for the measures of nutritional status.

Emmons et al., 1972

The purpose of the research by Emmons et al. (1972) was "to measure the impact of school breakfasts and/or lunches on the nutritive intake, biochemical measurements and physical growth of elementary school children during one academic year" (p. 268).

Method. The nutritional status of 844 first- through fourth-grade children from two rural school districts (District A and District B) in upstate New York was assessed at the beginning of the school year. At the time of the pretest, both districts offered school lunches and District A offered morning milk to first- through third-grade children, who could bring snacks from home to supplement the milk. After the pretesting was completed, these programs were maintained and children in District B were offered a school breakfast consisting of one-half pint of milk; one-half cup of fruit, fruit juice or vegetable; and three-fourths cup of cereal or a serving of enriched bread. The experimental period of the study lasted for approximately 4-1/2 months. During this period, all meals and milk in both districts were served free to all children regardless of economic need. Records were kep of each child's daily program participation. At the end of the study period, the children were retested to obtain data on the same nutritional measures that had been collected in the fall.

Nutritional status was measured by collecting dietary, biochemical and anthropometric data from the children. Interviewers who were nutritionists or students of nutrition obtained 24-hour dietary recalls from the children, and data from the recalls were converted into nutrient intakes using Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1963) and other sources. Blood was drawn from the arm of each child and biochemical analyses of all specimens were performed by the same person. Heights were measured without shoes; weights were taken using a balance scale, with the children wearing light underclothing.

Comparisons of fall and spring measurements and observations of changes occurring over the course of the study were made for only those children who participated in at least 70 percent of the school lunches in District A and, at least 70 percent of the school lunches and 70 percent of the school breakfasts in District B.

The nutritive levels of school breakfasts, school lunches, bag lunches from home, and milk plus snacks were computed from the 24-hour dietary recalls of the children. The nutrients supplied by the school lunch were compared with those supplied by bag lunches from home and with one-third of the RDA for children. Also, the nutrients supplied by the school breakfasts in District B were compared to the nutrients supplied by the milk plus snacks in District A. Data obtained in the fall for the contribution of school-provided food and milk to total 24-hour dietary intake were compared with the same data collected in the spring. Comparisons were made for children who would have been eligible or ineligible for free or reduced-price meals and for children who were identified as "nutritionally needy" and "nutritionally adequate." Eligibility for free or reduced-price lunch was determined by USDA criteria for family size and income that were in effect in New York at the time of the study (1970-1971). Nutritional need was based on a combination of dietary, anthropometric, and biochemical criteria. Children were classed as "nutritionally needy" if they met a minimum of two of the following criteria: (a) three or more nutrients below 70 percent of the RDA (National Research Council, 1968); (b) weight-for-age and/or weight-for-height either less than 90 percent or more than 110 percent of the Iowa standards, which were based on data gathered by Stuart and Meredith (1946); or (c) hemoglobin less than 11.5 grams per 100 milliliters and/or hematocrit less than 36 percent. Children were classed as "nutritionally adequate" if they met all of the following criteria: (a) all nine of the nutrients studied were at 70 percent or more of the RDA (National Research Council, 1968); (b) weight-for-age and weight-for-height were within 90 and 110 percent (inclusive) of the Iowa standards; and (c) hemoglobin at least 11.5 grams per 100 milliliters and hematocrit at least 36 percent. All other children were classed as "nutritionally intermediate."

The height and weight of each child in the fall and spring were compared with the average height and median weight of children of the same age and sex in the Iowa standards. Height and weight increments of "nutritionally needy" and "nutritionally adequate" children were evaluated in light of expected growth according to the Iowa standards. Finally, the percentages of children judged "nutritionally needy" in the fall who moved into the "nutritionally intermediate" or "nutritionally adequate" categories by spring were compared for District A and District B.

Results. Emmons et al. found that school lunches supplied significantly higher levels of all nutrients except calories and niacin than were supplied by the bag lunches from home. At least one-third of the children's RDA for protein, calcium, vitamin A, riboflavin and niacin was provided by the school lunch. At least one-third of the RDA for protein, riboflavin and niacin was provided by the bag lunch. The school breakfasts in District B provided significantly more of all nutrients than were provided by the morning milk plus snacks in District A.

The diets of children categorized according to nutritional status were compared within the two districts to determine fall-to-spring changes. In District A, the fall and spring diets of the "nutritionally adequate" children were similar, except for significantly lower intakes of vitamin A in the spring. In District B, the spring diets of the "nutritionally adequate" children were significantly higher in thiamin, riboflavin and vitamin C than their fall diets were. In District A, the diets of the "nutritionally needy" children were significantly higher in the spring than they had been in the fall for all nutrients except vitamin A. In District B, the diets of the "nutritionally needy" children were significantly higher in the spring than they had been in the fall for all nutrients studied. The authors suggested, based on the computed relative increments from home and school meals, that in District A, 15 to 26 percent of the fall-to-spring increase came from the school lunch and in District B, 75 to 93 percent of the fall-to-spring increase in calcium, vitamin A, thiamin, riboflavin and vitamin C came from school breakfast and lunch.

The diets of children categorized according to economic criteria were also compared within the two districts to determine fall-to-spring changes. In District A, the diets of the "ineligible" children were significantly higher in calories, iron, thiamin and vitamin C, but lower in vitamin A, in the spring than they had been in the fall. The diets of "eligible" children in District A were significantly higher in calories, protein and thiamin in the spring than in the fall. In District B, the diets of both the "eligible" and "ineligible" children were significantly higher in calories, calcium, protein, thiamin, riboflavin and vitamin C in the spring than they had been in the fall.

Analyses of variance indicated that in the fall, the home diets of children in both districts were similar in terms of nutrients consumed according to the 24-hour dietary recalls. The combined school and home diets of District A children in the fall were higher in calcium, vitamin A and riboflavin than the diets of District B children were. This difference in fall diets was attributed to the fact that in District A, 69 percent of the children ate school lunches and 40 percent had morning milk, whereas in District B, only 42 percent of the children ate school lunches and none had morning milk. In the spring, the home and total day's diets of children in the two districts differed. Although the home diets of District B children provided less calories, protein, calcium, iron and thiamin in the spring than did the home diets of the children in District A, the total day's intake of District B children compensated for the lower home intakes and exceeded the total day's intake of District A children in calcium, vitamin A, thiamin, riboflavin and vitamin C. According to the authors, "The large contributions of both school breakfasts and lunches were responsible for the superior nutritive levels of the children in District B" (p. 273).

Only 1.3 percent of the children tested in the fall had low hemoglobin values, while 11 percent had low hematocrits. In the spring, only 0.7 percent had low hemoglobins and 2.0 percent had low hematocrits. These numbers are too small for statistical purposes to compare the different effects of the school feeding programs on either hematological value. The distributions of hemoglobin and hematocrit values were not presented in the report.

Both "nutritionally needy" and non-needy children had height increments similar to the norm for the period studied, but those who were "nutritionally needy" and/or "eligible" for free meals had larger increments. The largest height increments were in District B where children received both lunch and breakfast. "Nutritionally needy" children in District B also tended to move toward the median weight group from starting positions of either 90 percent below or 110 percent above the norm between the fall and the spring. Neither the trend for height nor the trend for weight was statistically significant, however. The authors suggest that the 4-1/2 months that elapsed between the fall and spring measurements is too short a time period to show significant differences among the subgroups. Nonetheless these trends are important, especially when they are considered along with the fact that of the 26 percent of children in District A whc were classified as "nutritionally needy" in the fall, only 9 percent remained "nutritionally needy" in the spring; furthermore, of the 30 percent "nutritionally needy" children in District B in the fall, only 5 percent remained in this category in the spring. In District B, where children received both school breakfasts and lunches, twice as many children moved from the needy group to the non-needy groups than in District A, where only lunch and morning milk plus snack were provided. Most of this change, however, was reflected in increased dietary intake of nutrients and not in anthropometric or biochemical measurements.

Most of the Emmons et al. analyses appear to ignore the phenomenon of regression toward the mean, in which individuals measuring low on a variable at pretest tend to measure higher on posttest, and individuals high at pretest tend to measure lower on posttest. Thus, it is no surprise to discover that large numbers of "nutritionally needy" students identified on the basis of fall dietary intakes were improved in the spring. The crucial comparisons for testing program effects were the differences between change rates for Districts A and B, which represented the two "treatments," and none of these differences was significant.

DISCUSSION OF METHODS

The appropriateness of the research designs and methods used for the studies reviewed in the previous section depends upon the research objectives. These should follow from the goals of school nutrition programs and their anticipated effects on nutrition and health status. Some investigators believe the programs provide preventive health maintenance, while others believe they provide treatment for children with identified nutritional problems.

Either type of program outcome can be assessed from cross-sectional designs, provided that "pre-treatment" or baseline data are available on variables that the program is expected to affect. These can then be used to identify nutritionally high-risk populations or individuals. Because such data are rarely available, however, risk status and/or the prevalence of specific nutritional problems must be drawn from variables associated with nutritional status but not affected by program participation. Three cross-sectional studies that have attempted to determine nutritional effects all used measures of socioeconomic status (either family income or eligibility for free or reduced-price lunch) to identify groups at risk (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975; U.S. DHEW, HRA, CDC, 1972). The problem is that not all low-income children exhibit nutritional problems, and not all children from higher income levels are entirely free of nutritional risk.

According to a recent review by the General Accounting Office (1977), "At present, income criteria provide the best available means for targeting NSLP to reach the group of school children having the highest prevalence of nutritional deficiencies.... Nevertheless, it should also be noted that there are probably several times as many nutritionally needy children among the higher income groups--groups for which 'targetable' characteristics of nutritional need have not yet been established" (Comptroller General of the United States, 1977, p. 38). This problem confounds the analysis based on income/participation status. Lack of significant differences among the groups does not necessarily mean that the program has failed to benefit those children from both low and high income groups who were at risk prior to participation.

Although the assumption is not always explicit, the types of analyses and discussions contained in the studies that used a pre-posttest design suggest that the investigators were evaluating the ability of school nutrition programs to effect improvements in children who exhibited nutritional problems at the onset of the study. Critical issues in these studies are: (a) the appropriateness of measures used to identify nutritional problems; and (b) whether the time allowed to demonstrate improvement is sufficient, given the partial nature of the treatment. All three longitudinal studies raise questions about whether it would be possible to detect changes in nutritional status due to the programs in the short period from fall to spring.

In addition to these broad issues, specific points can be made regarding the strengths and weaknesses of the samples as well as designs, measures and analyses employed in the cross-sectional and longitudinal studies. Each of these is discussed below.

Sampling

Generalizability of results is a major consideration in the cross-sectional surveys that were reviewed. The only cross-sectional study of effects in nutritional status that can be generalized to the U.S. population is Hoagland's analysis of HANES data. The strength of HANES is that it is based on a probability sample with a respectable response rate, although the numbers in some cells in Hoagland's analysis are quite small.

The Ten State Nutrition Survey (1972) was plagued with sampling problems. Although the study was intended to represent the nutritional status of low-income persons, selection was based on the poverty income ratios of enumeration districts from the 1960 census and not on the verified income levels of participants in 1968, the time of the study. As a result, not all persons sampled from these districts had low incomes, which, among other factors, altered the planned representativeness of the sample.

The study of Price et al. (1975) was confined to Washington State. A cluster design was used, with sampling goals for subjects categorized by poverty status, school meal program participation, and ethnic background. The strength of this design is that it allowed for equal numbers of subjects in specified cells "in order to more readily discriminate differences." However, since prior estimates of the proportional cell numbers in the population could not be made, sufficient numbers of subjects for some of the cells were not available in the sample districts. The original objective of obtaining equal numbers of subjects in each cell was abandoned. This caused analysis of data to be based on fewer than five subjects in some cells. A further practical problem with the research design is that assignment of students to cell categories was left to school officials. The investigators reported that there were numerous misassignments, which later had to be corrected using data obtained from parents. This problem contributed to further deterioration of the original sample design.

Howe et al. (1980) drew their samples from single geographic locations, as did Price et al., but these researchers sampled relatively smaller numbers of students than were sampled in the other three cross-sectional studies. The number of students in the study by Howe et al. (1980) was 104.

Sampling in the longitudinal studies is subject to different problems. In order to perform a true experiment of program effects, random assignment of subjects to program and no-program conditions is a critical requirement, even though it is often difficult to obtain in field settings. While a randomized field experiment may be difficult to implement, attempts to overcome the difficulties are worthwhile because of the substantial advantages of random assignment, e.g., increasing the confidence with which inferential statements concerning causality can be made (Cook & Campbell, 1979). None of the longitudinal studies was able to achieve this condition. Lieberman et al. (1976) presented a compelling discussion of how difficult it was to attempt randomization of subjects in a study of school nutrition programs. Community leaders objected to the randomization and requested that the program be made available to all students in the selected grades at the study school. An adjacent school matched as carefully as possible on socioeconomic characteristics eventually served as the no-program control. Since neither school operated a breakfast program prior to the study, there is no reason to assume that self-selection bias was introduced at the school or program level.

Emmons et al. (1972) also used two separate schools for their longitudinal sample; however, the two schools each received a different combination of programs (school lunch and milk programs in one school versus school lunch and breakfast programs in the other). The objective of making comparisons between the schools was to see which combination of programs had the greatest effect on participants. The lack of a no-program control school makes it difficult to account for measurement and regression effects in this study.

Paige (1972) used subjects from four different schools, all of which offered the school lunch program to students. The programs were not initiated specially for the study (as was the case in the studies by Lieberman et al. and Emmons et al.). Instead, Paige chose schools with ongoing programs and classified students as participants and nonparticipants. As noted earlier, there was no explanation of the criteria for making this classification. It is, therefore, difficult to know which students Paige was comparing and whether self-selection was a factor in the results.

Design

Participation in all of the studies was treated as a categorical variable, that is, children were grouped into discrete, nominal categories that reflected qualitative differences, but did not express finer distinctions in degree or amount of participation. Various criteria were used to classify children into participant and nonparticipant groups. Although Howe et al. (1980) did not report their classification criteria, the other three cross-sectional studies categorized participants according to the number of times children usually ate the school meal per week. Hoagland's most recent analysis of HANES data and the Ten State Nutrition Survey (1972) arbitrarily set participation at two times or more per week and three times or more per week, respectively. Hoagland refined the nonparticipant class by separating children who attended schools where no program was available from children in participating schools who regularly chose not to consume the school lunch. Price et al. (1975) differentiated between partial participants (two to three times per week) and full participants (four to five times per week), but only in some analyses. These measures of participation provide only rough estimates of the frequency of participation and do not consider the effects of participation in more than one school nutrition program or the duration of participation over a child's school years.

Hoagland included a variable for the number of programs in the linear model, but did not try to describe or control for the duration of participation. Price et al. entered participation in the school lunch program and school breakfast program as separate variables in the regression equations but did not consider the combined effects of the two programs and school milk. None of the cross-sectional studies allowed for the possibility that the participation status of students might have fluctuated over the years that students attended school. This factor could have effects on the more long-term measures of nutritional status.

Finally, some of the reports of the cross-sectional studies did not clearly describe the "program" in which the subjects participated. In both the TSNS and HANES data, it was not possible to distinguish between the federally sponsored school lunch program and other lunches available at school.

The longitudinal studies suffer from similar failures to define participation status accurately. The most critical factor in a longitudinal design is how many "treatments" a subject receives over the period of the study. Paige (1972) made no attempt to determine how many participants actually ate the school lunch over the school year. In contrast, Lieberman et al. (1976) kept careful records of actual participation of each child in the study. The distributions are reported for the school year, but the child's actual participation was not entered as a variable into any analysis of program impacts. Emmons et al. (1972) also kept track of how many times children participated in the different programs studied in their schools. Instead of treating participation as a continuous variable, however, the investigators made an arbitrary decision that only children who ate a specified number of meals would be considered "participants." Data from children who ate fewer meals than the number specified were discarded from further analysis.

In the study by Emmons et al., the effects of participation in the school lunch program combined with either the school breakfast or the special milk programs were investigated. Multiple school nutrition program participation was not considered in the other two longitudinal studies. Lieberman et al. did not determine how many participants received school lunch or milk. Paige presumably chose schools where the breakfast program was not operating, but there is no indication that he assessed whether or not students received special milk.

Measurement

Selection of appropriate measures of nutritional status should be based, among other things, on hypotheses about potential program impacts. The General Accounting Office (1977) recommends that "the evaluation process should focus on selected diet-related health variables which are considered to be the most strategic to NSLP goals, either in the sense that they have the greatest impact on individual health or that they, better than any other, show whether NSLP is safeguarding the overall level of school child health as expected" (Comptro r General of the United States, 1977, p. 50).

The measures of nut ional status are reviewed in detail in Chapter II. No single variable will capture all features of nutrition and health status, and many combinations of different measures were used in the studies of program effects reviewed here. However, none of the studies attempted to justify the selected measures in terms of expectations about program effects. Therefore, unless a conceptual framework is adopted for comparison, it is difficult to judge the appropriateness of the selected measures. Such a framework is presented in Figure IV-1.

Figure IV-1 depicts a hypothetical model of causal relationships among the variables that influence the nutritional status of children. The meals offered by school nutrition programs supply nutrients to the student. The consumption of these nutrients, together with nutrients provided by meals from other sources, constitute the student's total dietary intake. This intake influences and, in turn, can be influenced by the nutritional status of the child. The student's nutritional status and nutrient intake can also be affected by genetic, metabolic and other factors.

In addition to the patterns among variables, Figure IV-1 shows four general types of measures used to assess nutritional status: dietary intake, biochemical, anthropometric and clinical measures. Dietary intake measures assess the nutrient intake of students and can be used to determine the program's contribution to total dietary intake, including the effects of participation on the development of long-term food habits as well as the effects on more immediate dietary intake.

Both immediate intake and long-term habits affect the levels of nutrients in the body, which are assessed biochemically and are indicative of nutritional status. Biochemical levels that fluctuate due to immediate intake may not be a meaningful reflection of health status unless the immediate intake is typical of a long-term pattern. Consequently, the biochemical tests that give an indication of the condition of body stores and of chronic deficiency or excess without observable physical symptoms are the most sensitive measures of nutritional status. The ideal biochemical measure is also one

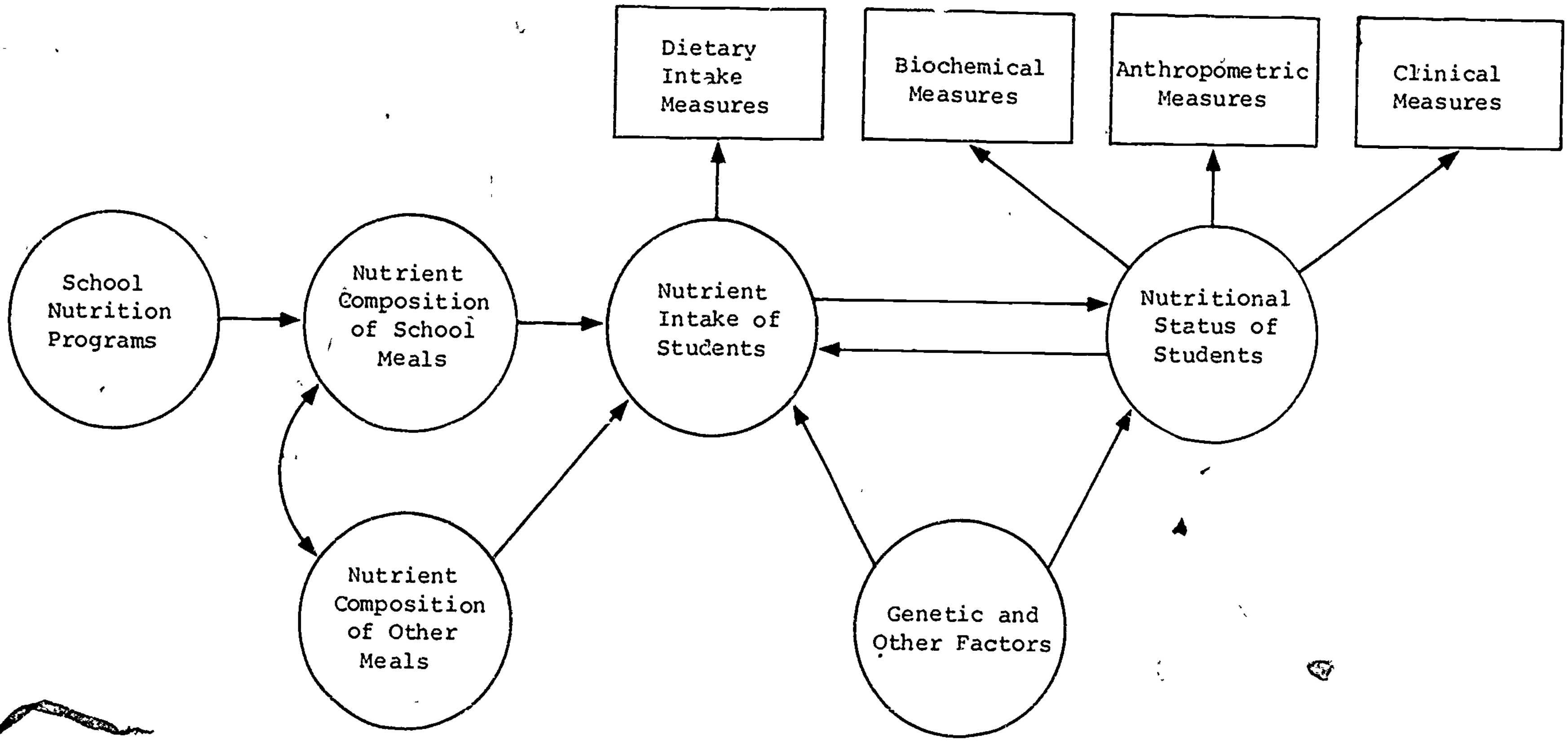

Figure IV-1. Conceptual Framework for Program Effects on Nutrition and Health Status that is not affected by extraneous conditions unrelated to nutrition. The strengths and limitations of various biochemical measures that are practical to use in large-scale nutrition surveys are discussed in Chapter II.

Anthropometry measures the state of growth and development. In children, anthropometry can be used to obtain an overall impression of nutritional status when genetic and other factors are considered. As discussed in Chapter II, anthropometric measures are also objective and relatively simple to obtain. They probably come closest to the CAO's conception of a set of variables that are "most strategic to NSLP goals," and show better than any other measures whether NSLP is safeguarding the overall level of school children's health.

Clinical measures are based on examinations for changes in physical appearance--for example, teeth, skin, and tongue--as indicators of nutrition and health status. Clinical signs represent the extreme end of the nutritional status continuum. In the United States, clinical evidence of nutritional deficiencies is not encountered in the school child population except in circumstances that are usually associated with severe disease or extreme neglect. It is, therefore, unlikely that clinical measures could be used to discover program effects in the general population of American school children.

The studies of school nutrition program effects address different segments of this conceptual framework. The cross-sectional studies represent both ends of the continuum. While only dietary intake was examined in the Ten State Nutrition Survey and the study by Howe et al., Hoagland looked at dietary intake and biochemical data. The analysis of dietary intake in each of these studies was confined to measures of immediate intake obtained by 24-hour dietary recalls.

Price et al. obtained data on immediate intakes using 24-hour dietary recall, and also used a detailed questionnaire to determine household food habits. This household information provided independent variables in the regression analyses of factors associated with nutrient intakes. It was also used to construct a set of dependent variables for regression analysis; however, school food program participation was included only as an independent variable in the economic analysis of factors affecting the money value of food.

Price et al. also included an extensive battery of biochemical tests. This might be viewed as a strength of the study in the sense that "no stone was left unturned." However, after exploring the relationships between the biochemical variables and the other variables assessed in this study, many of the biochemical variables with little theoretical justification as measures of program effects were dropped from the final analysis.

The longitudinal studies, in general, used the same anthropometric measures as the cross-sectional studies. Paige obtained no dietary information from any of the subjects. Lieberman et al. reported that home interviews were conducted with parents; however, only information about household income, size, and educational level was obtained, in addition to the 24-hour dietary recalls of study children. The study by Emmons et al. was designed to obtain data concerning the nutrient content of bag lunches from home for comparison with the nutrient content of school lunches. This enabled the investigators to examine whether or not the school nutrition program improved the participants' typical intake. None of the other longitudinal studies contains this feature.

Paige (1972) and Emmons et al. (1972) used biochemical measures of hemoglobin and hematocrit. Only Paige was able to find enough children with low hematocrit values to make analysis of program effects worthwhile. The weakness of hemoglobin or hematocrit as the sole measure of iron status has been pointed out in Chapter II. Black children constituted the greatest proportion of subjects in Paige's study. The failure of this study to recognize that standards commonly used to evaluate hemoglobin and hematocrit may be inappropriate for black individuals (Dallman et al., 1978; Frerichs et al., 1977; Garn et al., 1976) should not be viewed critically, since the study was conducted before this problem was generally recognized. Future research should take the differences into account, particularly if program effects among various ethnic groups are compared. In Paige's analysis, the problem is compensated for by examining the distribution of values as well as the number of individuals whose values fell below specified levels.

In general it appears that all of the longitudinal studies suffered from inadequate measurement of nutritional impacts. In view of the small number of children who were found to have low biochemical values in the fall, and the short time allowed to demonstrate changes in anthropometric measures, the likelihood of showing program benefits might have improved if the longitudinal studies had conducted more intensive investigations of dietary intake, e.g., the use of a dietary history. As discussed in Chapter II, a dietary history is recommended for use in longitudinal studies as a more reliable assessment of an individual's long-term dietary patterns than the 24-hour dietary recall.

All three longitudinal studies obtained pretreatment measures of nutritional status to identify "nutritionally needy" children or children "at risk." The students in the Emmons et al. study were classified as "nutritionally needy" if their (1) 24-hour dietary recall indicated that three or more nutrients fell below 70 percent of the RDA; (2) hemoglobin was lower than 11.5 grams per milliliter and/or hematocrit was less than 36 percent; and (3) weight-for-height and/or weight-for-age was below 90 percent or above 110 percent of the Iowa standards (Stuart & Meredith, 1946). It is possible that the criteria used by Emmons et al. may not have identified nutritionally needy children. The biochemical measures were dropped from further consideration because so few children actually exhibited low values. This left only dietary intake records and anthropometric measures to identify children at risk. As discussed in Chapter II, 24-hour dietary recalls do not necessarily reflect the long-term dietary intakes of an individual, nor does the intake of a nutrient that falls below the RDA indicate that an individual has a nutrient deficiency. Also, most authors agree that weight-for-age, per se, is not a reliable index of nutritional status. According to Fomon (1977), "a simple index of weight-for-age...is unlikely to have the sensitivity desirable for use in the United States" where the goal is to identify children "with mild or marginal nutritional abnormalities" (p. 19). Weight-for-height is a better measure, but diagnosis is not always clear for individuals unless evidence of the child's growth rate and/or medical history is available (Fomon, 1977). It is not unusual for a child's weight-for-height to vary 5 to 10 percent from one measurement to another. Single measurements at one point in time that fall 10 percent above or below normal do not necessarily indicate that the child is overweight or underweight. A more appropriate determinant of risk is weight-for-height that falls below the 5th percentile or above the 95th percentile on the growth charts (Center for Disease Control, 1975).

Paige used hematocrit, height, and weight measurements to determine the risk status of subjects, but did not include a dietary evaluation. The cutoff points used for height and weight measurements were more appropriate levels of risk than those used by Emmons et al. Children were judged at risk if height or weight was below the 10th percentile of the Stuart Boston standards. Overweight children were not identified, as they were in Emmons et al. Combined measures for hematocrit and weight and for hematocrit and height were used to refine the identification of at-risk children; however, the total number of subjects in these two categories was only 14 children--a number rather small for purposes of analysis.

The measures used by Lieberman et al. were similar to those used by Paige; however, only the anthropometric data were used to evaluate nutritional risk. The 16th percentile for height and the 84th percentile for weight on the Iowa growth curves were chosen as cutoff points to identify undernourished and overweight children. The numbers of children falling into these categories did not differ from the numbers expected in the general population; nor did any evidence of malnutrition appear when the percentile distributions of children from the program and control schools were compared with distributions obtained in other studies of school-age children. Although the investigators sought to show maximum benefits of the school breakfast program by choosing subjects judged by economic criteria to be at risk, the sample was not biased in the expected direction. Consequently, improvement from fall to spring based on group comparisons could not be shown.

Analysis

Strengths and weaknesses of analytical procedures used in the various studies are related to the design of the studies and the types of measurements that were obtained, and many of the specific issues in analysis have already been discussed. However, there are some general problems that are common to all of the studies. As mentioned earlier, one problem in both the cross-sectional and the longitudinal studies results from considering program participation as a categorical variable. This definition of participation leads to a loss of important data that may affect the long-term measures of nutritional status.

A second problem in most of the studies is the failure to consider extraneous factors that might confound program effects. As the conceptual model in Figure IV-1 shows, nutrient intake away from school and genetic, metabolic, and other factors can influence the various measures of nutritional status. Of all the studies, only those by Hoagland and Price et al. controlled for some of these factors in analysis. Price et al. additionally examined the data for nonlinear and interaction effects. The authors of the longitudinal studies relied upon analysis of variance as the primary statistical procedure to detect significant differences in the data that could be attributed to program participation. Although they acknowledged that a number of other factors could have influenced the results, none of the authors used multivariate or covariance analysis in an effort to control for these effects. In view of the fact that none of the longitudinal studies could achieve random assignment of subjects to treatment and control groups. the lack of attention to extraneous factors is a serious defect, threatening the confidence with which obtained differences between groups can be attributed to the programs.

SUMMARY OF FINDINGS CONCERNING NUTRITIONAL STATUS

The review of research in this section has not furnished consistent evidence of positive program effects on the nutritional status of students.

Based on the review, it appears that school lunch participants consume lunches that contain higher percentages of RDA for selected nutrients than nonparticipants; however, the impact of this advantage on the students' health is unclear. Comparisons of the mean daily intakes of nutrients or percentages of the RDA achieved by participants and nonparticipants generally do not show significant differences, except for participants' consumption of more vitamin A (Price et al., 1975, 1978); calcium (Howe et al., 1980; Price et al., 1975, 1978); and riboflavin and phosphorus (Price et al., 1978). When factors that are thought to influence dietary intakes (such as the child's height and weight) are taken into account, school lunch participants continue to have increased intakes of calcium, riboflavin, and phosphorus compared with nonparticipants (Price et al., 1978). Milk is a good source of these nutrients, and it is possible that the differences between the nutrient intakes of participants and nonparticipants can be explained in part by the milk served at lunch.

There is evidence that the dietary intakes of children who are from low-income families or who are judged to be nutritionally needy may be improved by the NSLP. Some of these children receive substantial portions of their total daily nutrient intake from the NSLP (Emmons et al., 1972; Price et al., 1975; U.S. DHEW, HRA, CDC, 1972).

One study suggested that SBP participants had higher intakes of several nutrients than students to whom the program was not available, but the sample of breakfast program participants was very small as reported by Hoagland (U.S. Congress, Congressional Budget Office, 1980). Breakfast school children consumed more of their total intake before 10:00 a.m. than control school children, and more control school children than breakfast school children reported having nothing to eat before 10:00 a.m. (Hunt et al., 1979). Another study showed that children who participated in both the NSLP and SBP had higher intakes of nutrients than children who received only the school lunch and morning milk (Emmons et al., 1972). Although other studies failed to show this effect (U.S. Congress, Congressional Budget Office, 1980; Lieberman et al., 1972), children participating in both the NSLP and SBP were found to have higher MARs than students participating in only the breakfast or lunch program (U.S. Congress, Congressional Budget Office, 1980).

The relatively few studies that have attempted to explore the effects of school meal programs on biochemical, anthropometric, and clinical indicators of nutritional status have all encountered technical problems that make it difficult to draw definitive conclusions from the results. The most commonly employed biochemical measures have been hemoglobin or hematocrit values. In most studies (Emmons et al., 1972; Price et al., 1975; and Lieberman et al., 1976), there were so few low hemoglobin or hematocrit values that it was difficult to distinguish program effects among the groups studied. Even when the occurrence of low hemoglobin or hematocrit values was more frequent, no discernible effects of program participation could be shown (Paige, 1972). Studies that evaluated other biochemical indices in addition to hemoglobin and hematocrit did not yield meaningful indications of program effects (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975). There is some evidence that anthropometric measures can show differences. For example, Price et al. (1975) found tendencies for participants and nonparticipants to have different weight patterns in some age-sex groups. However, none of the longitudinal studies that explored anthropometric changes over a school year found significant differences that could be attributed to the influence of school meals (Lieberman et al., 1976; Paige, 1972). As discussed in Chapter II, unless the children are malnourished, more time than the period between fall and spring may be needed to show program effects on anthropometric assessments of nutritional status.

B. *What Are the Effects of Participation on Milk Consumption?*

It is generally recognized in studies of school nutrition program effects that it is not the food, per se, but the nutrients contained in food that are essential for nutrition and health. Consequently, most studies of program effects on dietary intake have performed an analysis of the nutrient intakes of participants and nonparticipants rather than an analysis of the frequency or amounts of specific foods that children consume. Milk consumption of students represents an exception to this general principle. An expressed purpose of the SMP is to increase milk consumption among participating students. Furthermore, studies reviewed in the previous section suggest that the higher intakes of calcium, riboflavin and phosphorus by NSLP participants may result from increased milk consumption. Hence, milk consumption is of interest for its own sake as an indication of program effects.

In addition, milk waste among school children has received increased attention in recent years because there is growing evidence of lactose intolerance in certain segments of the population. It is likely that 60 to 90 percent of non-Caucasian people have an intolerance to lactose, the sugar in milk; this intolerance is due to low levels of intestinal activity for lactase, an enzyme required for digesting lactose (USDA, FNS, OPP&E, 1980). Following test doses of lactose, individuals who suffer from lactose intolerance exhibit symptoms that include flatulence, bloating, abdominal pain, and diarrhea. It is postulated that individuals with low lactase activity will spontaneously limit their milk consumption to amounts that do not cause distress. This spontaneous reduction in milk intake by susceptible individuals could be responsible for a portion of the milk waste in school feeding programs. (Lactose intolerance as it relates to the nutritional status of children in general is discussed in Chapter III.)

The influence of the type of milk offered on students' consumption of milk and other meal components is also of interest. Only a limited number of studies on each of these topics exists in the literature.

MILK CONSUMPTION

Two studies have focused on the effects of the Special Milk Program (SMP) on students' milk consumption. In one study by Anderson and Hoofnagle (1960), the quantity of milk consumed by children attending schools participating in the SMP was compared with the milk consumption of children in nonparticipating schools. In a more recent study (Robinson, 1975), the joint effects of student participation in the SMP and NSLP on milk consumption were assessed.

Anderson and Hoofnagle, 1960

Anderson and Hoofnagle (1960) attempted to determine whether milk provided by the SMP supplements or replaces milk that children would drink without the program.

Method. The study focused on children in the fifth through ninth grades in 100 schools, 50 participating in the SMP and 50 having their own milk service. The states in the study were: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, and West Virginia. Counties within the individual states were placed into one of four strata according to urbanicity and population size: counties with metropolitan areas over 500,000 were sampled at 100 percent; in the other strata, 20 percent of the counties were sampled proportionally at random by state. Data available within the counties were used to develop lists of program and no-program schools. Schools with enrollments of fewer than 30 students were excluded. No-program schools were selected randomly from these lists. Program schools were then selected to match the no-program schools as closely as possible in terms of urbanicity, economic level, size of enrollment, food services available, and participation in the NSLP. In the final sample, 31 of the 50 no-program schools and 30 of the 50 program schools participated in the NSLP.

The grades actually present in the selected no-program schools were sampled in proportion to their numbers. Grade sampling in program schools was matched on a school-by-school basis whenever possible. When schools had more than one class at a given grade level, the principals usually selected the class or classes to be interviewed. In the 100 sample schools, 8,444 fifth- through ninth-grade students in the selected classes were interviewed: 4,349 from the no-program schools and 4,095 from the program schools.

In the interviews, children were asked their age, sex, and school attendance on the previous day. Children were also asked about the types and amounts of milk they consumed, including the milk consumed during the morning at school; milk consumed with the school lunch or in addition to the school lunch; milk brought from home for lunch; and milk consumed after lunch. Similar questions were asked concerning milk consumption out of school and consumption of fresh fruit juices and beverages other than milk. To assist their recall of beverage consumption, children were shown actual glasses and bottles and scale drawings marked to show quantities in ounces. The children's recall of milk consumed during school hours was checked by an audit of the milk purchased by children in grades five to nine in each of the sample schools. When conducting the audit, an interviewer was stationed at the location in each school where the milk was sold, and asked each child if he or she had participated in an interview. Audit information was obtained by sex and grade of those in sample classes and other classes in the same grades.

Results. The mean quantities of milk consumed for 24 hours were compared for children in program and no-program schools. Computation of variances was based on the number of schools (not the number of children) in each group, since the school was the major sampling unit. A one-tailed test of differences between the means was used to determine whether consumption was higher in program schools than in no-program schools. Additional tests were performed to detect differences in 24-hour milk consumption related to urbanization, economic level, type of food service in the school lunch program, availability of soft drinks in the school, age and sex of the child, consumption of beverages other than milk, and consumption of fresh fruit.

The investigators found that the 4,095 children attending SMP schools had a higher per-capita intake of milk over a 24-hour period than the 4,349 children attending no-program schools. However, the data provided only indirect evidence that the higher intake was due to student participation in the SMP. Milk consumption was shown to vary according to factors such as urbanicity and income in both program and no-program schools. These factors were not controlled in the analysis of program effects. This lack of control in conjunction with the matching procedure used to equate the two groups increases the likelihood that the results may be due to regression artifacts.

Robinson, 1975

The purpose of the study by Robinson (1975) was to "assess the impact of the free milk provision on the Special Milk Program and to assess the impact of the Special Milk Program, in general, and the free milk provision, in particular, on the National School Lunch Program and on student milk consumption" (p. 2). In addition, the study attempted to assess milk waste and the factors associated with it, to update information on milk service operations, and to determine the impact of the SMP on the demand for milk in schools.

Method. To achieve these objectives, a cross-sectional survey was designed to determine the schools' participation in nutrition programs and the students' consumption and waste of milk. The SMP and/or NSLP participation status of 768 schools throughout the United States, excluding Alaska and Hawaii, was determined through questionnaires completed by school personnel. Approximately 20,000 students drawn from two classes in each school completed questionnaires concerning their milk consumption. Comparisons were made of the milk consumption of the students attending schools that offered either the SMP, the NSLP, both programs, or neither program.

The sample for the study was drawn from the universe of the nation's public and private schools listed by the Office of Education (DHEW), current as of 1972-73 for public schools and 1969-70 for private schools. A two-stage sampling design was used to select, first, 4,000 schools at random from the universe, and second, a subsample of 768 schools from five strata representing program history and participation in milk and lunch programs. Within each of the 768 schools, two separate subpopulations were sampled, with the ultimate cluster being the school. The first subpopulation consisted of students drawn randomly from two classes in each school and was sampled to study milk consumption. The second subpopulation consisted of milk containers dispensed during lunchtime at schools participating in USDA programs and was sampled to study milk waste.

A questionnaire was used to assess the milk consumption of students. For first- through fourth-grade students, the questionnaire was administered by enumerators to small groups of five; for older students, the questionnaire was self-administered. Students reported their age, sex, school attendance and lunch participation on the day prior to the survey, the type and location of the lunch eaten, their usual milk consumption at school and away from school, and the actual (recalled) amount of milk consumed at school and away from school on the day prior to the survey.

Milk consumption was recorded as an average number of glasses or cartons rather than ounces of milk consumed. Since no aids were used to help students visualize sizes and fractions of containers, considerable variation from actual consumption may have been reported by the students. The investigator recognized this limitation but stated that the objective of analysis was to compare relative rather than absolute differences between groups of students. No statistical tests to determine the significance of differences were applied.

Results. Analysis of data from the student questionnaires compared schools with and without the milk program for the mean 24-hour milk consumption by students at school and away from school. In addition to the availability of the SMP, other variables that were considered in relation to student milk consumption included the grade and sex of the student, availability of soft drinks, availability of flavored milk, eligibility of the student for free milk, and type of lunch eaten on the day prior to the survey. In each of these categories, the mean numbers of cartons or glasses of milk consumed for 24 hours, at school and away from school, were calculated for students in program and no-program schools.

Robinson found that students in schools with the milk program consumed almost 42 percent more milk at school and almost 10 percent more milk over the 24-hour period than students in schools without the program. In this study, mean away-from-school milk consumption of students from program and no-program schools was similar; therefore, differences in milk consumption were attributed to the milk the children received at school. According to Robinson, the higher level of student milk consumption in SMP schools may be due more to the NSLP than to the SMP itself; however, he concluded that both programs increased milk consumption. In schools that participated in the school lunch program--but not in the milk program--milk consumption at school was almost 30 percent higher than consumption in schools that participated in the milk program but not in school lunch. Robinson further noted that *a la carte* milk (whether subsidized by the SMP or not) may deter some students from participating in school lunch, but the data may be biased by the inclusion in the baseline comparison group of some schools that had recently dropped the SMP. These particular schools had high NSLP participation rates both before and after discontinuing the SMP.

In order to study the effect of the free milk provision, Robinson compared the 24-hour at-school and away-from-school milk intakes of children eligible or not eligible for free milk. He acknowledged that eligibility for free milk, as determined from school records, did not necessarily mean that children received free milk from the SMP on the day of the survey; nevertheless, he concluded that children eligible for free milk received 43 percent more milk at school and 22 percent less milk away from school than non-eligibles. Robinson went on to show that most of the milk received by free-milk eligibles was served as part of the milk required for the Type A lunch. A more clearly discernible effect of the free milk provision might have been shown in SMP schools that did not participate in the NSLP; however, the number of free-milk eligibles in these schools was too small to draw valid conclusions.

By considering the interrelationships among programs and comparing at-home and at-school consumption, Robinson was able to make stronger conclusions about the impacts and substitution effects of the SMP than Anderson and

Hoofnagle (1960). A weakness of Robinson's study is that the analysis was limited to simple comparisons of percentages due to the non-rigorous measures of milk consumption. It was not possible to determine the statistical significance of differences or to study interactions or the confounding effects of other factors, such as urbanicity and age of students, which have also been shown to affect milk consumption. Moreover, standard errors of estimate were not given for any of the reported statistics, making it difficult to evaluate the stability of means or differences between means from various groups.

MILK WASTE

In contrast to the numerous studies on food waste, only a few studies have looked specifically at milk waste in school nutrition programs. Even fewer studies have looked at this problem and the relationship it may have with student ethnicity and milk or lactose intolerance.

The study by Robinson (1975), which was described previously, also contained an analysis of milk waste at lunchtime. In this study, milk containers returned by children after lunch were collected at sample schools that participated in a USDA program. The frequencies of completely empty, partially empty and unopened containers were measured. It was found that, overall, waste at the USDA program schools averaged 11.5 percent. Almost 75 percent of all half-pints were completely consumed, 23 percent were partially consumed, and just over 2 percent were unopened. An average of 3.2 ounces of milk remained in the partially consumed cartons. The reseacher concluded that the SMP did not contribute to milk waste because milk waste at the schools offering the SMP only was 3.5 percent. Milk waste at the schools that offered the NSLP only or both the NSLP and SMP was 11.9 percent. The survey data revealed a number of factors that were related to variations in milk wasted; however, the racial background of the students was not studied.

Only a few small-scale studies have analyzed milk waste on a racial basis, and they obtained contradictory results. Paige et al. published a series of articles based on a study of the school lunch program in four schools in Baltimore (Paige et al., 1971, 1972). The methods used in this study were described in the previous section of this report. This study found that 20 percent of the black children drank less than half the milk served to them in the school lunch program, while only 10 percent of the white children returned half or more of their milk. These findings were replicated in a study by Paige and Graham (1974) with 320 black and 125 white elementary school children from a low-income area in Connecticut. In this study, 36 percent of the black children, compared to 18 percent of the white children, drank less than half the milk served to them. The authors speculated that black children consumed less milk due to lactose intolerance and seriously questioned whether milk should be a required component of Type A lunches in schools with high proportions of black children.

Stephenson et al. (1977) have criticized the conclusions of Paige et al. (1971, 1972) by emphasizing four important points: (1) the occurrence of lactose intolerance is not restricted to black children but affects white children also; (2) lactose intolerance does not necessarily indicate milk intolerance; (3) milk consumption is determined by factors other than lactose intolerance; and (4) the 20 percent figure quoted by Paige et al. (1971, 1972) is a relatively small percentage of all black children in the schools studied. Stephenson et al. collected data from 222 children in two schools in Ithaca, New York, to ascertain (1) milk consumption during school lunch, as measured by the investigators; (2) milk consumption outside of school, as reported by the children; (3) the children's preferences for certain dairy products; and (4) the occurrence of stomach aches after drinking milk, as recalled by the children. The children were first- through sixth-graders who participated in the NSLP. The volume of milk remaining in the cartons after lunch was measured twice in two weeks. A week later, the children completed a questionnaire that asked about their consumption of plain milk, flavored milk and orange juice on the preceding day; whether they liked plain or flavored milk, yogurt, cottage cheese, etc.; and whether they experienced stomach aches after drinking plain milk, flavored milk or orange juice. Overall milk consumption at lunch was found to be approximately three-fourths of a cup. Although consumption varied by sex, age and school, there was no significant association between milk consumption and race. On average, children reported consuming a total of 3.7 glasses of plain and/or flavored milk per day. Consumption outside of school was not related to race, age, sex or school. Over 90 percent of all children reported liking plain or flavored milk. While some children reported stomach pain after drinking milk, the number did not differ significantly between black and white children.

The study by Stephenson et al. is a more controlled investigation than that reported by Paige et al.; however, the Stephenson and Paige studies involved relatively small numbers of children in only a few schools. The fact that Stephenson et al. found a significant variation in milk consumption by school suggests that further research must be done on a larger, more representative sample.

As noted in the results of Stephenson et al., the age and sex of the child were important factors determining milk consumption. The study by Robinson (1975) also found associations among these variables. In both studies, girls consumed less of their milk than did boys. Robinson found a curvilinear relationship between milk consumption and age: the children's reports of the number of glasses or cartons of milk consumed for the whole day increased in the elementary grades, then decreased during junior and senior high school. However, Stephenson et al. found that the actual quantity of milk consumed at lunch showed a consistent increase with age, reflecting increased appetites and body sizes.

FLAVORED AND LOW-FAT MILK OPTIONS

The option of choosing flavored milk also has been shown to influence milk consumption. Robinson (1975) found that milk waste in schools offering flavored milk was 8 percent, compared with 14 percent in schools offering only plain milk. In a study of approximately 400 children in grades one to six, Guthrie (1977) found a similar tendency for the flavored milk option to reduce milk waste significantly; however, Guthrie also found that food waste from other Type A components increased when flavored milk was offered. The apparent "tradeoff" resulted in an increased intake of calcium and riboflavin and a reduced intake of iron, with no effect on the other nutrients. In all cases, iron intake was considerably below the one-third RDA goal. Calcium and riboflavin were adequate for younger children regardless of the milk served, but older children failed to meet their calcium goals when they could have only plain milk. Guthrie added that the significant increase in food waste represented an economic loss that was not compensated by the decrease in milk waste.

Offering low-fat milk instead of unflavored whole milk does not seem to have similar effects on milk waste although it does reduce the caloric value and fat content of the meal. Godfrey and Schutz (1972) found no difference in students' consumption of, or attitudes toward, low-fat and plain milk in a study conducted in two elementary, two junior high and two senior high schools in California. The students in each school received low-fat milk or whole milk in unlabeled cartons for one week each. Milk consumption was assessed by measuring the total amount of milk left in all the cartons after lunch on Friday of both weeks and taking an average based on the number of cartons returned. Students were given questionnaires after lunch that assessed how much they liked the milk served. In total, 8,394 milk cartons and 2,059 questionnaires were collected. In order to de-emphasize the researchers' focus on milk, the questionnaires also asked how much the students liked other foods on the menu. Consumption of other Type A components was not assessed in this study, but there is no reason to assume that there was any effect according to the type of milk served.

Although there were no significant differences between the consumption of, or attitudes toward, the two types of milk, there were significant differences in the amount of milk consumed between grades. Godfrey et al. (1972) found that elementary students consumed significantly less of both types of milk than junior and senior high school students, but liked both types of milk more than either of the older groups. The result concerning intake is similar to the trend toward increased consumption with age found by Stephenson et al. (1977). Further tests of the low-fat and skim-milk options are currently being carried out under the direction of USDA.

SUMMARY OF FINDINGS CONCERNING MILK CONSUMPTION

The effects of the SMP on students' milk consumption were explored in two studies (Anderson & Hoofnagle, 1960; Robinson, 1975). The investigations found that children attending schools with the SMP consume more milk in a 24-hour period than children in schools without the program. Since about 90 percent of schools with the SMP also have the NSLP, however, it is not clear whether this difference is due to the SMP, per se, or to the fact that milk is also a component of the school lunch.

Since the milk component of the school lunch pattern may be responsible, in part, for increases in the intakes of specific nutrients by participants, the question of milk and lactose intolerance (i.e., metabolic absorptive disorders associated with milk consumption) is potentially important. Only three studies were found that explored the relationship between these disorders and milk consumption of children from different racial groups who participate in school nutrition programs. The studies compared milk consumption between black and white children and obtained contradictory results. Paige et al. (1971, 1972, 1974) found that higher percentages of black students, compared to white students, drank less than half of the milk served to them at lunch, whereas Stephenson et al. (1977) found no relationship between race and milk consumption.

Three studies investigated the effects of offering different types of milk in school nutrition programs. A national study in over 700 schools (Robinson, 1975) showed that milk waste is significantly reduced when children are allowed the choice of flavored milk. A smaller study by Guthrie (1977) also showed this effect; however, this study indicated that increased milk consumption was accompanied by increased food waste among other Type A components. No difference was found in school children's consumption of, or liking for, low-fat or unflavored whole milk (Godfrey et al., 1972).

C. *What Are the Effects of Participation on School Performance, Behavior, and Nutrition Knowledge?*

The literature available on the non-nutritional effects of the school nutrition programs focuses primarily on behavioral effects and, to a lesser extent, on educational benefits. The findings of the review are discussed in terms of these major categories.

BEHAVIOR AND PERFORMANCE

In contrast to the literature reviewed thus far, in which studies of school lunch programs predominate, studies examining program effects on student behavior and school performance have tended to focus on breakfast. Pollitt, Gersovitz, and Garfiulo (1978) have comprehensively reviewed the literature addressing the educational benefits of the school nutrition programs. These authors distinguish between studies that attempt to determine the effect of morning feedings*, in general, on short-term behavior, and studies that look

---

*An exception was made to the criteria for selecting references to be reviewed to include studies that looked at the effects of morning feedings, in general, as well as studies conducted before 1960 that looked at the effects of school nutrition.

at the effects of the school lunch and breakfast programs, in particular, on long-term behaviors, such as attendance and school achievement.

Short-Term Behavioral Effects

Six studies on short-term behavioral effects have investigated the effects of eating or not eating breakfast and of eating a midmorning snack (Pollitt et al., 1978). The behaviors assessed were variously defined as nervousness (Laird et al., 1931; Keister, 1950), hyperactivity, withdrawal and hostile behavior (Keister, 1950), aspects of mental performance such as performing arithmetic and decoding tasks (Matheson, 1970), short-term attention (Dwyer et al., 1973), and physical performance measures such as neuromuscular tremor, grip strength and endurance (Tuttle et al., 1954; Arvedson et al., 1969). Brief descriptions of the features of each study will be followed by a discussion of their methods and findings, which are summarized in Table IV-2.

Laird et al., 1931. Laird et al. (1931) investigated the relationship between hunger and nervousness in children. Forty-eight first-, third- and fifth-grade children who had been rated as nervous by their teachers were divided into three groups: those who received no special feeding but instead played with toys (control group); those who received milk; and those who received milk and a calcium supplement. The children were fed at 9:30 in the morning for a two-week period. At the end of the experimental period, the children's behavior was reassessed, presumably by their teachers, who did not know to which group the children had been assigned. Although no statistical tests were presented, it was reported that over the two-week period, the nervousness of the group that was fed milk was reduced by an average of 6 percent. However, 50 percent of this group showed either no improvement or an increase in nervousness at the end of the two weeks. The researchers concluded that the nervousness of elementary school students is associated with hunger and can be reduced by midmorning feedings of milk.

Table IV-2. Summary of Studies of Short-Term Behavioral Effects of Morning Feedings

STUDY	TREATMENT	SAMPLE	MEASURES	ANALYSIS	RESULTS
Laird et al., 1931	Children received milk, milk plus calcium supplement or no special feeding at 9:30 a.m.	Children from grades 1, 3, and 5 who were rated as "nervous" N = 48	Behavior checklist to assess nervousness	Comparisons of pre- and post-treatment ratings of nervousness. No statistical tests.	Nervousness of groups receiving milk was reduced an average of 6%
Keister, 1950	Children were fed pineapple juice or water at 10:00 a.m.	Nursery school children N = 133	Observation of hyperactivity, withdrawal, hostile behavior and nervous habits for two hours after feeding	Comparisons of frequency of observed hyperactivity, withdrawal, hostile behavior and nervous habits after receiving juice or water	Children receiving juice exhibited fewer negative behaviors than children receiving water
Tuttle et al., 1954	Subjects alternated between eating breakfasts and not eating breakfasts; total daily intake was kept constant	12- to 14-year old boys from one school N = 7	Neuromuscular tremor magnitude, choice reaction time, grip strength, work rate, work output, attitudes and scholastic performance	Comparison of individual and group mean scores on measures taken when eating and not eating breakfast.	Maximum work rate and work output lower when breakfast was not eaten
Arvedson et al., 1969	One group received breakfasts that provided 400 calories and one group received breakfasts that provided 560 calories; the protein and carbohydrate composition of both groups' breakfasts were alternated weekly	11- to 17-year-old boys from one school N = 40	Blood glucose, work tests, concentration, hunger, tiredness	Comparison of measures among groups eating various types of breakfast	No differences were found except that blood glucose levels were higher when a protein-rich rather than a carbohydrate-rich breakfast was eaten
Matheson, 1970	Each student received orange juice or nothing alternately at 10:30 a.m. for ten days	Fifth-graders from three schools N = 100	Performance on math and decoding tests at 9:15, 10:30 and 11:45 in the morning; 3 day record of breakfast intake	Comparisons of performance when orange juice was given and when it was not. Comparison of performance at different times according to usual breakfast intake of children.	Performance was better on days orange juice was given. Performance of children with good and poor diets did not differ at various test times.
Dwyer et al., 1973	On group received liquid meal in morning: one group received liquid meal in afternoon	First-grade boys N = 139	Attention tasks; dietary recall of breakfast intake	Comparison of morning performance on attention tasks	Performance did not differ between those children fed the liquid meal in the morning and those fed in the afternoon.

Keister, 1950. Keister (1950) compared the effects of midmorning consumption of pineapple juice or water on the hyperactivity, withdrawal, hostile behavior and nervous habits of 133 male and female nursery-school children. Each child was observed at 30-second intervals for two hours following a 10:00 a.m. feeding, each being studied four times over the course of a year (twice when receiving juice and twice when receiving water). Keister found that the children who received juice exhibited significantly fewer negative behaviors than children who received water. Although there were no significant age differences, males who received juice behaved negatively less often than females who received juice.

Tuttle et al., 1954. Tuttle et al. (1954) reported two studies that looked at the effects of not eating breakfast on the performance of children. In the first study, seven 12- to 14-year-old boys from a local school alternated between eating breakfast for three weeks and not eating breakfast for two weeks over a 17-week period. The boys' total daily intake of nutrients was kept the same throughout the experimental period; when the boys were not eating breakfast, they received additional nutrients for lunch and dinner. Twice a week on the same days of the week, late-morning measurements were made of neuromuscular tremor magnitude, choice reaction time, grip strength and maximum work rate and output. The procedures and equipment used for testing were standardized. According to the summary report of the "Iowa Breakfast Studies" (Cereal Institute, 1976), the subjects were allowed to have practice periods prior to the experimental period in order to eliminate the effects of learning on the subjects' responses. The students' attitudes and scholastic performances were rated by their teachers and were reported to be better for the majority of the boys when breakfast was eaten. The authors found, based on comparisons of individual and group means, that when the boys did not eat breakfast, their maximum work rate and work output were significantly lower than when breakfast was eaten. This result was replicated with eighteen 12- to 14-year-old boys in the second study reported by the authors.

Arvedson et al., 1969. Arvedson et al. (1969) studied whether breakfast must provide one-quarter of the total daily recommended intake of protein and energy in order for students to have maximal mental and physical efficiency during the late morning. In the first phase of the study, the breakfast consumption of 203 Swedish students, aged 11 to 17, was assessed and found to include, on the average, 15 percent of the recommended daily allowance for protein and calories. Only one-third of the children ate a breakfast that contained the recommended 25 percent of their daily protein and caloric requirement. The researchers then explored the effect of the low intake on physical and mental capacity using forty 11- to 17-year-old boys from a boarding school. Four breakfasts were designed and alternated on an isocaloric basis over the four weeks of the study. Two breakfasts were high in protein and provided either 400 or 560 calories; two breakfasts were high in carbohydrates and provided either 400 or 560 calories. The boys were divided into two groups and each group received breakfasts that provided the same number of calories over the four-week period but that differed weekly in protein and carbohydrate composition.

A finger-prick blood sample used to assess blood glucose was taken 3-1/2 hours after breakfast and was followed by work tests on a bicycle ergometer. Concentration, hunger and tiredness were measured on the days that work tests were not administered. The authors found no significant difference in the physical and mental performances or in the reports of hunger and tiredness among the groups eating the various types of breakfast. Blood glucose, however, was significantly greater when a protein-high breakfast, rather than a carbohydrate-high breakfast, was eaten.

Matheson, 1970. Matheson (1970) examined the effect of the midmorning consumption of orange juice on the performance of arithmetic and decoding tasks. One hundred fifth graders were selected from three different schools and received orange juice at 10:30 on some mornings but not on others for a ten-day period. Their performance on decoding and addition tasks was assessed at 9:15, 10:30, and 11:45 each morning. A few weeks after the experimental period had ended, the usual breakfast intake of the students was measured using a three-day food record. Matheson found that the feeding of orange juice was related to better performance of arithmetic and decoding tasks at all three times of the morning and that decoding performance was especially better after the orange juice feeding. The researcher also found that the performance of the tasks at different times during the morning did not differ significantly between children whose usual breakfast intake was good or poor; however, consumption was measured not on the day the tasks were performed, but some weeks later.

Dwyer et al., 1973. Dwyer et al. (1973) assessed the impact of an instant breakfast on children's performance. The respondents in the study were 139 first-grade boys, one-half of whom were given a liquid meal in the morning and one-half of whom were given the same meal in the afternoon. The investigators compared the morning performances of the two groups on several attention tasks and found no differences. The breakfasts consumed at home by the control group were assessed using a dietary recall; however, the results were not reported quantitively as nutrient intakes but qualitatively as the frequency of eating breakfast (e.g., "sporadically" and "always").

Discussion of Methods and Findings

A comparison of the studies looking at short-term behavioral effects is difficult because they employed different types of measurements. It is also not always clear from the reports whether the midmorning feedings acted as supplements to, or substitutes for, breakfasts that children might ordinarily have received prior to arrival at school. Several researchers (e.g., Laird et al., 1931; Keister, 1950) examined emotional dimensions of behavior, defined as "nervousness," "withdrawal," and "hostile behavior." Both of these studies concluded that a midmorning feeding (milk in one case, fruit juice in the other) relieved the symptoms. Two other studies examined cognitive variables, such as attention to tasks, and decoding and arithmetic skills (Dwyer et al., 1973; Matheson, 1970). The authors drew different conclusions about the benefits of breakfast on the performance of these tasks. A third set of studies focused on measures of physical activity (Arvedson et al., 1969; Tuttle et al., 1954). Although Arvedson et al. (1969) found no significant difference in physiological response according to the type of breakfast eaten, omission of breakfast was shown to interfere with children's maximum work output in the "Iowa Breakfast Studies" (Tuttle et al., 1954).

The principal criticism of the studies by Laird et al. (1931) and Keister (1950) is an apparent lack of reliability and validity of the measures used to assess student behaviors. These judgments were guided by checklists supplied by the investigators. In the study by Laird et al., the checklist contained highly subjective terminology such as "repulsive bearing" and "mentally lethargic." Experimental and control conditions were imposed in both studies, but there is no indication that the observers in Keister's study were blind to the treatment that each child received.

Both of the studies that measured cognitive aspects of behavior used a midmorning feeding as the experimental condition (Matheson, 1970; Dwyer et al., 1973). In one case, the feeding consisted of orange juice (Matheson); in the other case, children were given a liquid "instant breakfast" meal (Dwyer et al.). Both investigators attempted to determine the typical breakfast habits of the students; however, the methods used had limitations. Matheson did not actually assess breakfast intake during the experimental period. Dwyer et al. did obtain dietary recall information on the day of testing, but reported the data in categories such as "sporadic breakfast eater" and "always eats breakfast." Actual intakes were not evaluated or compared for nutritional adequacy. The lengths of these experiments were relatively short; for example, Matheson's study lasted only ten days. This interval may have been insufficient to bring about adjustments in children whose breakfast habits were longstanding.

Tuttle et al. (1950) used a variety of experimental conditions to test the effects of breakfast on physical performance. The results of these very early "Iowa Breakfast Studies" are widely quoted examples of research demonstrating that the omission of breakfast decreases efficiency in the late morning hours and impairs attitudes toward school work. The portion of the studies that measured breakfast/no-breakfast effects on student attitudes was not as well controlled as the study of effects on physical performance. According to the summary report, the teacher who was in charge of supervising the boys during their meal periods at school "made careful observations of their attitudes and scholastic attainments." However, these reports were actually made from casual observations of individual behavior, rather than from a systematic observation checklist applied consistently to each subject. Also, the teacher making the observations knew whether the boys were or were not receiving breakfast on the days when observations were recorded.

In summary, these studies used a variety of approaches to assess effects on student behavior, but all employed some type of experimental design. Four of the studies evaluated the effects of a midmorning feeding on emotional and/or cognitive behavior (Dwyer et al., 1973; Keister, 1950; Laird et al., 1931; Matheson, 1970). These four studies suffered from lack of systematic controls on the observations made to categorize behavior and from failure to adequately assess food intakes of the children prior to their arrival at school. Two studies reported the effects of no breakfast and different types of breakfasts on physical performance in the late morning hours (Arvedson et al., 1969; Tuttle et al., 1954). In general, these two experiments were more adequately controlled than the studies looking at emotional and cognitive behavior. They used measures that were more objective and, therefore, less subject to observer bias, and obtained more accurate data on dietary intake.

There is no way to assure, however, that some of the results were not affected by the subjects' knowledge of the treatment they received.

Long-Term Behavioral Effects

Seven studies have looked at the long-term behavioral effects of school nutrition programs (Fellers, 1967; Koonce, 1972; Kreitzman, 1973; Lieberman et al., 1976; Lininger, 1933; Pinkus, 1970; and Tisdall et al., 1951). As a group, these studies exhibit more uniformity than the studies assessing short-term behavioral effects: school performance and attendance were commonly used as outcome measures and most of the studies used a longitudinal approach. However, the studies differ in the treatments that were investigated, the characteristics of the sample, the programs that were studied, and the specific tests and methods of analysis that were used. Brief descriptions of the features of each study will be followed by a discussion of their methods and findings, which are summarized in Table IV-3.

Lininger et al., 1933. Lininger et al. (1933) reported a study on the relationship between the milk consumption and scholastic performance of 4,133 "malnourished" students who were enrolled in special health classes. The use of milk was only one of the methods suggested by the class to promote good health. The students were classified as using milk or not using milk on the basis of information obtained in interviews with the children and their parents. (The actual quantities of milk consumed by the students were not obtained.) Students who were identified as using milk were further differentiated by the source of the milk, e.g., free milk at school, and milk at school and at home. Estimates of scholastic progress were based on the subjective reports of the children's teachers and were obtained for the majority of the students only. The authors reported improved scholarship in 45 percent of the students who used milk and in 24 percent of the students who did not. Although the students comprising the milk-users group could have been distinguished from each other by the source of their milk, the

Table IV-3. Summary of Studies of Long-Term Behavioral Effects of School Nutrition Programs

Study	Program(s)*	Treatment	Sample	Measures	Analysis	Results
Lininger, et al., 1933	SMP**	Students did or did not use milk	"Under-nourished" students ages 6-16 N = 4,133	Teachers' ratings of scholastic progress; reports of milk consumption	Percent of children receiving milk who improved compared with percent of children not receiving milk who improved.	Improved scholarship found for 45% of students using milk and for 24% of those not using milk.
Tisdall et al., 1951	NSLP**	Lunch program implemented and students selected to participate by modified randomization	Participants aged 5 1/2 to 10 1/2 and matched non-participants from three Canadian schools N = 200+	School grades: intelligence, reading and arithmetic test scores	Comparison of scores between participants and non-participants; no statistical analysis presented.	Grades and intelligence, reading and math scores of participants and non-participants did not differ.
Fellers, 1967	SBP**	Not clear from report	10th-grade participants and non-participants in one school N = 198	School grades, drop-out rate	Comparison of final grades and drop-out rate between participants and non-participants at end of school year.	Final grades and drop-out rates of participants and non-participants did not differ.
Pinkus, 1970	SBP	Students did or did not participate in breakfast program	Grade 4 from 8 Louisiana schools participating and not participating in SBP N = approximately 200	Pupil breakfast habits; pupil recall of crying, anger and misbehavior; parent and teacher records of pupil crying, anger and misbehavior; absenteeism; school grades for 1 month	Comparison of results between pupils in participating and non-participating schools.	Proportionally more no-program students went without breakfast than program students did. More no-program students than program students reported crying, being angry or misbehaving frequently; however, this difference was not reflected in teachers' and parents' records. Absenteeism and scholastic achievement of program and no-program children did not differ.
Koonce, 1972	SBP + NSLP vs. NSLP only	Students participated in school lunch, or school lunch plus breakfast, or neither program	Grades 1-3; students receiving free lunch and breakfast, free lunch only, or no school meals N = 60	Attendance; teacher ratings of students' disposition, responsiveness and classroom participation	Comparison of teachers' ratings between NSLP-only and NSLP + SBP participants; comparison of absence rates among the two participation groups and non-participation groups.	Teacher ratings were higher for NSLP + SBP children than for NSLP-only children. Absenteeism did not differ among groups.
Kreitzman, 1973	SBP**	Breakfast program implemented at treatment school but not at control school	Grades 3-5; one program and one no-program school in Atlanta, GA. N not reported	Attendance, grades, scores on achievement tests	Comparison of spring measures between program and no-program students. No statistical tests applied.	Achievement scores did not differ between program and no-program third-graders but tended to be higher for program fifth-graders than no-program fifth-graders.
Lieberman et al., 1976	SBP	Breakfast program implemented at treatment school but not at control school	Grades 3-6; one program and one no-program school in low-income neighborhood in Compton, CA. N = 551	Standardized tests for concentration, memory, abstract thinking performance	Comparison of fall and spring scores of students in program and no-program schools.	Test scores of program and no-program students did not differ.

*SMP = Special Milk Program
SBP = School Breakfast Program
NSLP = National School Lunch Program

**May include programs not sponsored by USDA.

authors did not report whether the proportions of students with improved scholarship differed along that dimension.

Tisdall et al., 1951. Tisdall et al. (1951) looked at the psychological development and school achievement of more than 200 Canadian children over a period of 2-1/2 years to determine the effect of a school lunch program. The students were 5-1/2 to 10-1/2 years old when the study began; they attended three schools. Participants were served lunches in the basement of a church that was located within walking distance of all three schools. Before assignment to participation and nonparticipation groups, the children were matched exactly for sex, medical examination results, school grade, and classroom and as closely as possible for age, height, weight, economic status, dental condition, mental ability and scholastic achievement. The investigators then randomly assigned one member of each pair to the participation group, except that siblings were placed in the same group and 20 percent of the pairs were placed in the nonparticipation control group at the request of their parents.

The children's school marks as recorded by teachers, scores on intelligence tests and scores on reading and math tests were used as measures of mental and scholastic development. These data were collected in the springs of 1947, 1948 and 1949. Although no statistical analyses were presented, Tisdall et al. (1951) reported that statistical procedures were used to determine that the participation and nonparticipation groups did not differ significantly on any of the measures. According to the authors, the results did not suggest that the school lunch accelerated mental or educational development.

Fellers, 1967. Fellers (1967) conducted a study to determine the effects of a breakfast program on the grades (as an indication of achievement), and the dropout rates of 198 tenth graders over one school year. Participants and nonparticipants did not differ in their final grades or dropout rates.

Because the participation rate was less than desirable, it is possible that the program effects were too small to be detected.

Pinkus, 1970. Pinkus (1970) looked at the breakfast habits, school performance and hunger-related behaviors of two groups of fourth-grade children; those participating in the School Breakfast Program and those attending schools that did not offer the program. The children were from eight Louisiana schools that met federal requirements for participation in the program and that were matched for the predominant race of the students, size of the fourth-grade classes and number of first- through sixth-grade teachers. Questionnaires were administered in March to obtain information from teachers, parents and approximately 200 students concerning breakfast and behavior patterns.

The author reported that nearly one-fourth of the students from the no-program schools did not eat breakfast, whereas less than one-tenth of the students from the program schools did not eat breakfast. More program school children than no-program school children ate a basic breakfast. Although more children in the no-program schools reported a higher frequency of crying, being angry and being asked to pay attention or to stop misbehaving during the previous month, no significant differences between the groups of children were obtained from the parents' and teachers' one-week records of the same behaviors. No significant differences were found for absenteeism, based on attendance records from March to September, or scholastic achievement, as measured by the number of D's and F's recorded during a one-month period.

Koonce, 1972. Koonce (1972) studied 60 first- through third-grade students in Anchorage, Alaska, to determine whether children eating both school breakfast and lunch had fewer absences and better classroom responsiveness than children who ate only school lunch. The attendance records of 20 students receiving lunch only, 20 students receiving lunch plus breakfast, and 20 students receiving neither meal at school were used to compare absences during the period from September to December in 1969 and 1970. No differences in absenteeism were found among the groups for the three-month periods. Teachers completed a checklist in September and December, 1970, for only the 40 children receiving school meals, to assess general disposition and classroom participation and responsiveness. The ratings of general disposition and classroom responsiveness and participation differed: the ratings of the lunch-and-breakfast children were significantly higher than the ratings of the lunch-only children. The author suggested that the three-month period was too short to detect differences in absence rates.

Kreitzman, 1973. Kreitzman (1973) explored the effect of a breakfast program on the school attendance and grades of third- and fifth-grade children. The students lived in a federal housing project but attended two separate schools in Atlanta, Georgia. The experimental school started a breakfast program during January and the control school did not offer a breakfast program. The methods used by the investigator were not fully described and no tests for the statistical significance of differences were reported. However, comparisons of achievement tests indicated no differences in scores between the two schools for either grade. The results concerning the third-grade children may have been influenced by the fact that the third graders at the control school were involved in a supplementary education program that was not offered to the third graders at the experimental school.

Lieberman et al., 1976. Lieberman et al. (1976) studied the effect of a breakfast program on black, low-income children in the third through sixth grades. The methods used in this study were described earlier in this chapter. In addition to the anthropometric and dietary measures, five psychological tests were administered by a psychologist at midmorning in the fall and spring of a school year to assess concentration, memory, abstract thinking, and classroom performance. Based on comparisons between the school with a breakfast program and the school without a program, the authors concluded that the school breakfast program has no effect on the performance of psychological tests. However, no consideration was given in the analyses to how often the children participated in the program.

Discussion of Methods and Findings

Of the seven studies looking at long-term behavioral effects, only one suggested that scholastic improvement may be greater for participants in a school feeding program (in this case, school milk) than for nonparticipants (Lininger, 1933). None of the other studies detected achievement or attendance benefits for participants of school lunch (Tisdall et al., 1951), school breakfast (Kreitzman, 1973; Lieberman, 1976; Fellers, 1967; Pinkus, 1970), or a combination of the two programs (Koonce, 1972). Some other significant relationships were found; for example, Pinkus (1970) reported that children in schools with a breakfast program reported significantly fewer episodes of crying, anger and misbehaving than children in schools with no breakfast program. Koonce (1972) found that children who received both breakfast and lunch were rated higher in "general disposition" than children who received only lunch.

All of these studies, however, exhibit serious problems with design and methodology that threaten the validity of their findings. In Lininger's study (1933), the criteria used to determine that the children did or did not drink milk and that the children were malnourished were not described. Also, scholastic progress was assessed using a subjective checklist compiled by teachers. The major flaw in Lininger's work, however, is that the teachers presumably knew which children were receiving the milk (Pollitt et al., 1978).

The studies by Fellers (1967), Pinkus (1970), Kreitzman (1973), and Lieberman (1976) were all designed to assess the effect of a school breakfast on students' school performance. Fellers studied student participants and nonparticipants in one school. The other three studies compared students at program schools with students attending schools where the program was not available. These studies vary in the extent to which the schools were matched on variables that could affect the scholastic performance of the students. In Kreitzman's study, for example, it was noted that a supplemental reading program was operating in the control school but not in the breakfast program school.

The reports of the studies are also unclear about whether the frequency of a child's participation in the program was taken into account. Most of the studies give no indication that records were kept on the number of times children ate the breakfasts served to them at school. Lieberman et al. (1976) did keep records on participation, but did not use this information in the analysis of effects on school performance.

Pinkus (1970) and Lieberman et al. (1976) were the only studies that gathered information on the students' at-home food intake to see whether total diet or morning food intake differed between breakfast program and control groups. Data in the study by Lieberman et al. were obtained by means of a 24-hour dietary recall. Pinkus collected information only on breakfast habits. Nevertheless, this information was sufficient to document that the quality and quantity of morning food consumed by children at the breakfast-program schools exceeded that of children attending schools without the program. Neither study, however, could document that the breakfast program resulted in improved nutrition for individual students.

The studies by Tisdall et al. (1951) and Koonce (1972) focused on the school lunch program. The Tisdall study found no differences in the grades and intelligence test scores of school lunch program participants and non-participants in Canada. No statistical tests were reported in the analysis of the results of that study. Koonce studied 60 children in Anchorage, Alaska for a three-month period; although no differences in absence rates were found, children eating both school meals received higher ratings for classroom behavior than children eating only the school lunch. The measures of classroom disposition were teachers' ratings of responsiveness, participation in classroom activities, and selected emotional traits, and there is no report of what procedures were followed to assure comparability of ratings among the different teachers. The small number of subjects and the short duration of the study make it difficult to draw valid conclusions from the results.

Analysis in most of the studies reviewed in this section was confined to comparisons of test scores, improvements in performance, or attendance over the period of study. The sophistication of statistical treatments varied widely. Kreitzman made no statistical tests and reported "significant differences" strictly by observation. Difference-in-means tests were used in the other studies. None of the studies attempted to control for participation in other school food programs or to measure the effects of extraneous factors on school performance.

NUTRITION KNOWLEDGE

Research concerned with program effects on children has generally focused on nutritional status or school performance. Other potential effects have not received much attention. It has been asserted that exposure to a well-balanced Type A lunch can improve students' nutritional awareness and knowledge of food (Mayer, 1966). A number of studies show this to be the case when the school food service is part of a comprehensive program of nutrition education. For example, Blakeway and Knickrehm (1978) report a successful program in Little Rock, Arkansas, in which nutrition education activities were developed as a cooperative effort among the food service department, a nutrition education specialist, and the instructional staff. The program altered students' consumption patterns in the cafeteria and reduced plate waste.

At present, there is no clear evidence in the literature that nutrition programs without an explicit educational component have any effect on students' nutrition knowledge, attitudes, or food practices away from school. In one study (Yperman & Vermeersch, 1979), school lunch participation was associated with poorer knowledge of the basic four food groups among first- through third-grade children (in this study, age and other factors known to influence school lunch participation were controlled by regression analysis). This study also showed that the diets of children whose parents had unfavorable attitudes about the nutritional quality of the school lunch contained a greater variety of foods than the diets of children whose parents had more favorable attitudes. Both of these findings are opposite to what might be expected if exposure to the Type A lunch produces positive effects in knowledge, attitudes or away-from-school food behavior. However, the sample was drawn from one school district in California and there is no assurance that the findings from this sample are in any way indicative of the general population. These and other potential relationships require further research.

SUMMARY OF FINDINGS CONCERNING SCHOOL PERFORMANCE, BEHAVIOR AND NUTRITION KNOWLEDGE

Two general approaches have been used to investigate the effects of school nutrition programs on non-nutritional aspects of student behavior. One approach looks at the effects of hunger on short-term behavior, while the other approach attempts to relate participation in school feeding programs to long-term effects on school achievement and attendance. Studies of short-term effects yield conflicting results, and studies that have investigated the long-term effects of school feeding programs on school achievement and attendance have not conclusively demonstrated significant relationships. Whether programs targeted toward malnourished students, *per se*, could have beneficial effects on students' achievement is still unresolved.

It is possible that exposing children to the components of nutritious meals through participation in school nutrition programs will improve their attitudes toward nutrition and increase their nutrition knowledge. However, there are no studies to document whether or not simple exposure to nutritious foods, rather than specific activities in, for example, nutrition education curricula, has an effect on students' awareness and knowledge of nutrition.

THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON FAMILIES

The overall focus of this section is on the following major question:

WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON FAMILIES?

The findings are presented of a review of research concerning the effects of the school nutrition programs on the families of participating children. The particular effects on families which were of interest are indicated in the following subquestions which guided our review:

A. *What Are the Effects of Participation on Family Food Expenditures?*

B. *What Are the Effects of Participation on Family Food Consumption?*

C. *What Are the Effects of Participation on Social Interactions Among Family Members?*

Several researchers have indicated that the effects of the school nutrition programs on families have been relatively unexplored and minimally documented (Read, 1973; Popkin, 1979). The current review of research has further confirmed this conclusion. Only one major study was found that assessed program effects on family food expenditures and food consumption (Price et al., 1975); no studies were found that looked at program effects on social interactions among family members.

A. *What Are the Effects of Participation on Family Food Expenditures?*

The sample of households surveyed by Price et al. (1975) in Washington State consisted of the families of all children who participated in the study. The sampling procedure, described more fully earlier in this chapter, used a probability sample to identify districts and schools within eight geographic regions of the state. Students were randomly selected within each school to represent 12 sampling cells (Mexican-American, blacks, whites; below poverty, above poverty; and participants, nonparticipants). A consent form for both child and family participation was obtained by an interviewer for each child identified in the sampling procedure so that the sample of families agreeing to participate would be the same size as the sample of children. In the few cases where siblings were selected, families were counted more than once.

Families were interviewed in the home by local data collectors trained in the administration of the household questionnaire. Generally, the adult who prepared the food for the family served as the respondent. The household questionnaire obtained data on demographics, attitudes toward the school lunch, socioeconomic characteristics, meal preparation and planning, and the "management style" and psychological need structure of the homemaker.

Almost 40 percent of the families had children who were free-lunch recipients. Nearly all below-poverty* Mexican-American and black families had children participating in the lunch program, while two-thirds of the below-poverty whites had children participating in the program. Participation among above-poverty families was proportionally higher for Mexican-Americans and blacks than for whites. The potential value of the

*Below-poverty students were defined as those eligible for free or reduced-price lunches according to Washington State guidelines. In the year of the study (1971-72), the reduced-price criterion level was $4,320 per year for a family of four.

free lunch was estimated as $7.00 per month per participating child (the number of lunches served in a month multipled by the average price of a lunch at the time of study), and the value of free lunches received by participating households ranged from $7.00 to $56.00 (one to eight participating children). The mean value that the free lunch could contribute to eligible households in the study was $23.38 per month or about $210.00 per year. Price et al. concluded that the income transfer of free lunch benefits accounted for more than 4 percent of the total income of eligible participating families.

The demographic and economic data collected in the Washington State household survey were analyzed to determine the factors influencing the dollar value of food obtained by households. After a preliminary search for interactions using the Automated Interaction Detector program (Sonquist & Morgan, 1964), a regression model was specified that incorporated the following independent variables: total monthly household income, total household assets, number of persons in the household, dollar value of food stamps received monthly, dollar value of free school lunches received monthly, value of home-produced food, pay period for major income earner, education of respondent, region of origin of the head of household, number of meals purchased outside the home per month, ethnic status, and current work status.

The regression analyses indicated that income (log transform), household assets, family size, and the dollar value of food stamps and free lunches all exerted a significant influence on the dollar value of the food obtained in the household. The authors explained that the regression coefficients for food stamps and free lunch can be "interpreted as marginal propensities to consume, i.e., that amount by which the value of food obtained (per equivalent adult) actually increases for each additional dollar in value of free lunches or 'bonus' stamps received (per equivalent adult) by the household" (Price et al., 1975, Chapter IX, p. 42).

The regression coefficients for predicting a dollar's worth of obtained food per dollar of benefits from the two food assistance programs were as follows:

	All Groups Combined (N = 992)	Mexican-Americans (N = 245)	Blacks (N = 256)	Whites (N = 491)
Food Stamps	.30**	.61**	.43**	.15*
Free NSLP Lunches	.60**	.26	.59*	.79**

**$p < .05$, *$p < .10$

On a dollar-for-dollar basis, the free lunch made a stronger contribution to the household food budget than food stamps. Each dollar's worth of free lunch yielded a 60-cent increase in the total value of food used by the household, while a dollar's worth of food stamps yielded only a 30-cent increase in the food used. When the data were analyzed separately by ethnic group, however, this pattern appeared to be primarily true only for whites. The NSLP benefits appear to supplement the food budget for whites and, to a lesser extent, for blacks, since the marginal propensities to consume (79 cents and 59 cents, respectively) are high, but they appear to substitute for food dollars in the Mexican-American group, where the coefficient of 26 cents implies that the other 74 cents of NSLP benefits is spent on non-food items.

The results are puzzling, however, and were not explained very confidently by the authors. For example, the authors suggested that the unusually high coefficient of 79 cents observed for whites might be an artifact of multicollinearity in some way. If multicollinearity, i.e., correlation, between food stamps and free lunch participation was a problem for the white group, however, it was probably a problem for the other groups as well. Although the authors tested whether the food stamp and free lunch coefficients were significantly different from zero, they do not appear to have tested whether they were significantly different from each other, or whether all these apparent race-by-program interactions were significant. When the coefficients for the subgroups and all groups combined are summed (i.e., for all groups combined: .30 + .60 = .90; for Mexican-Americans: .61 + .26 = .87; for blacks: .43 + .59 = 1.02; and for whites: .15 + .79 = .94), the sums, ranging from .87 to 1.02, do not differ greatly. This may suggest that the variation in the two coefficients among the several groups could be an artifact of the correlation between food stamps and free lunch participation. Thus, a more refined analysis might enable us to conclude only that the "marginal propensity to consume" is about 90 cents for every two dollars (or 45 cents for every dollar) of food stamps, free lunch, or both. To the extent that the dollar value of food stamps and free lunch are unreliably measured, the true marginal propensities are likely to be slightly higher--if we assume that these values are measured with a reliability of .80, for example, the marginal propensity would be estimated as about 50 cents per dollar.

Another analysis of the household data (Price, Price & Womach, 1975) examined parents' opinions of the school lunch. Questions related to parents' perceptions of problems with the school lunch and their attitudes toward lunch prices were raised in the household interview and later tabulated. The authors found that the price of the school lunch in the Washington sample ranged from 30 to 40 cents, with a mean of 35 cents. Seventy percent of the parents thought the lunches were reasonably priced, although this varied with the price, and smaller proportions of blacks and Mexican-Americans agreed. The opinion that the lunches were reasonably priced did not differ significantly among participants and nonparticipants.

The authors speculated that parents' perceptions of the cost of a sack lunch versus the price of school lunch might influence participation in the lunch program. Percentages of parents who thought they could prepare a sack lunch for less money than the school lunch price were calculated for the various ethnic groups (black, whites, and Mexican-Americans), by poverty level and participation status. Overall, 43 percent of the sample thought they could prepare a sack lunch for less. This percentage varied among families below the poverty level (26 percent of the below-poverty participants and 41 percent of the below-poverty nonparticipants) and among families above the poverty level (31 percent of the participants and 62 percent of the nonparticipants). The results also varied by ethnic group, with the percentage being 27 percent for Mexican-Americans, 34 percent for blacks, and 44 percent for whites. Percentages were further tabulated among the above-poverty families at a variety of different prices to determine at which pricing level families thought they could prepare a sack lunch for less money than the school lunch. Nonparticipants consistently thought that they could prepare a sack lunch for less than the cost of the school lunch.

The authors suggest that several factors affected the families' response to this question: the mother's work status, perceived quality of the school lunch, and the management style of the parent all might influence the value placed on the sack lunch. Only among white families, however, did the authors find clearly significant statistical differences in participation status based on the price of the school lunch versus that of preparing a sack lunch. For this group then, the price of school lunch will, at some pricing level, be weighted against the expense of a sack lunch in terms of overall family food expenditures to determine participation.

B. *What Are the Effects of Participation on Family Food Consumption?*

The household survey in the Washington State Study (Price et al., 1975) included a series of questions related to the frequency of serving foods from 31 major food groups in order to detect patterns of family food consumption by ethnic group, income, and participation categories.

Analysis of variance was used to test the significance of differences among the means. In order to understand household food patterns more fully, principal components analysis with varimax rotation was used for all individual food items served by at least 20 percent and not more than 80 percent of the households in the sample. Several different analyses were run using different combinations of food items, for the entire sample and also separately by ethnic group. Factor scores for selected factors were then treated as dependent variables in regression analyses; socioeconomic variables and scores on the management style and psychological need scales were treated as independent variables.

Very few significant differences were found among the food consumption patterns of families with participating and nonparticipating children. For example, among below-poverty white families, participants differed from nonparticipants in four categories: higher percentages of participants served sandwiches, canned fruit and pudding, but lower percentages of participants served snacks. Among above-poverty blacks and whites, two significant differences appeared between participants and nonparticipants; high percentages of participants served soups and TV dinners. Other differences were found in the frequency of serving fruit juices, ethnic food, and some vegetables, but no clear patterns emerged. The authors suggested that many of the differences may be due to chance or regional variation. In fact, where significant differences were found, the direction of causality was uncertain; that is, certain food patterns in the home may influence participation or participation may influence food patterns at home.

C. *What Are the Effects of Participation on Social Interactions Among Family Members?*

One of the criticisms frequently aimed at the SBP is that serving breakfast has traditionally been a family responsibility, and having breakfast together fosters family unity and stability by promoting a healthy interaction among family members. However, no published research findings that examined this issue were identified. It may be difficult to isolate the effects of school nutrition programs on family interactions because other social trends, such as an increase in the number of working mothers, may have confounding effects on family structure and interactions (USDA, 1974). The complexity of examining such confounding effects may, at least in part, account for the dearth of research in this area.

SUMMARY OF FINDINGS CONCERNING FAMILIES

The Washington State Study (Price et al., 1975) appears to be the only major research that investigated program effects on families by engaging in primary data collection and analysis. Price et al. (1975) looked at the effects of children's participation in school nutrition programs on their families' food expenditures and food consumption. Participation in school meals that are provided free was found to have a fairly strong income supplementation effect. Price et al. (1975) reported that a dollar's worth of free school lunch resulted in an increase of 60 cents in the total value of household food used by eligible and participating families. Price et al. also compared the food consumption patterns of families participating and not participating in the NSLP. They found few significant differences between groups, and speculated that the observed differences might be due more to regional variations than to program effects.

A commonly mentioned barrier to establishing breakfast programs is that school breakfasts would interfere with a time traditionally set aside for families to be together and to "interact," but there is apparently no research that explores this presumption.

THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS

This section provides a brief review of research concerning the effects of the school nutrition programs on schools and school districts. If effects are interpreted to mean the effects of participation per se--i.e., the direct effects of program subsidies and regulations on schools and school districts--then no such research could be found. There have been numerous studies of factors influencing schools and districts to participate in the programs, (see Bentley et al., 1980, for a review), but no studies of the effects that the participation decision has on the schools and districts. These effects would vary, depending on whether these institutions would provide meal service in the absence of the federal programs. For institutions that would provide meal services even if the federal programs did not exist, the program subsidies may be used to reduce local expenditures, and may also increase student participation by lowering meal prices to full-price students as well as to students receiving free or reduced-price meals. Increased student participation, in turn, is likely to result in increased total operating costs but lower average (per meal) operating costs for the meal service. Schools and districts that have been induced to offer one or more types of meal service, by the presence of the federal programs, could have the effects just mentioned, as well as effects of stimulating the local economy due to increased local food purchases and other expenditures, increased employment, and sometimes investment in additional food facilities. Since the major direct effect of the federal programs is to reduce the cost of meal service to participating schools and districts, studies that examine the costs of school meal service would provide some indirect information on the direct effects of participation.

The lack of studies on the direct effects of participation is not surprising, since most schools and districts have participated in one or more of the programs for a long time. Those schools and districts that do not participate in any of the programs are atypical, and cannot be considered as an adequate comparison group for schools and districts that do participate. Without such a comparison group, it is impossible to separate the effects of participation in the school nutrition programs from the effects of inflation, increased unionization, demographic changes, and other factors influencing schools and school districts.

A number of studies have provided information on the effects of planned variations in program operations and procedures on schools and districts. Although there are many studies of this kind, we chose to present only a few relevant studies in order to illustrate the kind of research previously conducted. An additional study considers the overall role of the school nutrition programs in the national economy, and the effects of major changes in the programs on the economy. While this economic study does not address the question of program effects on schools and districts, it does consider the economic effects of the aggregate expenditures of local schools and districts on food, equipment, and personnel used in the school nutrition programs.

Each of the four studies reviewed here deals with a different aspect of the major question:

WHAT ARE THE EFFECTS OF THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS?

The first study considers changes in operational procedures that are totally at the discretion of the local school or district. The second study also considers variations at the local level, but within narrow guidelines established by FNS. The third and fourth studies consider changes that result from FNS policy regarding the school nutrition programs. As a group, the four studies explore the following effects of participation in the school nutrition programs:

- The effects of various food delivery systems on the cost, quality and acceptability of school lunches (Lough et al., 1978a and 1978b).
- The effects of alternative meal patterns on the cost, nutritional quality and acceptability of school lunches, and on food service operations (Harper et al., 1978).
- The effects of cash in lieu of commodities on food selection, and the cost and quality of meals (USDA, FNS, 1980).
- The economic effects of the school lunch program, and major variations in the current program, on business receipts, gross national product (GNP) and employment (Nelson & Perrin, 1976).

Food Delivery Systems

Colorado State University, under contract from FNS, conducted a pilot study to determine differences in four food delivery systems. The following delivery systems were considered:

- On-Site: food was prepared in individual schools and served there.
- Central/Hot: food was prepared in central kitchens and delivered to individual schools heated and in bulk.
- Central/Chilled: food was prepared in central kitchens, delivered to individual schools chilled and preportioned and then reheated.
- Frozen: meals were purchased frozen and preportioned; meals were heated at individual schools.

The results of this study were presented in four separate reports. Two of these reports describe the evaluation of the acceptability of menu items

(Harper et al., 1978) and the nutritional value of meals (Jansen et al., 1977) for each food delivery system. These reports are reviewed in Chapter V, Targeting of Program Benefits. The other two reports considered the physical facilities required for each food delivery system (Lough et al., 1978a) and the meal costs associated with each system (Lough et al., 1978b); these two reports are reviewed here.

The sample in the Colorado State University study consisted of 16 schools selected by FNS, including four schools with each type of delivery system. The sample was chosen from schools that volunteered to participate in the study; thus, the sample may not have been representative of all schools with these types of food delivery systems. The small sample size also made it less likely that significant results would be obtained. During a one-week test period, each school served ten specific food items. On-site data collection teams obtained samples of these food items for analysis, as well as data on physical facilities, costs, and plate waste.

Physical Facilities. A detailed description of the facilities was compiled for each food service. This description included a layout of all building space, including such fixtures as sinks, restroom facilities, floor drains, and exhaust systems. Separate inventories were compiled for both major and minor equipment, including both a description of the equipment itself and estimates of its purchase and installation costs. Both the actual number of meals produced during the week and the estimated potential production were determined for each food service. Facility requirements and costs were then computed on a per-meal basis using both the actual production level and the estimated production capacity.

The Frozen system required the least space per meal, while the Central/Hot system required the greatest space per meal. This was true for both actual and potential production levels. The Central/Hot system also had the highest facilities costs per meal for both actual and potential production levels;

the Frozen system had the lowest facilities costs at both levels. The On-Site and Central/Chilled systems were similar in their space requirements and facilities costs at both actual and potential production levels. The four Frozen systems had the greatest productive flexibility, operating at an average of 60 percent of productive capacity. The On-Site systems operated at an average of 67 percent of their capacity, while the Central/Hot and the Central/Chilled systems operated at an average of 75 percent of their capacities.

Meal Costs. Meal costs were analyzed in terms of labor cost, food cost, miscellaneous costs, and total costs. Summary sheets were prepared for all food service workers, indicating the number of minutes spent in preparation, serving, cleaning, transportation, supervision, and other functions. Each worker's time was then multiplied by the appropriate wage rate to determine the cost of labor devoted to each activity. Total labor costs were then divided by the number of meals prepared in order to determine per-meal labor costs. Food costs were determined by obtaining a list of all food items used during the week, together with the quantity and unit price of each item. Miscellaneous costs (including overhead) were determined by the school accounting office. Total costs included labor, food, and miscellaneous costs, plus the cost of space and equipment described above. Because space and equipment costs were estimated for both actual production and estimated capacity, total costs were also estimated for actual production and estimated capacity.

Meal costs for each of the four delivery systems were then compared using analysis of variance. Several statistically significant differences were found among the four systems:

- Preparation time and costs were greatest for the On-Site system and least for the Central/Chilled and the Frozen systems.

- The Central/Hot system had the greatest cleaning time and costs, while the Central/Chilled system had the least.
- Total labor costs and requirements were highest for the On-Site system, averaging 30.7 cents and 6.4 minutes per meal; the Frozen system required an average of only 13.6 cents and 2.4 minutes per meal.

Although the Frozen system showed the lowest average space, equipment, and labor costs per meal, the food costs were highest for this system. This was due to the fact that the food costs for this system already included a large portion of the other costs, such as preparation and transportation. This tended to cancel the advantages shown for this system in other areas, so that no significant differences among the four systems existed for total meal costs. The large variations in per-meal costs within each type of delivery system did suggest that substantial cost reductions might be realized through efficient design of the food delivery system and the choice of a food delivery system appropriate to local conditions.

Alternative Meal Patterns

Colorado State University also conducted a study of alternative meal patterns, under contract to FNS (Harper et al., 1978). Its purpose was to evaluate alternative menu planning approaches with respect to nutritional quality, plate waste, costs, and the opinions of students and food service managers. The comparisons of nutritional quality and plate waste are reviewed in Chapter V, Targeting of Program Benefits. The sample for this study consisted of 48 high schools selected by FNS from those volunteering to participate in the study. Thus, selection bias may keep this sample from representing all high schools.

The study consisted of two phases. During the first phase, which lasted four weeks, all schools used the Type A offer-versus-serve (OVS) menu pattern.

Under this meal pattern, students are offered choices from the five food items required for the Type A meal, but are required to select only three items for the lunch to be reimbursable. During the second phase, the 48 schools were assigned to three different groups. For the six weeks of the second phase, each group of 16 schools instituted one of the following meal patterns:

- Type A, in which students were required to select all five components.
- Basic Four, in which students were required to select one item from each of the four basic food groups.
- Free Choice, in which the only restriction placed on students' choices was a maximum meal size.

During the first two weeks of the second phase no data were collected since this period was assumed to represent a transitional period with atypical, short-term adjustments occurring.

Each school was visited by a data-collection team for one week during each phase of the study. Data were collected on food costs, other costs, and student participation. The data collectors verified the ingredients used in preparation of the lunches, took sample trays to determine serving sizes, recorded students' food selections and plate waste, and administered a questionnaire surveying student opinions. Approximately 40 to 50 students in each school were included in the food selection, plate waste, and opinion survey sample. The data collectors also collected data on labor utilization, interviewed the school lunch manager, and recorded their own subjective opinions regarding the lunch program at each school. In order to ensure operational uniformity among the schools, several regional briefings were held for the school lunch managers prior to the first phase of the study. The meal patterns were reviewed in detail for each school, schedules were confirmed, and data-collection and publicity materials were distributed. The procedures used to determine food and labor costs were the same as those described for the study of food delivery systems (Lough et al., 1978a and 1978b) above. The following statistically significant differences were found between Phase I--with the regularly used OVS meal pattern--and Phase II--with the Type A, Basic Four, and Free Choice meal.

- Labor requirements and costs per meal were lower for the Free Choice alternative than for the OVS pattern. This was primarily attributable to the 40 percent increase in student participation under the Free Choice alternative.
- Food costs, exclusive of commodities, were lower for the Free Choice alternative than for the OVS pattern.
- Total meal costs were also lower for the Free Choice alternative than for the OVS pattern. This reduction was also due to the large increase in participation under the Free Choice pattern.
- Students considered the Free Choice pattern to be the most preferred, OVS and Basic Four as intermediate, and Type A as the least preferred pattern.
- School lunch managers reported mixed reactions to all three variations that were tried in Phase II. They reported that food service staff considered the OVS pattern to be the easiest pattern to implement, and the Free Choice to be the most difficult. The preference for the OVS pattern is understandable, since this was the pattern with which the staff was most familiar. The major difficulties with the Free Choice pattern were the requirements for forecasting demand for individual items, pricing individual items, and determining reimbursements. (Because students paid different prices for different meals under Free Choice, a slightly different reimbursement pattern was used for this alternative.)

The only major differences observed in this study were between the OVS pattern and the Free Choice alternative, which represented the most radical departure from the OVS pattern. The fact that the study only allowed six weeks of operation for each alternative pattern used in Phase II may have prevented other significant differences from being observed. It may well be that additional significant differences would appear after a meal pattern was in use for a period of time, and initial implementation problems were worked out.

Cash in Lieu of Commodities

The concept of providing schools with cash payments in lieu of commodity donations had been examined in two previous studies. The first of these studies (USDA, ERS, 1975) indicated that, while the largest school districts could purchase food for about the same prices paid by USDA, smaller districts paid substantially higher prices. The second study (Erickson, 1977) compared local and state lunch costs in Kansas, which received cash in lieu of commodities, and Oklahoma, which received commodities. While local costs were approximately the same, state administrative expenses were over three times as great in Oklahoma as in Kansas. Because of major differences between the two states, it was later concluded that this difference could not be attributed solely to the use of cash-in-lieu by Kansas. In order to resolve this issue and to provide information on other questions about cash-in-lieu, Congress mandated a pilot study of this alternative to the present commodity distribution program (USDA, FNS, 1980). The mandate for this study fixed the sample size at ten local projects. It also called for an analysis of state costs for such a program. The wording of the mandate effectively restricted this part of the study to a comparison between Kansas, which had been receiving cash in lieu of commodities since fiscal year 1975, and a state that received commodities. Colorado was chosen for this comparison because its food service was similar to that of Kansas, except for the use of commodities.

For the analysis of local costs and operations, eight school districts were selected from approximately 50 that had indicated willingness to participate in the study (in response to a notice in the Federal Register). The voluntary nature of this sample may have induced selectivity bias, making the sample unrepresentative of schools in general. All of the treatment schools received commodities prior to the study. They discontinued the use of commodities on July 1, 1978, and received cash in lieu of commodities for the 1979 fiscal year. After the completion of the experiment, they reverted to receiving commodities. The temporary nature of the change may have prevented them from adjusting to the use of cash in lieu of commodities, thus either causing certain operational problems or restricting the implementation of operational changes to facilitate the use of cash-in-lieu. To avoid contaminating the state data, none of the eight school districts was located in either Kansas or Colorado. Two additional schools, one in Kansas and one in Colorado, were used as controls. No changes were instituted in these school districts, the Kansas district continuing to receive cash in lieu of commodities and the Colorado district continuing to receive commodities.

A four-part questionnaire was mailed to the school districts participating in the study to collect data for October 1977 (prior to participation in the cash-in-lieu experiment) and October 1978 (after the eight sites had been participating for several months). The first part of the questionnaire addressed characteristics of the districts, costs, and student participation; the second part was directed to procurement and quality control practices and costs; the third part addressed food use patterns and costs; and the fourth part, collected only at a subsample of schools, requested detailed information on food, labor, and other costs. Plate waste data were also collected for a sample of students. Information on state and federal administrative expenses was collected during interviews at the federal, regional, and state levels.

Local costs--including food, labor, other, and total costs--were compared for October 1977 and October 1978 to examine differences associated with participation in cash-in-lieu. October 1978 data were adjusted for price changes since October 1977. While food costs decreased in six of the eight districts participating in cash-in-lieu, they also decreased in the Colorado districts, which operated on the commodity distribution program for both years. The authors suggest that food costs in many districts decreased from 1977 to 1978 and that the decreases exhibited by the six participating sites cannot be attributed solely to cash-in-lieu. Labor costs appeared to increase among the cash-in-lieu sites, although the authors acknowledge that problems with the data and other extraneous factors make analysis of these costs inconclusive. Similarly, no definitive conclusions were drawn about other costs. Overall, no consistent trends in costs were found in the study. This suggests that either cash-in-lieu had no significant effect on costs or that the effect was not strong enough to isolate from the confounding effects of other factors.

Another area of analysis examined the effects of cash-in-lieu on state and federal administrative expenses. State administrative costs were compared for Kansas, which operated solely on a cash-in-lieu basis, and for Colorado, which operated under the commodity distribution program. Administrative costs on a per-lunch basis were lower in Kansas than Colorado. The authors projected that if Colorado switched to cash-in-lieu there would be a reduction of approximately 30 percent in administrative expenses. Such savings cannot necessarily be expected in other states. The savings at the federal and regional levels associated with a change from the current commodity distribution program to a program operating fully on cash-in-lieu were also estimated. Such a changeover would eliminate most of the current shipping costs and would require fewer employees at the federal and regional levels. The authors estimate a net savings of $36 million annually.

Overall, the study identified few significant impacts associated with cash-in-lieu. This may be related more to the limitations of the study than to the operations of cash-in-lieu. The limitations are clearly identified in the report and include the following:

- The sample size of ten (which was mandated by Congress) was too small to draw statistically sound conclusions for types of districts, regions, or the country.
- Since the districts were selected from applications submitted to USDA, the sample may be subject to selectivity bias.
- The study period of one year may have been too brief to expect significant impacts to occur.
- Confounding factors, such as a teachers' strike in one of the participating districts and rapid changes in food prices during the study period, may have caused difficulties in isolating the effects of cash-in-lieu.

The approach taken in the study was basically that of analyzing case studies. The results, therefore, provide implications for cash-in-lieu in only a few specific settings and cannot be generalized for any larger groups.

Economic Effects

The effects of the National School Lunch Program on the U.S. economy were estimated in a study by the Economic Research Service (Nelson & Perrin, 1976). Although this study did not deal directly with the effects of the program on schools and districts, the economic effects with which it deals are primarily the result of food and equipment purchases by schools and districts, federal contributions to these purchases, and federal commodity donations to schools and districts. Results of the study are presented for two years: calendar year 1972 and fiscal year 1974. The first year was used as the basis for most of the initial calculations and adjustments, while the second year was the most recent year that had the data needed for estimation of effects. An adjusted version of the U.S. Department of Commerce input-output model of the U.S. economy was used for this study. This model produced estimates of the effects of the program itself, and of certain major variations in the program, on business receipts, gross national product (GNP), and employment by sector of the economy. The following three alternatives to the National School Lunch Program were considered:

- Universal Free Lunch: All students would be eligible for free lunches.
- Reduced-Price Lunch: Students currently eligible for free lunches would continue to receive free lunches, while all other students would receive reduced-price lunches.
- Free Lunch Only: Federal subsidies would be restricted to those students currently eligible for free lunches.

Economic consequences of the alternatives were based on estimates of participation and program cost derived in the Comprehensive Study of the Child Nutrition Programs (USDA, 1974).

Table IV-4 summarizes the findings for the current NSLP. This table shows the total increases in business receipts, GNP, and employment attributable to the cash and commodity contributions of the NSLP, together with the combined impact of both cash and commodities. When these totals are disaggregated, it appears that the largest increases in business receipts occurred in the food manufacturing sector, specifically in the dairy products, meat and poultry products, and canned and preserved foods sub-sectors. The agriculture, forestry and fisheries sector also showed a significant increase in receipts, while the finance, insurance and real estate sector and the retail trade sector showed significant reductions in receipts. The largest number of jobs attributable to the school lunch program were located in the agriculture, forestry and fisheries sector, with food manufacturing a distant second. Only the retail trade sector showed a significant decrease in employment as a result of the program.

Table IV-4. Economic Effects of the National School Lunch Program

	Calendar Year 1972			Fiscal Year 1974		
Increases Due To:	Business Receipts ($1,000)	GNP ($1,000)	Jobs	Business Receipts ($1,000)	GNP ($1,000)	Jobs
Federal Cash Contributions	428,608	297,189	19,726	573,194	397,534	26,383
Federal Commodity Purchases and Contributions	409,642	50,339	13,247	409,155	50,213	12,052
Total Federal Contributions	838,250	347,528	32,973	982,349	447,747	38,435

Table IV-5 compares the three alternative proposals to the current NSLP. It was estimated that the Universal Free Lunch alternative, which would require the greatest increase in federal support and would yield the greatest increase in participation, would yield the largest additions to business receipts, GNP, and employment. The Reduced-Price Lunch program would yield small increases in receipts, GNP, and jobs, and the Free Lunch Only program (which would lower both participation and federal contributions) would produce slight decreases in all three areas. The distribution of all these changes across different sectors of the economy was similar to the distribution of impacts for the current program, e.g., the largest impact on business receipts was in the food manufacturing sector, and the largest impact on employment was in the agriculture, forestry, and fisheries sector.

Table IV-5. Comparison of Economic Effects of Alternatives to the Current National School Lunch Program

	Estimated Changes from Current Program Levels: FY 1974		
Alternative Program	Business Receipts ($1,000)	Gross National Product ($1,000)	Jobs
Universal Free Lunch	+1,163,400	+808,910	+53,562
Reduced-Price Lunch	+ 377,350	+262,072	+17,371
Free Lunch Only	- 99,524	- 69,073	- 4,582

All estimates were based on the assumption that both the cash and commodity contributions to the programs were financed from federal taxation of the household sector. The reported effects represent the net impact of the program, after adjusting for these taxes. The input-output model used for this study implicitly assumes that all changes resulting from the program reflect real changes in the economy, rather than nominal changes. That is, a change of $1 million could represent any combination of increased production and inflation that totals $1 million; the model assumes that such a change represents $1 million in increased production only. The estimates are also based on the assumption that the only school lunch program is the National School Lunch Program, and that no school lunch programs would exist in the absence of this federal program. The last two assumptions tend to exaggerate the estimated impact of the program, the first by including monetary changes and the second by ignoring alternative non-USDA programs.

SUMMARY OF FINDINGS CONCERNING SCHOOLS AND DISTRICTS

The studies of program variations discussed in this section (Harper et al., 1978; Lough et al., 1978a, 1978b; USDA, FNS, 1980) all share the same three methodological problems: small sample sizes, self-selection of the sample (i.e., all schools were chosen from a relatively small number of schools that volunteered to participate in the studies), and a short time period for experimental variations to have an effect. Although these problems and others (see Bentley et al., 1980) limit the generality of the results obtained by these studies, the conclusions drawn by these researchers can be summarized as follows:

- The labor, equipment, and food costs associated with different delivery systems (on-site preparation, central preparation with hot bulk delivery, central preparation with chilled preportioned delivery, and purchase of frozen preportioned meals) were found to vary significantly, even though no significant differences were found in per-meal costs across systems.
- Food and labor costs were reported to be significantly lower when students were allowed free choice in their food selection, compared to the Type A offer-versus-serve menu pattern. However, the effort required for planning and serving meals under free choice was found to be higher.
- In the study comparing schools receiving commodities and schools receiving cash in lieu of commodities, no significant differences were found. However, state administrative costs were lower in Kansas, where all schools received cash in lieu of commodities, than in neighboring Colorado, where no schools received cash-in-lieu.

The final study used input-output analysis to evaluate the effects of the school lunch program on the national economy (Nelson & Perrin, 1976). There are two significant limitations on the results of this analysis. First, the model does not consider the possibility that many schools and districts would continue to offer lunch programs in the absence of the federal subsidy; the analysis essentially assumes that the programs would disappear if federal subsidies were removed. Second, the increases in business receipts and gross national product attributed to the program include both real increases in production and increases in the prices of the goods and services purchased by the programs (primarily food). After describing the limitations on the results, the authors examined the effects of the school lunch as currently defined, and compared its effects with the estimated effects of three alternative lunch programs:

- Universal free lunch to all students;
- Free lunch to all students currently eligible and reduced-price lunch for all other students; and
- Federal subsidies limited to those students currently eligible for free lunches.

The effects of the current lunch program on the national economy were estimated for both calendar year 1972 and fiscal year 1974. These effects included the following:

- An increase in gross national product (GNP) of approximately $348 million in calendar year 1972 and $448 million in fiscal year 1974;
- An increase in business receipts of approximately $838 million in calendar year 1972 and $982 million in fiscal year 1974, concentrated primarily in the food manufacturing sector and the agriculture, forestry and fisheries sector, with decreased receipts in the financial, insurance and real estate sector and the retail trade sector;
- An increase in total employment of approximately 33,000 jobs in 1972 and 38,000 jobs in fiscal 1974, primarily in the agriculture, forestry and fisheries sector, with smaller gains in food manufacturing and a small loss of employment in the retail trade sector.

The authors estimated that if the universal free lunch alternative had been in operation in fiscal 1974, an additional $1,163 million in business receipts, $809 million in GNP, and 54,000 jobs would have resulted. The universal reduced-price lunch with a free lunch option would have resulted in smaller gains, while the limitation of federal subsidies to the free lunch program would have reduced business receipts, GNP, and employment slightly.

145

SUMMARY OF CHAPTER V. TARGETING OF PROGRAM BENEFITS

This chapter examines selected topics concerned with the targeting of services by the school nutrition programs. These programs have broad legislative mandates to serve the entire school-age population; however, recent program history shows a program emphasis on meeting the nutritional needs of the poor.

The term "targeting" has a positive connotation, and implies : only aiming at a target but hitting it. There are two different, but related, ways in which the term can be used. In one sense, the targets of the program are children who would not otherwise have adequate diets. In this sense, targeting refers to the goal of delivering program benefits to groups with particular economic or nutritional needs: All children need appetizing and nutritious food, but children obviously differ in terms of the extent to which their families and communities have the resources and nutritional knowledge to assure that attractive, well-balanced meals are available. In another sense, the meals themselves are the target of the programs. In this sense, targeting refers to the goal of ensuring, through program regulations and policy guidance, that school meals meet the best standards of nutritional adequacy.

Like all chapters in this document, Chapter V is organized around a series of questions. For each question, we review the relevant research literature that meets the criteria set forth in the Introduction. The chapter has two main questions:

1. *HOW ARE SCHOOL NUTRITION PROGRAMS TARGETED?*

This question is addressed through two sub-questions, one concerned with the criteria for free and reduced-price meals and the other concerned with multiple participation of families in federal food assistance programs other than the school nutrition programs.

A. *Do Family Size and Income Criteria Identify Children at Nutritional Risk?*

Each year, the Secretary of Agriculture issues eligibility criteria that are used by participating schools to determine which students are eligible for free or reduced-price meals or for free milk under the Special Milk Program. As discussed in Chapter I, these eligibility criteria provide the principal means for ensuring that needy students have access to the programs. The eligibility criteria are based on the poverty income guidelines issued each year by the Office of Management and Budget (OMB) for families of various sizes. The current free and reduced-price eligibility criteria are set at 125 percent and 195 percent, respectively, of the OMB poverty income guidelines for non-farm families. (Prior to January 1, 1981, the USDA eligibility criteria included a semiannual cost-of-living adjustment for changes in the Consumer Price Index between the time that the OMB guidelines were issued and the time that school began; this adjustment was eliminated under PL 96-499.)

Since it is well known that indices of poverty and nutritional risk are correlated, as shown in Chapter III, the general answer to the research question is "Yes." However, it would also be useful to answer a more difficult question: whether the current eligibility criteria are optimal in some sense--for example, whether they identify a higher proportion of children at nutritional risk than other kinds of income criteria. No research was found that bears on such a question; however, it is the kind of question that needs to be addressed for purposes of justifying or changing program policies on the eligibility criteria.

We did find two studies that examine the match between the eligibility criteria existing in the early 1970s (when the studies were conducted) and indices of nutritional risk (Emmons et al., 1972; Paige, 1971). These studies found that the family size and income criteria did not invariably identify students at nutritional risk, and that many students from affluent or relatively affluent families were nutritionally needy. However, as reported by Emmons et al., a higher proportion of eligible students (36 percent) than ineligible students (26 percent) were found to be nutritionally needy. Since these two studies were conducted, eligibility criteria have been revised and made nationally uniform, but it is likely that any choice of cut-points would yield numerous false positives (nutritionally non-needy poor students) and false negatives (nutritionally needy affluent or relatively affluent students), owing to the intrinsically low correlation between indices of poverty and nutritional need. Thus, economic criteria cannot be fully substituted for nutritional criteria in identifying the nutritionally needy. However, it may be possible to have a better match between the eligibility criteria and nutritional risk.

Another question that could be asked is whether the school nutrition programs are meeting the nutritional needs of certain subgroups that may be at particular risk, such as Indians, migrant workers, and pregnant teenagers. There is some evidence, reviewed in Chaper III, that certain kinds of nutritional problems are more prevalant among blacks, teenagers, or other identified subgroups; however, we found no studies that focused on the targeting of the programs to such subgroups.

B. *To What Extent Do Families Participate in More Than One Federal Food Assistance Program?*

Many families qualifying for free or reduced-price meals also qualify for other federal assistance programs intended, in whole or in part, to aid needy families in securing adequate diets. In addition to the school nutrition programs, these federal assistance programs include Food Stamps; Supplemental Feeding Program for Women, Infants and Children (WIC); Child Care Food Program (CCFP); Nutrition Program for the Elderly; and Summer Food Program for children.

It should not be assumed, simply because family members obtain food benefits from more than one program, that the family as a whole is being assured an adequate diet. Thus, the legitimate targeting issues concerned with multiple program participation are (1) the extent to which it occurs, and (2) whether the combined package of nutritional benefits available to families of various types is adequate, less than adequate, or more than adequate. Congress obviously intends for the programs to be adequate but has not defined how adequacy should be evaluated.

Studies that have examined the extent of multiple program participation have reported that it is very common. For example, a survey of food stamp families indicated that 38 percent had children receiving free or reduced-price lunches (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1974).

Another survey of low-income families indicated that 66 percent participated in more than one assistance program (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1973). More examples could be cited, but these reports of overlap do not indicate whether the obtained program benefits are complementary or duplicative in nature, or whether the programs are effective in improving the nutritional well-being of the participants.

Two studies attempted to assess the nutritional adequacy of the benefits that could theoretically be received by families that participate in all of the federal assistance programs for which they qualify. In the first study, the General Accounting Office (GAO) used the USDA Thrifty Food Plan as a yardstick for diet adequacy. Using particular family configurations, GAO concluded that anywhere from 21 to 230 percent of a family's nutritional needs could be met by combinations of the existing programs (Comptroller General of the U.S., 1978). In a detailed rejoinder, USDA (1978) pointed out that the Thrifty Food Plan does not in fact provide an adequate diet, as GAO had assumed, and usually cannot be obtained at the market prices GAO had estimated. Most of the computational assumptions of the GAO report were questioned by USDA, and while GAO included parts of the USDA memo in the text of its report, most of the USDA criticisms were neither refuted nor addressed. Instead, GAO defended its report as a first attempt at addressing legitimate concerns about the adequacy of the diets available to needy families, and called for a study to determine the precise extent of program overlaps and gaps, the economic value of various combinations of program benefits, and the nutritional value of diets actually and theoretically available to participants in various programs.

The second study used the USDA Low Cost Food Plan (which is regarded by USDA as providing a more adequate diet than the less expensive Thrifty Food Plan) as a yardstick for diet adequacy (Temple-West & Mueller, 1978). Using a variety of family configurations (limited in size to three or four members), the authors attempted to compare the cash value of food or food stamps received from federal assistance programs with the market price of the Low Cost Food Plan. They concluded that healthy families with young children could meet their nutritional needs, but that families with adolescent children, adult males, elderly adults, or members needing nutritional supplementation could not meet their nutritional needs through the combination of federal food assistance programs available to them. Unfortunately, Temple-West and Mueller did not discuss their estimation procedures in sufficient detail to assure that they did not make some of the same kinds of errors that plagued the GAO report on multiple program benefits. As the GAO report and USDA reply indicate, it is not at all simple to "add up" benefits received from various programs or to establish the real price of an adequate diet for families of various kinds. In order to address this question, fundamental information is needed about the kinds of diets actually available to needy families and about the real nutritional benefits available from assistance programs. The Consumer and Food Economics Institute (CFEI) of USDA is currently analyzing data from the Nationwide Food Consumption Survey of 1977-1978, an exhaustive survey of the food consumption and household expenses of the American population. The CFEI analyses are expected to provide estimates about the cost of nutritionally adequate diets that are more realistic than the ones currently available.

2. *DO THE SCHOOL NUTRITION PROGRAMS MEET THE NUTRITIONAL NEEDS OF SCHOOL-AGE CHILDREN?*

For this major question. the targets of the program are considered to be the meals that serve the nutritional needs and meet the nutritional problems of school-age children. There are three sub-questions: one concerned with the nutrient content of school breakfasts and lunches as served and as consumed; a second concerned with nutrient content for nutrients that are commonly deficient in school-age diets; and a third concerned with USDA responses to the findings of nutritional studies, which make the programs more responsive to advances in nutritional knowledge and to the needs of program participants.

A. *What is the Nutrient Content of School Meals?*

There have been numerous studies of the nutrient content of school lunches, but only one study of school breakfasts. For all nutrients except energy (calories), USDA's goal for the school lunch is that it should meet one-third of the recommended dietary allowances (RDA). RDA are presented as daily "intakes of nutrients that meet the needs of healthy people" (National Research Council, 1980, p. 8). The rationale for the one-third RDA goal is that three meals per day are traditional in our culture; thus, if the school lunch provides one-third of RDA, it is doing its "share" in providing an adequate daily diet. Obviously, this one-third goal is reasonable only as an average. There are disadvantaged students for whom school meals represent the only nutritious food that is available; there are other students whose consumption of between-meal snacks is so high that the school lunch adds calories to what may be an overconsumption of energy and may or may not add needed nutrients.

USDA has no formal dietary goal for energy. Most studies have found that the energy content of school lunches is on the order of 20 to 25 percent of RDA. In view of concern about obesity as a health risk, low energy intake may actually be desirable, provided that adequate intakes of other nutrients are available.

For the school lunch, one or more studies found:

- Reimbursable meals provide adequate amounts of protein, vitamins A, C, and D, riboflavin, niacin, vitamin B_{12}, calcium, iodine, and phosphorus.
- The principal nutrients found to be deficient in school lunches, both as served and as consumed, were iron and thiamin.
- RDA have only recently been established for folic acid, vitamin B_6, magnesium and zinc. Reliable food composition data are not available for these nutrients, which makes them difficult to study. Folic acid has not been studied in school meals. In the two studies that examined the vitamin B_6, magnesium and zinc content of school lunches, data were obtained by chemical analysis. All three nutrients were found to be below the goal of one-third of the RDA.

USDA has no formal RDA goal for the nutrient content of school breakfasts. In the single study of the school breakfast, the researchers adopted one-fourth of the RDA as a "reasonable yardstick," perhaps with the rationale that while breakfast is one of the traditional three meals in our culture, it is often lighter than the lunch or evening meal (Opinion Research Corporation, 1979). At the time this study was conducted, program regulations allowed three different breakfast patterns that qualified for reimbursement, and the focus of the study was as much on comparing the three patterns as on assessing the general adequacy of the breakfasts.

- Overall, the breakfasts as consumed did not meet the goal for vitamin A and iron, and for elementary students, they did not meet the goal for thiamin, calcium (females only), or phosphorus.
- Additionally, the energy content was consistently below one-fourth RDA.

- One of the three breakfast patterns--the "grain-fruit" pattern which consists of a fortified cake-like product and milk--provided one-fourth RDA for all indicator nutrients and less than one-fourth RDA for energy, with little plate waste.

As the study of school breakfasts indicates, it is possible to meet almost any reasonable dietary goal for vitamins or minerals, using fortified foods or vitamin supplements. However, it is a fundamental nutritional principle that "RDA are intended to be met by a diet of a wide variety of foods rather than by supplementation or by extensive fortification of single foods" (National Research Council, 1980, p. 1).

The recent USDA/USDHEW (1980) dietary guidelines recommend that Americans reduce consumption of fats (especially saturated fats and cholesterol), sugar, sodium, and alcohol, and that they consume a variety of foods, including foods with adequate starch and fiber. The dietary guidelines are expressed in terms of macronutrients rather than in terms of the individual vitamins and minerals stressed in the RDA. While none of the studies of the school nutrition programs has focused primarily on these macronutrients, some of them have been discussed in a few studies. Nutritionists recommend that proportion of energy from fat be limited to 30 or 35 percent. Three studies of the school lunch reported that fat constituted from 38 to 43 percent of energy, which is somewhat high. Only one study published values on sodium in the school lunch (Murphy et al., 1968, 1969, 1970). The average sodium content was 1,466 mg; for children of the ages studied by Murphy et al., one-third of the recommended safe and adequate daily allowance is from 300 to 900 mg (National Research Council, 1980). No studies were found that differentiated between saturated and unsaturated fat or that reported levels of cholesterol, sugar or fiber in school meals.

Thus, the apparent nutritional problems in school meals (primarily in school lunches) are low iron and thiamin, and excessive fat and sodium. Vitamin B_6, magnesium and zinc may also be low, but only a few studies have assessed these nutrients.

It should be noted that the studies reviewed in this chapter were conducted over the period 1966-1979, during which the RDA changed three times (1968, 1974 and 1980; the 1980 changes available in draft form in 1979). The state of the art in the assessment of nutrient content of foods also advanced, as nutrient data bases were updated and made more complete in terms of both food items and nutrients. Additionally, the school nutrition programs were continually changed and improved in order to make them more responsive to students' needs. Thus, the research reported in this chapter has been conducted during a time of growth in nutritional knowledge and of adaptation of the programs to changing legislative mandates, nutritional beliefs, and student needs.

B. *Do School Meals Contain Adequate Amounts of Nutrients That Are Deficient in the Diets of School-Age Children?*

The previous question focuses on the nutrient content of the school meals in general, while the present question focuses on whether the school lunch is adequate for specific nutrients and macronutrients that have been associated with particular nutritional problems found in school-age children, as reviewed in Chapter III.

- Vitamin A, vitamin C, calcium, and iron are nutrients that are of general concern, because research indicates that the diets of some groups of American children do not meet the RDA for these nutrients. The research indicates that school lunches provide over one-third RDA for all except iron.

  Iron intake is consistently a problem in dietary surveys, and iron deficiency anemia is considered to be one of the most common nutritional diseases. It has proved difficult to bring iron up to the one-third RDA goal, however, partly because increasing the required quantities of foods rich in iron may have undesirable side effects. Increasing requirements for bread and bread products, for example, would also increase energy intake, while increasing meat would also increase the fat and cholesterol in the diet.

- Vitamin B_6, magnesium and zinc have also been found to be below the RDA in some studies of school-age children. Research on the content of school lunches for these nutrients is limited but findings suggest that the levels may be less than one-third RDA.

- The principal thiamin deficiency disease is beriberi, which is extremely rare in the United States. Diets of school-age children are usually shown to be adequate in this nutrient. Thus, while thiamin is consistently under one-third RDA in studies of the school lunch, thiamin is not considered a major nutritional problem. The principal source of dietary thiamin is whole grain and enriched bread and cereals. An increase in these products would also increase energy intake.

- Overconsumption of energy, salt, fat, cholesterol, and sugar are also concerns. Research indicates that energy content of school lunches is acceptable, but that sodium and fat content are high. Cholesterol and sugar content have not been studied. Recent changes in the school lunch pattern are aimed at reducing levels of all five of these dietary constituents.

C. *What Response Has USDA Made to the Findings of Nutritional Studies?*

USDA constantly monitors significant research bearing on the school nutrition programs, and is aware of program features that require adjustment in order to improve the targeting of program services. As part of its ongoing program of evaluation research, USDA has sponsored studies of alternatives to the traditional Type A meal pattern. One such alternative is the "nutrient standard" or "computer-assisted nutrient standard" (CANS) approach to menu planning, in which menus are designed by systematically selecting foods on the basis of nutrient content to meet nutrient goals, without necessarily adhering to the traditional "basic four food groups" of the Type A pattern. Studies of this alternative indicate that the nutrient standard is more accurate than the Type A pattern in meeting the RDA goal for most nutrients, but that it does not improve the ability of the school meals to meet the one-third goal for iron and thiamin.

In 1975, USDA introduced the Type A offer-versus-serve (OVS) provision in senior high schools, allowing their students to select only three of the four type A components and still qualify for reimbursement. This provision was intended to increase the acceptability of school meals, thereby reducing plate waste. In 1978, OVS was extended to junior high schools and intermediate grades. An evaluation of OVS found that it did not differ significantly from the Type A pattern in terms of the nutrient content of lunches (Harper et al., 1978).

In January 1980, final regulations were issued for controlling the sale of foods competing with school meals. These regulations established nutrition standards for competitive foods and defined foods of minimal nutritional value. Sale of foods having minimal nutritional value was restricted until after the last lunch period. These regulations were aimed at assuring that the food available in USDA schools, whether under USDA auspices or not, met minimal nutritional standards.

Between 1976 and 1980, USDA made numerous efforts to modify the Type A meal pattern itself. After extensive review and study of the proposed and interim regulations, final regulations were issued in two parts (Federal Register, August 17, 1979 and May 16, 1980):

- The list of bread alternates was expanded to include additional cereal products such as bulgur, corn, grits, pasta, and enriched and wholegrain rice, in order to increase variety in school meals and allow many traditional cereal products to be reimbursable.
- Unflavored low-fat, skim, or buttermilk were required to be offered in school lunches to provide students the option of reducing fat intake by choosing these alternates.
- Students and parents were required to be involved in the planning of the school food programs, since student and parent involvement is usually found to be associated with higher participation and lower plate waste.

- Several goals were recommended for menu planning, in keeping with current nutritional advice:
  - Including several foods with iron each day, vitamin A food at least twice a week, and vitamin C food several times a week;
  - Offering a variety of foods from which children may choose a reimbursable meal; and
  - Keeping fat, sugar, and salt at moderate levels.
- Schools were encouraged to vary portion sizes, to provide larger portions to older children, and smaller portions to younger children who request them.
- The required quantities of certain meat alternates (eggs, beans, and peas) were increased so that they would provide the same amounts of protein as the portions for meat and the other meat alternates.
- The bread requirement was changed to increase the number of servings required from five to eight slices per week, with the aim of increasing the amounts of iron, thiamin, riboflavin, niacin, and vitamin B_6 in the meals. As discussed in the final regulations, USDA recognized that this would increase energy to some extent, but it was felt that the advantages outweighed the disadvantages.

Since the cumulative effect of these changes has altered the Type A pattern significantly, the term "Type A pattern" has been dropped in favor of "school lunch pattern" or "reimbursable meal."

CHAPTER V. TARGETING OF PROGRAM BENEFITS

Lawrence A. Jordan
Kathryn Nelson
Joyce Vermeersch

Targeting refers to the goal of delivering program benefits to groups with particular economic or nutritional needs. The enabling legislation for the school nutrition programs gives them a broad mandate to serve the entire school-age population. The National School Lunch Program (NSLP) was intended "to safeguard the health and well-being of the Nation's children" (Section 2, National School Lunch Act, 1946). The Special Milk Program (SMP) was intended "to encourage consumption of fluid milk by children in the United States" (Section 3, Child Nutrition Act, as amended, 1970). Through the free and reduced-price meal provisions of the NSLP and the free milk provisions of the SMP, however, the Congress has also recognized the special needs of poor children. Presumably children with economic needs are more likely to have nutritional needs, but as shown below, the match between economic and nutritional needs is far from perfect.

The School Breakfast Program (SBP) has had a shifting mandate. At first, the program was intended as a pilot program, primarily for poor children (Section 4, Child Nutrition Act, 1966). In the early stages of program development, the states were given the following priorities in allocating federal resources:

> In selecting schools for participation, the State educational agency shall, to the extent practicable, give first consideration to those schools drawing attendance from areas in which poor economic conditions exist, to those schools in which a substantial proportion of the children enrolled must travel long distances daily, and to those schools in which there is a special need for improving the nutrition and dietary practices of children from low-income families (Section 4, Child Nutrition Act, as amended, 1971).

The SBP had free and reduced-price meal provisions from its inception, and also allowed USDA to provide additional funds to cover up to 80 percent of operating costs for schools with "severe need." Thus, the SBP enabling legislation recognizes the special needs of children from low-income families. More recently (1975), the legislation that provided permanent authorization for the SBP expanded the program's focus to include all children.

In a recent review of federal food policy, Austin and Hitt (1979) examined populations that are at risk nutritionally in the United States. The authors indicated that low-income populations as well as populations with poor food consumption patterns may be at nutritional risk:

> For several reasons, not the least of which was the failure until the late 1960s to recognize and accept that there are many hungry people in the United States, an exact determination of who is undernourished in the general population is still not available. However, evaluation of the existing data has led many observers, including panels from the 1969 White House Conference on Nutrition, to conclude that certain groups are at higher risk for undernutrition. These groups include low-income people, pregnant and lactating women, infants and preschool children, Indians, migrants, rural poor in Appalachia and the South, the elderly, and people with illnesses, including patients in hospitals.
>
> While nutrient deficiencies exist at most income levels, the poor are clearly at the greatest nutritional risk. In addition to insufficient income, other factors such as food habits, food composition and prices, and nutrition knowledge play a role in determining the quality and quantity of food consumed (Austin & Hitt, 1979, pp. 2-3).

The school nutrition programs currently use family size and income criteria based on the Census Bureau poverty income guidelines to identify children who are eligible for free and reduced-price meals. One purpose of providing free and reduced-price meals is to encourage participation in program services by the population that is assumed to be most nutritionally needy. All children enrolled in schools that offer the programs are eligible to purchase meals at the federally subsidized "full price," but children from poor families are encouraged to participate by the provisions for free or reduced-price meals. The use of family income as the eligibility criterion for free and reducedprice meals can be justified on several grounds. The cost of meals is more likely to be a barrier to participation for children from low-income families than for children from more affluent families; accordingly, free and reduced-price meals are likely to be a greater incentive to participation for children from low-income families. Low family income is also likely to be associated with nutritional deficiencies. However, our initial findings on the nutritional status of school-age children (see Chapter III) suggest that while low family income may place children at greater nutritional risk, nutritional problems are not limited to low-income families. Thus, the targeting of free and reduced-price program services purely on an income basis would not include all nutritionally needy children.

Two recent General Accounting Office (GAO) studies have discussed the issue of program targeting (Comptroller General of the United States, 1977, 1980). The 1977 GAO study acknowledges that income guidelines may be the best known means of selectively targeting program services to the nutritionally needy, but urges the identification of other characteristics that indicate nutritional need. In addition, the study discusses whether the food served in the school food programs meets the nutritional needs of school children. For example, iron deficiency anemia has been identified by several nutrition surveys as a problem for adolescent females, and the extent to which this problem is addressed by the types of food served in the school programs is of interest. The GAO suggests that by modifying the nutritional standards tha guide the school meal patterns, the targeting of program food services to meet the nutritional needs of schcol children would be improved.

The 1980 GAO study of the School Breakfast Program discusses the use of family size and income criteria to identify nutritionally needy children and states:

> ...it may be inaccurate to presume all children from families with incomes below a certain level are nutritionally needy or that their parents do not feed them breakfast. On the other hand, changes in food technology and students' eating habits are casting some doubt on the assumption that children from middle- and upper-income families are well-nourished (Comptroller General of the U.S., 1980, p. iii).

The literature reviewed in this chapter addresses both of these targeting issues (i.e., providing specific foods through the programs to meet the nutritional needs of the school population, and using income criteria for receipt of free and reduced-price meals to improve the targeting of the programs for nutritionally needy children).

Our review was guided by the following research questions:

<u>*HOW ARE SCHOOL NUTRITION PROGRAMS TARGETED?*</u>

A. <u>*Do Family Size and Income Criteria Identify Children at Nutritional Risk?*</u>

B. <u>*To What Extent Do Families Participate in More Than One Federal Food Assistance Program?*</u>

<u>*DO THE SCHOOL NUTRITION PROGRAMS MEET THE NUTRITIONAL NEEDS OF SCHOOL-AGE CHILDREN?*</u>

A. <u>*What Is the Nutrient Content of School Meals?*</u>

B. <u>*Do School Meals Contain Adequate Amounts of Nutrients That Are Deficient in the Diets of School-Age Children?*</u>

C. <u>*What Response Has USDA Made to the Findings of Nutritional Studies?*</u>

These questions have also been used to structure the presentation of findings.

In order to identify all references relevant to targeting issues, bibliographic searches were conducted and studies were included that meet the review criteria. In addition, we reviewed USDA efforts to improve program effectiveness by improving the targeting of program benefits.

HOW ARE THE SCHOOL NUTRITION PROGRAMS TARGETED?

This question is addressed through two sub-questions, one concerned with the criteria for free and reduced-price meals and the extent to which they identify children at nutritional risk, and the other concerned with multiple participation of families in federal assistance programs and the extent to which the combined benefits are adequate.

A. *Do Family Size and Income Criteria Identify Children at Nutritional Risk?*

Since 1970, the Secretary of Agriculture has been responsible for issuing free and reduced-price meal eligibility criteria. These criteria are based on the poverty income guidelines that are approved each year by the Office of Management and Budget (OMB). The current eligibility criteria are based on 125 percent and 195 percent of the OMB poverty income guidelines, for free and reduced-price meals, respectively.* As discussed in Chapter III, it is

* OMB issues separate poverty income guidelines for farm and non-farm families of various sizes, but the USDA eligibility criteria are based only on the guidelines for non-farm families. Slightly higher guidelines apply for residents of Alaska and Hawaii. Poverty income was originally based on three times the amount needed to purchase food under the USDA Thrifty Food Plan, for families of various sizes. Effective January 1, 1981, Public Law 96-499 made several changes in the eligibility criteria. Prior to January 1, 1981, the eligibility criteria included a semiannual cost-of-living adjustment, based on changes in the Consumer Price Index between the time that OMB issued its guidelines and the time that school started; that adjustment has been eliminated. Also, before that date, families were allowed to reduce their reported income for special hardship conditions (unusually high medical expenses; shelter costs in excess of 30 percent of income; special education expenses due to the mental or physical condition of a child; and disaster or casualty losses). Public Law 96-499 replaces these hardship deductions with a standard deduction.

well established that indices of poverty and nutritional risk are correlated. However, we do not know the extent to which the targeting of program benefits is improved when the current free and reduced-price criteria are used, nor whether there are criteria that would be optimal, in some sense, for identifying children at nutritional risk.

Only two studies have specifically examined the question of the match between the family-size and income criteria on the one hand, and nutritional risk on the other (Emmons et al., 1972; Paige, 1971). Both studies were conducted in the early 1970s. Uniform national free and reduced-price eligibility criteria were not established until the middle of the 1970s, however, and while the results from studies using the criteria in force in New York State (where the Emmons et al. study was conducted) and in Baltimore (where the Paige study was conducted) are suggestive, they cannot necessarily be generalized to results that would have been obtained in other states or to results that would be obtained at the current time.

According to Emmons et al., their study addressed the following issue:

> If one views free or reduced-price school lunches as another form of income maintenance, then the use of economic criteria to determine eligibility for free lunches is sensible.... On the other hand, if one views the free school lunch program as an effort to provide a nutritious noonday meal for children who need nutritional supplementation, it would be better in theory to base eligibility on some measurement of nutritional need. When economic criteria are used, it is assumed that children with the greatest need for nutritional supplementation are identified, i.e., that economic need is synonymous with nutritional need (Emmons et al., 1972, p. 262).

This way of stating the issue is perhaps too extreme, since it is unlikely that anyone really believes or assumes that economic and nutritional need are "synonymous." Empirical correlations between indices of economic and nutritional need are of modest size, at best. If the question about the relation between poverty criteria and nutritional risk is reduced to a test of the assumption that the two are synonymous, implying that they are perfectly correlated, then the answer is "no." However, this statement of the issue by Emmons et al. does help point up a paradoxical feature of the enabling legislation for the lunch program: while the lunch program is intended to "safeguard schoolchild health" (implying nutritional aims), the differential distribution of program benefits to various groups of students is governed principally by the income criteria for free and reduced-price meals (implying economic aims).

Emmons et al. studied 844 children in grades one through four, from two rural school districts in upstate New York. One aspect of the study examined the use of income criteria to identify children who were at nutritional risk. (Another aspect of the study was to assess the nutritional impact of the nutrition programs; this aspect is reviewed in Chapter IV.) Parents completed questionnaires on family composition, income, education, and other demographic factors. On the basis of the information supplied by the parents, the authors classified the students as eligible for free school lunches using the New York State family size and income criteria that were in effect at the time. A total of 23 percent of the children were judged to be eligible for free lunches. (Emmons et al. reported results separately for their two school districts, but we have combined them.)

Nutritional need was based on a combination of anthropometric, biochemical, and dietary findings. Children were classified as "nutritionally needy" if they met <u>two</u> or <u>three</u> of the following criteria:

- Three or more nutrients below 70 percent of the RDA;
- Weight-for-age and/or weight-for-height either less than 90 percent or more than 110 percent of the current Iowa standards, which were based on data gathered by Stuart and Meredith (1946); or
- Hemoglobin less than 11.5 grams per 100 milliliters and/or hematocrit less than 36 percent.

Children were classed as "nutritionally adequate" if they met <u>all</u> of the following criteria:

- All nine of the nutrients studied were at 70 percent or more of RDA;
- Weight-for-age and weight-for-height were within 90 and 110 percent (inclusive) of the Iowa standards; and
- Hemoglobin at least 11.5 grams per 100 milliliters and hematocrit at least 36 percent.

All other children were classed as "nutritionally intermediate." Using these criteria, 26 percent of the students were classed as nutritionally adequate, 45 percent as intermediate, and 28 percent as needy.

Our cross-tabulation of the data of Emmons et al. (1972) is shown in Table V-1. There is a significant relationship between free lunch eligibility and nutritional status ($p < .05$). The authors found that 36 percent of the 167 children eligible for free lunch were also nutritionally needy. These children would be identified as needy using either economic or nutritional criteria. For the 573 ineligible children, 26 percent were nutritionally needy. These children would receive school lunches only if their families chose to pay the full price. As Emmons et al. observed, "Although a higher <u>percentage</u> of eligible than ineligible children were nutritionally needy, a smaller <u>number</u> of eligible than ineligible children were nutritionally needy" (p. 267).

Despite the significant relationship noted in Table V-1, the authors found that economic measurements, such as family size and income, were not strongly correlated with the anthropometric, dietary, or biochemical findings. Family income did not appear to be a <u>major</u> determinant of nutritional status. Emmons et al. concluded that economic criteria for receipt of program benefits cannot be justified solely as proxies for nutritional need, and

Table V-1. Cross-Tabulation of Free Lunch Eligibility and Nutritional Status in the Emmons et al. Study*

Free Lunch Eligibility	Nutritional Status			TOTAL
	Adequate	Intermediate	Needy	
Ineligible	158 (27.6)	266 (46.4)	149 (26.0)	573
Eligible	31 (18.6)	76 (45.5)	60 (35.9)	167
TOTAL	189	342	209	740

*Row percentages are in parentheses. The table is based on Emmons et al. (1972, Table 5, p. 265), combining data for the two districts studied. For this table, $\chi^2 = 8.64$, $p < .05$.

suggested that any change in the eligibility criteria should depend on whether the programs are intended as income maintenance or nutrition supplementation programs.

The second study that addressed this issue was conducted by Paige (1971) in Baltimore. This study also examined the nutritional effects of the programs on students and is reviewed in Chapter IV. Paige studied four elementary schools that had the NSLP and were located in low-income areas of Baltimore. There were 742 children included in the sample, which was drawn from the first, second, and sixth grades. Measures of height, weight, and hematocrit were taken for each child. The data collection team classified each child in terms of participation or nonparticipation in the school lunch program. At the time of the study, children who received free or reduced-price meals were selected "administratively" by the principal, in collaboration with teachers, social workers, parents, and other interested parties. (The article by Paige is not clear on this point, but apparently all students classified as participants received free lunches, and none received full or reduced-price lunches.)

Based on anthropometrics and hematocrits, the children were judged to have some degree of undernutrition if they met one of the following criteria:

(1) hematocrit less than 34 percent; (2) height equal to or below the 10th percentile of the Stuart Boston anthropometric charts and hematocrit less than 36 percent; (3) weight equal to or below the 10th percentile of the Stuart Boston charts and hematocrit less than 36 percent; and (4) height equal to or below the 25th percentile and weight equal to or below the 10th percentile of the Stuart Boston charts. The author found that 221 children had deficient anthropometrics or hematocrits. Of this number, 70 did not participate in the school lunch program. This group of 70 children, which represents 9 percent of the total sample, was identified by growth and biochemical criteria as nutritionally needy, but did not participate in the lunch program--presumably because they were not judged as eligible for free lunches. Because of the limited information presented by Paige, it is difficult to draw further conclusions from this study.

Both Paige and Emmons et al. reported similar findings: many of the children who were found to be "nutritionally needy" using a combination of biochemical, anthropometric and dietary criteria were not also identified as "economically needy," and vice versa. We are likely to find similar results regardless of the nutritional and economic criteria in use, owing to the low observed correlations between any given indices of nutritional and economic status. Both Paige and Emmons et al. used somewhat arbitrary indices of nutritional status, with nutritional need indicated by particular cutoff points on distributions of anthropometric and hematological measures. The measures used were convenient, but they are not the only or best measures of nutritional status. Since "nutritional status" is a multidimensional construct, the use of any single index of nutritional status is likely to distort or conceal results for particular components of nutritional status. (For example, if hematocrits were excellent measures of iron nutriture, while anthropometric measures were poor measures of iron or other kinds of nutriture, then including the anthropometric measures in the indices of nutritional status as Paige and Emmons et al. did, would tend to obscure results that held only for iron.) Furthermore, because the measures of nutritional and economic status are essentially continuous variables, dichotomizing their distributions into "adequate/not adequate" and "eligible/not eligible" categories (or trichotomizing them into "adequate/intermediate/needy" and "free/reduced/full-price" categories) entails some distortion and weakening of the apparent relationships between nutritional and economic need.

It should be clear that there is no simple answer to this targeting question about the match between the economic criteria and nutritional risk. However, the targeting of nutritional benefits could be improved if more was known about the distribution of nutritional status over families of varying economic status. Are there differences between the families below 125 percent of poverty and the families between 125 and 195 percent of poverty, for example, or between the latter and the rest of the families? The 125 and 195 percent cut-points may be reasonable for representing degrees of nutritional need, but they have no strong basis in analytical findings.

Common sense asserts that there are limits to the cost of nutritious food, and that above some income level (for families of a given type), additional money spent on food does not improve nutritional status; however, existing research does not show where the point of "diminishing nutritional returns" might lie. Research on this issue is complicated by the fact that the free and reduced-price meal provisions now interfere with the measurement of the condition they are intended to correct--namely, differential needs for children from families from different income levels. To the extent that the free and reduced-price provisions are used and succeed in improving diets for the poor, differences in nutritional status due to income differences will be difficult to detect. Moreover, because other federal assistance programs also help poor families to have adequate diets, they may further reduce any anticipated correlation between economic disadvantage and nutritional risk. The issue of multiple program participation is discussed in the next section.

B. *To What Extent Do Families Participate in More Than One Federal Food Assistance Program?*

Several federal food assistance programs are available to aid eligible individuals and families in obtaining adequate diets. In addition to the school nutrition programs, such programs include Food Stamps; Supplemental Feeding Program for Women, Infants, and Children (WIC); Child Care Food Program (CCFP); Nutrition Program for the Elderly; and Summer Food Program for children. Some of these programs provide meals directly to eligible individuals, while others make money or its equivalent available to individuals for the purchase of food. In addition to these programs, food distribution programs disperse food directly to schools and agencies for use in the preparation of meals served to eligible individuals. In some cases, food is distributed directly to individuals. By law, individuals may participate in food assistance programs for which they meet the eligibility criteria. People may, therefore, participate in more than one program where eligibility criteria are similar.

The extent to which individuals participate in more than one program and thus receive multiple benefits has been the subject of several research reports. This literature has been reviewed and summarized by the General Accounting Office (Comptroller General of the United States, 1978). Of interest here is the degree to which families with children participating in free or reduced-price school meals receive benefits from other federal food assistance programs. In general, studies that have examined this issue have counted the number of programs in which families participate, but have not examined the more difficult question of whether multiple program benefits complement or duplicate one another. For example, the first study cited by the General Accounting Office (GAO) examined fiscal 1971 program data for a variety of food assistance programs (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1972). The report estimated that 33 percent of U.S. families receiving food stamps and food distributions also had children receiving free or reduced-price school lunches, and that 44 percent of families receiving Aid to Families with Dependent Children (AFDC) also received food stamps or food distributions and free or reduced-price school lunches. This study suggested that more information is needed about whether multiple program benefits may have a duplicating effect. (It should be noted that the assumption of implied food assistance, in cash benefit programs such as AFDC, is not universally held.) In another study completed a year later by GAO, a random sample of 1,758 households from low-income areas was examined to determine the level of participation in 100 federal, state, and local programs (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1973). Approximately two-thirds of the households benefited from more than one program; 34 percent of the 198 households receiving food stamps also had children participating in the free lunch program.

A survey conducted by Chilton Research Services for USDA was based on a nationwide sample in which 2,191 food stamp and 2,364 food distribution households were interviewed (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1974). Among the 1,988 families actually receiving food stamps at the time of the interview, 38 percent had children receiving free or reduced-price school lunches. The households surveyed received benefits from an average of three federal food assistance programs.

FNS (1975) later prepared a report to Congress that discussed the results of the Chilton Study and the relationship of the food stamp program to the other federal food assistance programs. This report acknowledged that a large number of food stamp recipients also had children receiving free-lunch benefits. The authors argued that such multiple-program benefits were reasonable because school lunches are provided at a time and place when it is inconvenient to rely on household food supplies; school lunches may provide more adequate nutrition than lunches brought from home; and the 1970 amendments to the school lunch legislation specifically stated that all children should have access to school lunches, including children unable to pay for their lunches.

As discussed in the previous section, the Washington State Study (Price et al., 1975) also looked at the extent of multiple-program participation among the sample of households surveyed. More than half of the households that had children receiving free lunch (56 percent) also obtained food stamps. A study of the WIC delivery system conducted by the Urban Institute (1976) found that 31 percent of the WIC households studied had children receiving free or reduced-price lunches and 7 percent of the households had children receiving free or reduced-price breakfasts. In addition to the above studies summarized by GAO, the study by Emmons et al. (1972) of two rural school districts in upstate New York found that of the families eligible for free lunch, 51 percent in one district and 58 percent in the second district were also food stamp recipients.

Recently the GAO initiated an empirical study of participation in multiple federal assistance programs (Comptroller General of the U.S., 1978). The purpose of this study was to examine interrelationships among domestic assistance programs and to identify potential overlaps and gaps in program benefits.

The GAO report emphasized overlaps rather than gaps, though some gaps (in the form of inequitable coverage) were identified for the food stamp program. Field work was conducted in Oakland, California, and in surrounding Alameda County. Program benefits and participation were analyzed for 95 Oakland households--25 randomly selected AFDC families, 25 randomly selected food stamp families, and 45 families whose children comprised two kindergarten classrooms from a school in a low-income area. Sixty of the families benefited from two or more programs, and 20 of these received benefits from AFDC and food stamps, as well as from the free lunch, breakfast and milk programs. Based on the results of the field survey, GAO constructed seven hypothetical low-income households, and reported that the food programs could provide anywhere from 21 to 230 percent of the household's estimated food needs under the Thrifty Food Plan, which has been the statutory basis of food stamp allocations since 1977 (USDA, Agricultural Research Service, Consumer Food & Economics Institute, 1975).

The thrust of the GAO report was that while all of the programs are sanctioned under law, there may be inequities in the amount of benefits received by families of various kinds, because of the "piecemeal authorization and administration" of the programs. USDA agreed that a more rational structure than the existing one was needed, and pointed out a number of areas where pending or proposed legislation would address some of the apparent inequities of the programs. USDA also noted serious errors in the GAO's estimates of monetary benefits under the various plans, due to incorrect assumptions about the nutritional benefits provided by the Thrifty Food Plan, to miscalculations of economic benefits under all of the major assistance programs, and to the use of a sample that was entirely too small and unrepresentative for making recommendations about major changes in national policy (USDA, 1978). GAO defended its analysis by stating that its results were not meant to provide national projections of costs or savings, but only to illustrate some possible combinations of the benefits that might be received by a family. GAO did not respond to any of the detailed criticisms of its methods for calculating benefits, so it is not clear whether any of the numerical results of the study can be salvaged. GAO recommended that USDA, HEW and the Community Services Administration (which are responsible for one or more of the programs) conduct a study to determine the precise extent of overlaps and gaps, the nutritional value of diets actually and theoretically available to program participants, and the economic value of various combinations of program benefits. The 1977-78 Nationwide Food Consumption Survey is expected to provide considerable information on the nutritional and money val of food used by poor families (e.g., USDA, Science & Education Administration, 1979, 1980), but these data have not yet been reported or analyzed in sufficient detail to address issues of multiple program benefits.

A recent study prepared by an advocacy group (Temple-West & Mueller, 1978) attempted to approach the issue of multiple program participation from a perspective not adopted in any study discussed so far. Rather than counting the number of programs in which families participate, this study focused on the adequacy of the nutritional benefits associated with the various food assistance programs. The authors attempted to identify the food needs of low-income households and the contributions of the various programs to these needs. USDA's Low Cost Food Plan was selected as a standard which represented the minimum dietary needs of households. While the Thrifty Food Plan is the basis for food stamp allocations, leading nutritionists and USDA's Agricultural Research Service have cautioned against using this plan as the basis for providing nutritionally adequate diets (USDA, 1978). As Temple-West and Mueller observed, the slightly more expensive Low Cost Food Plan provides a more adequate diet, and more nearly resembles the food actually consumed by poor families.

The authors proceeded by comparing the cash value of food stamps that could be received by families with various numbers of adults and children of various ages, with the dollars needed by the same households to purchase the Low Cost Food Plan. This comparison showed that the food stamp allocation only met the food needs of families with preschool children. When the authors added the value of food that could be received from all other food assistance programs--including the NSLP, SBP, and the child-care food, summer feeding, and feeding for the elderly programs--the combination of all programs only met the food needs of families with preschool and younger children. The needs of families with adolescent children, adult males, or elderly persons were not fully met. The authors also pointed out that "the Low Cost Food Plan is intended to be a maintenance diet for low-income persons, not a therapeutic plan for those already suffering from some kind of nutritional deficiency or overt malnutrition" (Temple-West & Mueller, 1978, p. 14). Thus, their results indicated that federal food assistance programs only met the food needs for <u>healthy</u> families with preschool children. As family food needs increased with older or more numerous children, the federal food programs were less successful in providing adequate diets. The authors acknowledged some limitations of their methods, notably failure to allow for variable prices of food in some regions and variable access to programs. It should be noted that the authors did not report their methods for assigning cash values to program benefits in enough detail to allow the methods to be evaluated. As shown by the USDA response to the GAO report on multiple program participation (Comptroller General of the U.S., 1978; USDA, 1978), there are numerous pitfalls to avoid in making these comparisons.

In assessing the extent to which families with children participating in school meals receive multiple food assistance benefits, most of the studies reviewed in this section focused solely on examining the number of programs in which families participated. Such participation figures were used to assert that low-income households received duplicate benefits and that "overlaps" in benefits among programs existed. We could find only one study that attempted to assess the effect of multiple program participation in terms of dietary adequacy (Temple-West & Mueller, 1978). Further research on the nature of program benefits and their nutritional efficacy is necessary in order to determine more appropriately whether legally permitted multiple benefits are desirable and whether food assistance programs distribute benefits equitably among needy families of various kinds.

DO THE SCHOOL NUTRITION PROGRAMS MEET THE NUTRITIONAL NEEDS OF SCHOOL-AGE CHILDREN?

In an earlier section of this chapter, the question of whether school nutrition program benefits are targeted to children in nutritional need was approached by considering whether low family income is directly associated with nutritional risk. This section considers whether the nutrient content of school meals, both lunch and breakfast, is targeted to the nutritional needs of school-age children. First, studies are summarized here that have assessed the nutrient content of school meals, as served or consumed, and have determined whether they meet the established USDA goal of one-third of the RDA for school lunches, and an unofficial research goal of one-fourth of the RDA for school breakfasts. Next, the nutrients that have been determined by these studies to be either adequate or deficient in school meals are reviewed in terms of the major nutritional problems of school-age children. Finally, the concluding section of the chapter summarizes current USDA efforts to improve the targeting of program benefits to students.

A. *What Is the Nutrient Content of School Meals?*

Many studies have analyzed the nutrient content of school meals. FNS has established a nutritional goal for school lunches, which is that one-third of the RDA should be provided for all nutrients (except energy). We have included studies that have analyzed whether the nutrient content of school lunches, as served and as consumed, meets this one-third goal for selected nutrients. Most of the studies were conducted when the official USDA meal pattern was called the "Type A pattern," and we will commonly refer to the Type A pattern when the studies are discussed. Several studies of experimental alternatives to the Type A pattern, such as the "Nutrient Standard Menu" or the "Computer-Assisted Nutrient Standard Menu" are also reviewed. In recent years, the USDA meal requirements have changed in so many details that the expression "Type A pattern" is no longer used, and the current program and research literature simply refer to the "school lunch pattern" or the "reimbursable meal." We will discuss these changes further in the last section of the chapter.

An RDA goal has not been officially established for the school breakfast. For the one study that has examined the nutrient content of the school breakfast (Opinion Research Corporation, 1979), the researchers adopted one-fourth of the RDA as a criterion for assessing nutrient adequacy. Breakfasts tend to be lighter than lunch and dinner, and snacks also contribute to the daily total, so a one-fourth criterion is probably reasonable--though obviously there are wide individual and cultural variations in the amounts consumed at various meal times. It should be emphasized, however, that a one-fourth RDA criterion for the nutrient content of breakfast has no official standing.

The nutrients most often analyzed in studies of the school lunch are protein, vitamin A, ascorbic acid, thiamin, riboflavin, and niacin. Energy intake (calories) has also been studied. FNS has not established a one-third RDA goal for energy, as it has for the other nutrients, but in most of the studies reviewed the researchers compared the energy intake to one-third of the RDA. This common research use of a one-third energy goal must be viewed with considerable caution, since the RDA for energy must be treated differently than the RDA for other nutrients:

> In contrast to other nutrients for which recommendations are made here, the energy allowance is established at a level thought to be consonant with good health of average persons in each age group and within a given activity category. Thus the recommendations for energy represent the <u>average</u> needs of people in each category, whereas for other nutrients recommended intakes are high enough to meet the upper limits of variability of almost all people of this age and sex (National Research Council, 1980, pp. 16-17).

Thus, the RDA for most nutrients includes a "safety cushion," so that the RDA is considered adequate for all or almost all individuals in each age-sex category. For energy, however, activity level must also be considered: "It should be emphasized that the maintenance of desirable body weight throughout adult life by an individual is dependent on achieving a balance between energy intake and energy output" (<u>ibid</u>.). Since excess energy intake leads to obesity, there can be little or no "safety cushion" for energy. In view of the prevalence of obesity among school-age children, there is some question whether an energy goal of one-third of the RDA would be appropriate, even as an average. The National Food Consumption Survey (USDA, SEA, 1980) shows that, on average, children consume only 24-28 percent of their total calories at lunch. Thus, when research shows that the energy content of the school lunch is below one-third of the RDA, it should not be considered a defect of the program. In any case, energy needs for individuals are dependent on energy output, and many individuals will need more or less than the average amount of energy at lunch time in order to have appropriate energy consumption on a daily basis.

It should be noted that the RDA have been revised several times during the period under review, and that we will report on research using different editions of the RDA. The most recent editions were the seventh (1968), eighth (1974), and ninth (1980). Changes from edition to edition have been relatively slight, however, and should not affect the generality of the conclusions drawn. Changes in the 1980 RDA for school-age children affected vitamin E, vitamin C, niacin, riboflavin, and vitamin B. r all but vitamin B_6 the allowances were reduced. The main changes affecting children in the 1974 RDA were as follows: protein, vitamin B_{12} and magnesium allowances were reduced; riboflavin and vitamin B_6 allowances were increased; the thiamin allowance for younger children was increased and for older children was reduced. Also in 1974, an RDA for zinc was added for the first time.

Most studies that report nutrient values use food composition tables to convert obtained data into nutrient equivalents. In general, the food composition tables contain data obtained from USDA (e.g., Agriculture Handbooks No. 8 and 456, Home and Garden Bulletin No. 72, USDA, ARS, CFEI, various dates), supplemented by data obtained directly from manufacturers and from published reports. Over the years, availability of supplemental data has greatly expanded the number of food items for which nutrient values are available. In addition, some data base developers have imputed data for food items by using known nutrient values for similar foods. The larger data bases are updated more or less continuously, as data become available for new food items or as new values are published for existing items. The increased availability of nutrient information has resulted in differences within the same data base over time as well as differences among data bases at a given point in time. It is rarely possible for a reader to carefully evaluate the adequacy of the data base used in a given study. Perhaps the only general guidance that can be offered is that more recent studies are likely to use more complete data bases than earlier studies, and that more complete data are available for some nutrients than for others. Reported deficiencies in nutrients for which there is only limited information (e.g., vitamin B_6, folic acid) must be interpreted with caution, since the reported nutrient intakes may represent minimum values based on the set of food items for which data were available in the data base, rather than actual values based on all food items consumed. As shown by many of the papers and discussions at the most recent conference of nutrient data base users, there is a widespread recognition that greater sharing and standardization of data bases is needed (Morgan, 1980).

School Lunch as Served

The National School Lunch Act requires that lunches served by participating schools must meet nutritional standards prescribed by the Secretary of Agriculture. The Type A pattern has been the standard for meeting this requirement since 1946. The pattern specifies quantities of food in four basic groups that are expected to provide one-third of the RDA (except energy) for the 10- to 12-year-old child.

Since the RDA includes margins of safety for the levels of nutrients, lunches that do not meet one-third of the RDA should not automatically be classified as poor. The Type A pattern prescribes amounts of food from the four food groups rather than actual menus, so it is not expected that lunches will precisely meet one-third of the RDA for all nutrients every day. The regulations state, however, that "the goal should always be met over one week's time" (USDA, FNS, Regulations, August 22, 1978). The quantities of food required by the Type A pattern have been periodically reviewed by the Department of Agriculture as new editions of the RDA are published and as more data on food composition become available.

Several studies have attempted to assess the contents of school lunches as served relative to the goal of providing one-third RDA. The results of these studies differ depending on which nutrients were chosen for analysis, whether nutrient values were obtained by chemical analysis or calculated from food composition tables, how many meals were sampled, and which particular edition of the RDA was used for comparison. Despite these variations, several consistent findings have emerged from the major studies. These studies are summarized in Table V-2 and are discussed in the following text. Each study is reviewed in terms of its overall sample, food collection methods, analysis, nutrients studied, and findings.

Table V-2. Studies of Nutrient Content of School Lunches as Served

AUTHOR	SAMPLE	FOOD COLLECTION	ANALYSIS	INDICATORS STUDIED*	FINDINGS*
Doucette, 1971, Maretzki and Chung, 1971	Five high schools in Hawaii	124 lunches were sampled from the five schools.	Recipes for the 25 menus from which the sample lunches were selected were collected. Average serving sizes were provided by cafeteria managers. These data were used to calculate nutrient values using food composition tables. Values were compared to the 1968 RDA.	Energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, calcium, phosphorus and iron.	Shortages were found for iron, calcium, and energy.
Comptroller General of the United States, 1978	New York City, Cleveland, and Los Angeles. 12 elementary schools.	One lunch tray was collected in each school for five consecutive days (60 lunches total)	Lunches were packed in dry ice and shipped to a laboratory for chemical analysis. Nutrient levels were compared to the 1968 RDA, except that the 1974 RDA were used for zinc.	Energy, protein, vitamin A, vitamin C, thiamin, niacin, vitamin B_6, calcium, phosphorus, magnesium, iron, zinc, and iodine.	Shortages of 5 percent or more below the RDA goal were found for vitamin A, iron, magnesium and zinc at over half of the schools. Some of the schools also had shortages for thiamin, calcium, vitamin B_6, and energy.
Head et al., 1973	North Carolina. 21 schools, both elementary and secondary; 23 lunch lines were represented in the sample, 11 elementary and 12 secondary.	Four lunch trays were selected from each lunch line on each of five randomly selected days in the fall and spring.	Nutrient levels of food served were determined both by chemical analysis and by calculation. Foods in the sample were flushed with nitrogen then packed and shipped in dry ice to a laboratory for analysis. Recipes for all foods were also collected and nutrients in the lunches were calculated from Agriculture Handbook No 8. Data were compared to the 1968 RDA	Energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, calcium, iron and fat.	Chemical analysis: lunches were below one-third RDA for energy, ascorbic acid, thiamin, calcium and iron. Calculation: lunches were below one-third RDA for energy, thiamin, calcium, and iron. Except for iron and calcium, chemical values were lower than calculated values for all nutrients. Fat averaged 43 percent of energy

* There is no formal goal for the energy content of school lunches, so "shortages" (amounts less than one-third of RDA) should not be considered a defect of the program.

Table V-2. Studies of Nutrient Content of School Lunches as Served (Cont'd)

Martin, 1971	One junior high and two elementary schools in Pennsylvania.	Five hot and five cold lunches were sampled in each school.	Recipes were collected for each lunch, and average serving size of each item was determined. Nutrient values were calculated from food composition tables. Data were compared to the 1968 RDA.	Energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, calcium, iron, and fat.	Only iron was found to be below the RDA goal Fat averaged 43 percent of energy.
Murphy et al., 1968, 1969, 1979	300 schools in 19 states; sample was designed to be representative of Type A lunches in the United States.	Four lunch trays were collected in each school on five consecutive days; trays were randomly selected while sixth-grade students were being served.	Lunches were frozen and shipped to a laboratory for chemical analysis. Data were compared to the 1968 RDA.	Energy, protein, vitamin A, vitamin D, thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12}, calcium, phosphorus, magnesium, iron, sodium, potassium, and fat.	Lunches were found to be below one-third RDA for magnesium, vitamin B_6, iron, and energy. Sodium and potassium, for which RDAs were not established, averaged 1,466 mg. and 1,190 mg., respectively. Fat averaged 38.8 percent of energy.
Opinion Research Corporation, 1979	67 schools including 43 schools with both breakfast and lunch programs (27 elementary and 16 secondary) and 24 schools with just the lunch program (15 elementary and 9 secondary).	Lunch trays were collected each school day during one test week in 1978-1979; five trays were randomly selected while each of the two test groups were being served (fifth/sixth grades and tenth/eleventh grades).	Recipes for all menu items were collected and verified by data collectors. Sample trays were weighed to determine average serving sizes for each item Nutrient levels were then estimated from the average serving size and nutrient composition data. Nutrient values were compared to the RDA, presumably the 1974 edition.	Energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, calcium, iron, niacin, and fat.	Deficiencies as compared to RDA were found for energy, thiamin, and iron.

130

Table V-2. Studies of Nutrient Content of School Lunches as Served (Cont'd)

USDA, Food and Nutrition Service, 1979	104 schools in 35 states and the District of Columbia: 52 schools with on-site food preparation facilities and 52 with preportioned-delivered lunches. This includes 80 elementary, 17 junior high, and 7 senior high schools.	In schools with one Type A lunch, five sample trays were randomly selected as fifth, ninth, and tenth grade students were being served. In schools with more than one Type A offering, five servings of each Type A item were randomly selected as the test grades were served.	In on-site schools, data collectors observed meal preparation and recorded recipes and ingredients. Where preportioned meals were served, descriptions of menu items and ingredients were obtained. Nutritive value of lunches was calculated based on the amount of each ingredient in each menu item using Agriculture Handbook No. 8. Data were compared to the 1974 RDA.	Energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, niacin, calcium, phosphorus, and iron and fat.	Findings are presented by type of food preparation, by school level, and by sex. In general, shortages of energy, iron, and thiamin were found in comparison to one-third of the RDA. Fat averaged 39 percent of energy

181

In 1966, the Agricultural Research Service and the Consumer Marketing Service of the United States Department of Agriculture conducted a nationwide survey to evaluate the Type A pattern (Murphy et al., 1968, 1969, 1970). In this study, food samples from four trays served to sixth-grade students were collected each day for five consecutive days in 300 schools located in 19 states. Food samples from each school were chemically analyzed, and the data were compared with the 1968 edition of the RDA for 10- to 12-year-old children. The nutrients studied included protein, vitamin A, vitamin D, thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12} calcium, phosphorus, iron and magnesium; sodium and potassium (for which RDA are not established) and energy were also analyzed.

Results of the study showed that for all schools, the average nutrient values met or exceeded one-third of the RDA for protein, vitamin A, thiamin, riboflavin, niacin, vitamin D, vitamin B_{12}, calcium and phosphorus. For two nutrients, magnesium and vitamin B_6, the average value f.. all 300 schools was less than one-third of the RDA. The average for iron was also below one-third of the RDA for girls. Sixty percent of the schools did not meet the goal for magnesium, and more than one-half of the schools failed to provide one-third of the RDA for vitamin B_6. Over 90 percent of the lunches from the 300 schools were deficient in iron for 10- to 12-year-old girls. These lunches did not even provide one-fourth of the RDA for iron. According to the authors, there is no food or group of foods that could furnish enough iron in the lunch to meet one-third of the RDA under the Type A pattern current at the time of the study. Average energy levels were close to the RDA goal for girls and slightly lower for boys.

There was much variation in the nutrient values among the different schools. For example, more than one-third of the schools were below one-third of the RDA for vitamin A. Whether or not lunches were low depended on the specific inclusion of foods rich in vitamin A on days when the samples were collected. Nearly one-half of the meals failed to meet the thiamin goal for girls. Forty-two of the 300 schools failed to meet one-third of the RDA for vitamin B_{12}, which is surprising since vitamin B_{12} is prevalent in milk and protein foods. Forty-two of the schools also failed to meet one-third of the RDA for calcium. Therefore, it is likely that the Type A pattern requirements for milk or protein foods were not served in schools that failed to meet calcium and vitamin B_{12} goals.

Head et al. (1973) conducted a study of energy, fat, and seven nutrients in the Type A lunch. In this study, lunches were sampled from 21 schools with 23 lunch lines in North Carolina for five days in the autumn and five days in the spring. The lunches from each school were subjected to a chemical analysis of protein, fat, energy, vitamin A, ascorbic acid, thiamin, riboflavin, iron, and calcium. In addition, recipes for all of the foods were collected from each school and nutrient values were calculated for the recipes using values from Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1963) and information obtained from manufacturers. Values were calculated for each recipe and analyzed for each student tray, with values averaged over the five days. The mean calculated values were then compared with the mean analyzed values from the five-day sample trays. Both analyzed and calculated values were compared to one-third of the 1968 RDA.

Results from the chemical analysis indicated deficiencies when mean values were compared to the RDA for ascorbic acid, iron, energy, thiamin, and calcium. Results from the calculations revealed that energy, thiamin, calcium and iron were deficient when compared to the RDA. The authors noted that for all nutrients except iron and calcium the values obtained by chemical analysis were lower than those obtained from calculations using Handbook No. 8. There was also considerable variation among schools in different regions of the state and in the same schools on different days. The authors observed that the differences between calculated and analyzed values for ascorbic acid and thiamin were large enough to cause concern about food handling procedures in school kitchens, which may result in the loss of nutrients through cooking.

Another study of nutrients served in the Type A lunch was conducted by the General Accounting Office (Comptroller General of the United States, 1978). The GAO contracted with a private laboratory to conduct chemical analyses of 60 lunches from 12 elementary schools in New York City, Cleveland, and Los Angeles. For five consecutive days, in each of the 12 schools, one Type A lunch of the kind served to 10- to 12-year-old children was purchased, measured, frozen, and shipped to the laboratory. Analyses were made for 13 nutrients (energy, protein, phosphorus, niacin, iodine, vitamin C, vitamin A, iron, zinc, magnesium, thiamin, calcium, and vitamin B_6), to determine whether the average values for the five days met the goal of one-third of the RDA for a 10- to 12-year-old child. This goal was met at all schools for 5 of the 13 nutrients (protein, phosphorus, niacin, iodine and vitamin C). Lunches from each school were below the goal of one-third RDA for at least one of the other eight nutrients. Seven of the 12 schools were low in vitamin A; nine schools were low in iron; and all 12 schools were low in zinc and magnesium. The deficits for these nutrients ranged from 5 to 50 percent below the goals. Smaller deficits were found for energy, thiamin, calcium and vitamin B_6. The findings of the GAO study are limited by the small number and arbitrary selection of schools, but for those schools it revealed fairly widespread failure to meet the RDA goals for vitamin A and the three minerals (iron, zinc, and magnesium).

Four additional studies reported amounts of nutrients served in Type A lunches, but these studies obtained nutrient values from food composition tables rather than from chemical analysis. In 1977, FNS conducted a pilot study of food and nutrient consumption in 104 elementary and secondary schools (USDA, FNS, 1979). One of the purposes of the study was to analyze the nutrient value of school lunches as served. Some of the schools included in the nationwide sample served lunches prepared on-site, while others served preportioned meals prepared off-site. Recipes and ingredients for each menu item were either recorded by data collectors or were obtained from the kitchens where food was prepared. Five random servings of each menu item were selected and weighed to determine average weights per item. Recipes and average weights were then used to calculate the nutritive value of the lunches from food composition tables in Agriculture Handbook No. 8 (USDA, ARS, CFEI, 1975).

Nutrient values were calculated for energy, fat, protein, iron, calcium, phosphorus, ascorbic acid, vitamin A, riboflavin, thiamin, and niacin. Values were compared with the 1974 edition of the RDA. Findings of the study indicate that for elementary schools, lunches prepared on-site were below the goal in energy, while preportioned meals did not meet the RDA goal for either energy or iron. Similar findings were reported for secondary schools, where, in addition, thiamin did not meet the RDA goal for males.

The second study using food composition tables to examine the nutrient content of school lunches was part of a larger study that also examined the nutrient content of school breakfasts (Opinion Research Corporation, 1979). This discussion focuses on the analysis of school lunches; school breakfasts are reviewed later.

Using data from a screening instrument sent to 2,500 schools, a sample of test schools was purposively selected to represent a wide variety of socioeconomic characteristics, geographic areas, enrollment sizes, and types of food service systems. The sample contained 43 schools with both the breakfast and lunch programs and 24 schools with just the lunch program. Five sample lunch trays were randomly selected at each school during each day of the test week. The trays were collected while students in grades 5, 6, 10, and 11 were being served.

Recipes for each menu item served during the test week were sent to Opinion Research Corporation prior to actual data collection. Data collectors verified the recipes on site and calculated the average serving size for the sample lunches. Nutrient values were calculated from food composition tables using the serving size and recipe data. Nutrient values were then compared to the RDA for energy, fat, protein, calcium, iron, phosphorus, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. Although it is not stated in the draft report, the 1974 edition of the RDA and the 1975 edition of Agriculture Handbook No. 8 were presumably used as the standard for analysis. Results were similar to previous studies--energy, thiamin and iron were supplied in amounts significantly below the one-third RDA goal.

The third study using food composition tables to examine the nutrient value of school lunches was conducted by Martin (1971). Nutrient values were calculated for five hot and five cold lunches served in each of three Pennsylvania schools. Menus were collected for each meal, and average serving sizes were determined by weighing five portions of each menu item. Nutrient values for the meals as served were calculated from food composition tables and were then compared to one-third of the 1968 RDA. The author found that although the hot lunches at both the elementary and junior high levels offered more nutrients than cold lunches, both the hot and cold lunches fell below the RDA goal only for iron. Energy and the nutrients studied including protein, calcium, vitamin A, thiamin, riboflavin, and ascorbic acid, met or exceeded one-third of the RDA.

The fourth study, reported by both Doucette (1971) and Maretzki and Chung (1971), was conducted in five high schools in Hawaii and also used food composition tables to examine the nutrient content of school lunches as served. Cafeteria managers provided the investigators with information on recipes, ingredient portions, and serving sizes for 25 school menus. From this information and food composition tables, the nutrient content of 124 lunches was estimated. The total of 124 lunches was comprised of 24 lunches served in each of five high schools and one other lunch served in four of those schools. The lunches were analyzed for energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, calcium, phosophorus, and iron. Results of the study indicate that the lunches as served met one-third of the RDA for protein, phosphorus, thiamin, riboflavin, vitamin A, and vitamin C. Lunches did not meet the RDA goal for iron, calcium, and energy.

The consensus of findings from these studies is that the quantity of food supplied by Type A lunches provides less than one-third of the RDA for energy in both elementary and secondary schools. Although the Type A pattern was not designed with a goal for energy, the low levels of energy in the lunches are related to the failure of most lunches to meet one-third of the RDA of energy-dependent nutrients such as thiamin, magnesium, and iron (Murphy et al., 1968, 1969, 1970).

The types of foods selected by menu planners to meet Type A requirements also affect the average nutrient content of school meals. Vitamin A is an example of a nutrient that is dependent on the selection of certain foods rather than on the total amount of food supplied. Since some foods are exceptionally high in vitamin A, average levels over a week's time can be adequate without serving these foods every day. Schools that do not average one-third of the RDA for vitamin A are ones that seldom serve foods rich in vitamin A. Inclusion of foods high in ascorbic acid also must have special attention from menu planners. Average ascorbic acid content of school lunches appears adequate when values are calculated from food composition tables; however, in at least one study, ascorbic acid was found to be considerably lower than expected when food samples were subjected to chemical analysis (Head et al., 1973). Head et al., concluded that cooking practices (long cooking of vegetables and cooking food far in advance of service) could contribute to the lower ascorbic acid values obtained when chemical analysis rather than food tables were used.

Because of the types of food selected and other factors, all of the studies found considerable variation in the number of schools actually meeting one-third of the RDA for most nutrients. Even when the overall average values met the one-third RDA goal, the average values for many individual schools did not meet the goal. The wide variation discovered among schools highlights the importance of obtaining a nationally representative sample of schools when evaluating the nutrient content of Type A lunches. Evaluations for periods longer than five days may be necessary to place confidence in average values obtained in studies of a small number of schools--especially for nutrients such as vitamin A, which vary widely in school lunch menus.

School Lunch as Consumed

The nutritional benefits of the school nutrition programs can be realized only if the food served to the children is actually consumed. High amounts of food waste can reduce nutrient intake significantly below the one-third RDA goal even when the meals are nutritionally adequate as served. Adequate targeting of nutritional benefits, therefore, involves serving food that the students will consume.

Several studies have attempted to quantify the amounts of food wasted in school meals and to identify factors that are associated with plate waste. A comprehensive review of the literature on plate waste in the school food programs was completed by Altschul (1976). At least three studies have confirmed that secondary-level students waste less food than elementary-level students. Jansen and Harper (1978) found that secondary students consumed 92 percent of the food served in school lunches, while elementary students consumed only 76 percent. Data reported by Head and Weeks (1975) show that secondary students consumed 83 percent of food served while elementary school children consumed 79 percent. FNS (USDA, FNS, 1979) also reported a similar trend for secondary students to consume more (77.3 percent) than elementary students (75.3 percent). If these measurements can be considered representative averages, it appears that secondary students fail to consume from 15 to 20 percent of food served to them in Type A lunches, and elementary students fail to consume from 20 to 25 percent.

The amount of food wasted varies for the different Type A components: "Typically, the consumption, by weight, of foods high in energy such as entrees, dairy products and desserts is higher than the consumption of many foods with less energy such as vegetables" (USDA, FNS, 1979, p. 96). Since the nutrient densities of these foods vary, a difference of 15 to 25 percent between

19

amounts of food served and amounts consumed does not always correspond to an equal reduction in the amount of nutrients in the lunches.

Four of the studies reviewed in the previous section that measured the nutrient content of school lunches as served, also determined the nutritional value of lunches actually consumed by students (Head et al., 1973; USDA, FNS, 1979; Opinion Research Corporation, 1979; Martin, 1971). In determining the nutrient value of the lunches as consumed, each of the four studies built on the methodology outlined in Table V-2; that is, after the initial sample was drawn, lunch trays were collected, and nutrient values of lunches as served were analyzed, each of the four studies proceeded to analyze food consumed by students in the sample. This further analysis required several steps in addition to the methodology outli·ed in the previous sect ... (1) the selection of a sample of student lunch trays after lunch had been consumed; (2) the measurement of food left on trays, which was then subtracted from the average serving size to determine the amount of food consumed; (3) the determination of the nutrient levels of food actually consumed either by using food composition tables or laboratory analysis; and (4) the comparison of nutrients consumed to the RDA goal. Each of the four studies is reviewed in this section in terms of these additional steps.

There is also one study (Price et al., 1975) that determined the nutrient content of lunches as consumed but did not study the value of lunches as served. This study employed a different design from the others discussed in this and the previous sections. The methodology of the Price et al. study will be described at the conclusion of this section.

In the study conducted in North Carolina (Head et al., 1973; Head & Weeks, 1975), lunch trays were collected at regular intervals (every third or fourth student) after students had eaten their lunch. Approximately 75 trays were collected at each school in the sample. Inedible refuse was removed, and the remaining food was flushed with nitrogen and shipped to a laboratory for analysis. At the laboratory, nutrient values of the plate waste were determined for each of the nine indicators outlined in Table V-2. Nutrients actually consumed were determined by subtracting the nutrient content of the plate waste from the nutrient content of the meals as served. The authors found that energy levels in the meals as consumed were below one-third of the RDA. (In this part of the study, the 1974 edition of the RDA was used as the standard.) Other nutrients that were consumed in amounts below the goal include ascorbic acid, thiamin, and iron. While elementary school children consumed adequate amounts of iron, older students consumed only 69 percent of the one-third RDA goal. Average thiamin and ascorbic acid intakes of all students fell below the goal. Average intakes of the other nutrients studied (protein, riboflavin, vitamin A, and calcium) met the one-third RDA goal.

The study conducted by FNS and described in the previous section (USDA, FNS, 1979) also calculated the amount of food consumed by a sample of students. Trays were randomly selected from 30 students in each school at the end of the lunch period, and the edible but unconsumed portion of food on each tray was weighed. This weight was subtracted from the average weight of a serving of food to obtain the amounts of food consumed. Then, nutritive values for the food consumed were calculated from food composition tables. The results indicate that the average amounts of food consumed by elementary and secondary students under both food delivery systems (on-site and preportioned/delivered) provide over one-third of the RDA for protein, calcium, phosphorus, vitamin C, vitamin A, riboflavin, and niacin. For both groups of students and both delivery systems, energy, iron, and thiamin did not meet the one-third RDA goal.

Opinion Research Corporation (1979) also calculated nutrients as consumed in school lunches as part of their study. A systematic sampling scheme was used to select student lunch trays as students passed through the serving line. A total of 80 student trays per school were sampled from students in grades 5, 6, 10, and 11. Trays were collected for five consecutive days. After eating, students returned their trays, and waste was weighed and recorded. Amounts consumed by each student were obtained by subtracting waste from average serving sizes of each menu item. Nutrient content was then determined by calculation from food composition tables.

Opinion Research Corporation found that lunches consumed by elementary students supplied significantly lower percentages of the nutrient goals for energy, protein, calcium, iron, phosphorus, thiamin, niacin and vitamin C than lunches consumed by high school students. However, only energy, iron and thiamin were significantly below one-third of the RDA. At the high school level, energy and thiamin consumed by males were significantly below one-third RDA. Iron was consumed below one-third RDA by both males and females. The one-third RDA goal was met for all other nutrients studied, including protein, vitamin A, ascorbic acid, riboflavin, niacin, calcium, and phosphorus.

In Martin's (1971) study, consumption of hot and cold lunches was compared. Experimental menus were prepared for five hot and five cold lunches that met the existing Type A standard and were "planned to be as nearly comparable in nutritive value as possible." Plate waste data were measured and subtracted from the average weight of the serving size for each menu item to identify the amount of food consumed. Food composition tables were then used to determine the level of nutrients consumed. The author found that nutrient intake was generally higher for hot lunches than cold lunches. For both hot and cold lunches, nutrient consumption was above the one-third RDA goal for energy and all other nutrients studied except iron.

The Washington State Study (Price et al., 1975) reported food consumption data for approximately 1,000 children between the ages of 7 and 14. Three 24-hour dietary recalls were administered to over 90 percent of the sample. On the day of each recall, children were observed eating their school lunches in order to estimate amounts of food eaten, traded, or discarded. The school lunch consumed by the children was photographed. Plate waste was weighed, and weights were recorded. In addition, a log was maintained of all school lunch menus and the average weights of each menu item as served.

Using food composition tables, these data were used to compute the children's total daily intake, the contribution of the school lunch to daily intake, and the percent of the 1974 RDA met by daily intake. A further analysis of these data compared the contribution of the school lunch as consumed to the goal of meeting one-third RDA. Findings indicate that for all ethnic groups (Mexican-American, blacks, whites) school lunches provided one-third or more of the RDA for protein, calcium, phosphorus, vitamin A and riboflavin. Vitamin C was above the RDA for Mexican-Americans and whites, but not for blacks. Energy, iron, thiamin, and preformed niacin were below the RDA goal for all three ethnic groups.

A summary of the findings of the cited studies, comparing nutrient values of school lunches as served and consumed to RDA standards, is given in Table V-3. Iron, thiamin, and energy, identified as being deficient in lunches as served, were also found to be deficient in lunches as consumed. These findings suggest that those nutrients frequently failing to meet the one-third RDA goal in lunches as served will fall even further below the goal when lunches are consumed. None of the studies reported consumption data for vitamin B_6, zinc or magnesium, which have also been found to fall below one-third of the RDA in lunches as served. It is likely that the levels of these nutrients in lunches as consumed by students would be lower. For those nutrients that meet one-third of the RDA in lunches as served, there is usually enough of a margin to allow an average adequate intake of these nutrients even when 15 to 25 percent of the food is not consumed.

Other Dietary Constituents in School Lunch

Recently, the USDA and the Department of Health and Human Sevices jointly released dietary guidelines that call for reducing the amount of fat, cholesterol, sugar and salt in the American diet (USDA/USDHEW, 1980). The school lunch pattern is not currently designed to meet specified goals for these constituents as it is for protein, vitamins and minerals. Furthermore, no scientific body has issued specific (i.e., quantified) allowances for fat, cholesterol, sugar and salt that are comparable to the RDA.

Table V-3. Summary of Studies of NSLP Nutritional Adequacy

	LUNCHES AS SERVED								LUNCHES AS CONSUMED				
	MURPHY *	HEAD ET AL *	HEAD ET AL +	GAO *	FNS +	ORC +	MARTIN +	DOUCETTE +	HEAD & WEEKS *	FNS +	ORC +	MARTIN +	PRICE ET AL +
ENERGY (CALORIES)[a]	X	X	X	X	X	X	O	X	X	X	X	O	X
PROTEIN	O	O	O	O	O	O	O	O	O	O	O	O	O
VITAMIN A	O	O	O	X	O	O	O	O	O	O	O	O	O
VITAMIN D	O												
VITAMIN C (ASCORBIC ACID)		X	O	O	O	O	O	O	X	O	O	O	O
THIAMIN	O	X	X	X	X	X	O	O	X	X	X	O	X
RIBOFLAVIN	O	O	O		O	O	O	O	O	O	O	O	O
NIACIN	O			O	O	O				O	O		X
VITAMIN B-6	X			X									
VITAMIN B-12	O												
CALCIUM	O	X	X	X	O	O	O	X	O	O	O	O	O
PHOSPHORUS	O			O	O	O		O		O	O		O
MAGNESIUM	X			X									
IRON	X	X	X		X	X	X	X	X	X	X	X	X
ZINC				X									
IODINE				O									

* = CHEMICAL ANALYSIS
\+ = CALCULATIONS FROM FOOD COMPOSITION TABLES
X = NUTRIENT LEVELS DID NOT MEET ONE-THIRD RDA STANDARD
O = NUTRIENT LEVELS DID MEET ONE-THIRD RDA STANDARDS
BLANK = ADEQUACY OF NUTRIENT LEVELS NOT REPORTED OR NOT DETERMINED
a = THERE IS NO FORMAL RDA GOAL FOR ENERGY, AND FAILURE TO MEET ONE-THIRD RDA SHOULD NOT BE CONSTRUED AS A DEFECT IN THE PROGRAM.

A few studies have assessed the amounts of these dietary constituents in school meals. Murphy et al. (1968) reported that in 300 schools surveyed, fat constituted an average of 38.8 percent of the energy found in lunches. In the study by Head et al. (1973) fat averaged 43 percent of energy. Of the sample trays, 13 percent had over 50 percent of their energy derived from fat. In another study of the fat content of lunches served in 104 elementary and secondary schools (USDA, FNS, 1979), the percent of energy derived from fat averaged 39 percent, but almost 23 percent of the elementary school lunches and 11 percent of the secondary school lunches provided 45 percent of the total energy from fat. Martin found that fat averaged 43 percent of energy in the lunches she surveyed. These levels of energy derived from fat, however, far exceed the 30 to 35 percent level recommended by some health authorities (e.g., National Research Council, 1980, p. 36).

None of the studies discussed above differentiated between saturated and unsaturated fat, nor were the levels of cholesterol, sugar, or fiber in the meals analyzed. The sodium content of school meals was analyzed by ~~only~~ one of the cited studies. Murphy et al. (1970) reported that the average sodium content of Type A lunches was 1,466 milligrams, with a range from 873 to 2,345 milligrams. If one-third of the day's sodium is supplied by lunch, ranges for the day would be from 2,619 to 7,035. Since the estimated "safe and adequate" range for daily sodium intake is only 900 to 2,700 for children 11 years of age and older (National Research Council, 1980), the school lunches studied by Murphy had an excessive amount of sodium.

School Breakfast as Served and as Consumed

To date, only one study has reported on the nutrient content of school breakfasts. It was conducted by the Opinion Research Corporation (1979) under contract with USDA. At the time this study was conducted, program regulations allowed three different breakfast patterns that qualified for federal reimbursement. The "basic" school breakfast pattern consisted of one-half pint of fluid milk, one-half cup of fruit/vegetable juice, and one slice of bread or cereal equivalent; an "augmented" pattern supplemented the "basic" pattern with a protein-rich food such as eggs or breakfast meat and the third pattern substituted a "formulated grain-fruit product" for the bread and cereal of the "basic" pattern. The nutrient content of these products was required to meet federal specifications.

The sample for the study included 67 schools nationwide: 43 schools that participated in the School Breakfast Program and the National School Lunch Program and 24 schools that participated only in the National School Lunch Program. Data collection and analysis procedures were identical to those described earlier for the Opinion Research Corporation study on school lunch, and are not repeated here.

The draft report did not state how many schools served the "basic" and "augmented" patterns, but indicated that only three elementary schools served the "formulated grain-fruit product." Nutrient values were reported as averages at specified grade levels for all students who were served each of the patterns over the five days. The numbers of students in each category were as follows:

	Basic	Augmented	Grain-fruit
Elementary			
Males	871	653	136
Females	865	688	80
Secondary			
Males	426	420	0
Females	242	201	0

The nutritional content of breakfasts as served and as consumed was estimated using Agriculture Handbook No. 8, for energy, protein, vitamin A, ascorbic acid, thiamin, riboflavin, niacin, calcium, phosphorus, iron, and fat. Since USDA has no official RDA goal for breakfast, as it has for lunch, the authors selected an arbitrary level of 25 percent of the RDA as the goal for evaluating the nutritional value of breakfasts as served and as consumed. (They also evaluated energy intake and consumption against a one-fourth RDA criterion. As with the corresponding research criterion for energy at lunch, this breakfast criterion may be reasonable as an average, but individuals may require more or less of their energy needs at breakfast.)

Table V-4 summarizes the major nutrient deficits found in the study, ignoring differences among the three breakfast patterns. Breakfasts as consumed were uniformly below one-fourth of RDA for energy, vitamin A, iron and preformed niacin, for both elementary and secondary students. The authors explained that the niacin goal probably would have been met if the niacin equivalent value of protein could have been included. so that they considered energy, vitamin A and iron to be the major nutrient deficiencies. In addition, elementary students consumed breakfasts deficient in calcium and phosphorus (all students), and calcium (females only). Served breakfasts had higher nutrient values than consumed breakfasts, with the differences due to plate waste. (No attempt was made to measure losses due to cooking.) The served and consumed breakfasts had similar deficits, although there were instances in which the served breakfasts were adequate (sometimes for females only) but the consumed breakfasts were not.

For elementary students, the served breakfasts were adequate for thiamin (females only), calcium and phosphorus; for secondary students, the served breakfasts were adequate for energy (females only) and vitamin A (females only).

When differences in the three breakfast patterns were considered, the "grain-fruit" pattern, which included a fortified "super donut" or "super bun," appeared to be superior in terms of nutrient quantities to the "augmented" pattern, and the latter appeared to be superior to the "basic" pattern. The grain-fruit pattern met the one-fourth RDA goal for all nutrients except energy. It was higher than the other two patterns in energy; however, it was also higher in fat as a percentage of energy (44 percent, compared with 39 percent for the augmented pattern and 28 percent for the basic pattern). The

Table V-4. Major Nutrient Deficits in Opinion Research Corporation (1979) Breakfast Data, Using One-Fourth RDA as a Standard

	Breakfast as Served		Breakfast as Consumed	
	Elementary Students	Secondary Students	Elementary Students	Secondary Students
Energy[d]	X	X[a]	X	X
Protein				
Vitamin A	X	X[a]	X	X
Ascorbic Acid				
Thiamin	X[a]		X	
Riboflavin				
Niacin	X[c]	X[c]	X[c]	X[c]
Calcium			X[b]	
Phosphorus			X	
Iron	X	X	X	X

[a] Males only.

[b] Females only.

[c] Preformed niacin only; does not include niacin equivalents in protein.

[d] For all nutrients, the one-fourth standard is for research purposes, and has no official standing. The one-fourth standard for energy will not be appropriate for many individuals, and may not be appropriate in the aggregate.

198

authors remark that the plate waste for the grain-fruit products was also quite low (about 2 percent of the amount served), so it appears to be popular with students. These findings about the grain-fruit pattern should be regarded cautiously, since the study included only three elementary schools and no high schools that served it. The augmented breakfast has a protein dish such as eggs or sausage added to the basic breakfast consisting of cereal, milk and juice. It supplied significantly higher amounts of calories and protein than the basic breakfast, but did not appear to provide significantly more of the other nutrients.

For served breakfasts, the levels of all nutrients were higher for secondary than for elementary students, owing to larger serving sizes. The authors found that secondary students also tended to receive more nutrients as percentages of RDA. However, increasing the serving sizes for elementary students is probably not appropriate, since elementary students also tended to waste more food than secondary students.

In summary, breakfasts as served and as consumed in elementary schools typically supplied less than one-fourth of RDA for energy. Both iron and vitamin A were also below one-fourth RDA as served and consumed. High-school breakfasts supplied energy closer to the one-fourth RDA goal, but iron and vitamin A were still low both as served and as consumed. Other nutrients such as calcium, phosphorus, and thiamin may also present problems under minimal or "basic" breakfast pattern requirements.

B. *Do School Meals Contain Adequate Amounts of Nutrients That Are Deficient in the Diets of School-Age Children?*

The major findings from studies that assess the nutritional status of school-age children, which were reviewed in Chapter III, are briefly summarized here. Dietary findings from nutrition surveys show that school-age children consume levels of calcium and iron that do not always meet the Recommended Dietary Allowances. Some subgroups of children also have low intakes of vitamin A and ascorbic acid. More limited data indicate that vitamin B_6

magnesium, zinc, and folic acid, may be problem nutrients in the school-age population. Potentially excessive intakes of dietary fat, cholesterol, sugar, and salt are also of concern. Deficient dietary intakes observed in these studies are not necessarily accompanied by low biochemical values for these nutrients. However, poor iron status, as measured by hemoglobin, hematocrit, and transferrin saturation levels is a consistent finding. Low-income children generally have lower levels than children from higher-income families.

Some biochemical studies have shown that vitamin A, riboflavin, vitamin B_6 and folic acid may also be of concern for selected subgroups. The Ten State Nutrition Survey (TSNS) and another study of children in Texas (Larson et al., 1974) discovered low levels of serum vitamin A among Spanish-American children. Low-income children in the TSNS also had low urinary riboflavin values. Low serum folate levels have been reported among teenage girls, especially those who are pregnant (Van de Mark & Wright, 1972).

Poor growth and development, obesity, and dental caries are also problems that affect school-age children in the United States. Evidence of retarded growth has been found among young children from low-income families. Low-income children are also thinner on average than children from higher income groups (Ten State Nutrition Survey, HANES). After age 16, however, low-income black females have the greatest numbers who are obese (Gran & Clark, 1976). The incidence of dental caries shows a relationship with income. In the TSNS, low-income children had fewer dental caries than high-income children, but low-income children had poorer levels of dental care. Other problems that are seen with increased frequency among school-age children are elevated serum lipids and hypertension. Although average serum cholesterol levels for children generally fall within the normal range, some studies have found children with values over 200 mg% (e.g. Lauer et al., 1975; Hodges & Krehl 1965; Lee, 1978). Dietary constituents are not well correlated with serum cholesterol values but some investigators have found associations with obesity, and level of physical activity (e.g., Hodges & Krehl, 1965; Foster et al., 1977).

Elevated systolic blood pressure has been found in several studies of school-age children (Lauer et al., 1975; Christakis et al., 1967). Although the role of diet in the etiology of high blood pressure is controversial, obesity is associated with this condition (Lee, 1978; Christakis et al., 1967; Hodges & Krehl, 1965).

Table V-5 compares selected findings of surveys identifying nutrition problems of school-age children in the United States with corresponding data from the studies of the nutrient content of school meals reviewed in the previous section. These findings are predicated on a one-third RDA baseline for lunch and one-fourth RDA for breakfast. The contribution of school nutrition programs to the development of obesity cannot be adequately assessed apart from food intake measures obtained throughout the entire day. There is evidence that some children consume over one-third of their total energy from between-meal snacks (Frank et al., 1978). For these children it may be beneficial that school lunches and breakfasts on the average provide fewer calories. On the other hand, poor growth and development due mainly to an insufficient quantity of food have been shown to be problems among young low-income children. These children could derive substantial benefit from school meals that make up for energy deficits.

Iron deficiency is another problem that has been repeatedly documented in nutrition surveys of school-age children. Studies of school lunches and breakfasts show that iron is consistently below the goal of one-third RDA for lunch and one-fourth RDA for breakfast. So far, school menu patterns have been unable to contribute to the solution of this child nutrition problem.

Other nutrients such as calcium, ascorbic acid and vitamin A that are frequently investigated in children's diets are on the average adequately supplied by school lunches. However, the vitamin A content of lunches as served is variable among schools and may be low in school breakfasts. As noted earlier, exposure of food to heat and light during preparation in schools can limit the availability of ascorbic acid.

Table V-5. Comparison of Selected Findings of Surveys of Nutritional Status of Children and Nutrient Content of School Meals

NUTRITION PROBLEMS IDENTIFIED IN SURVEYS OF SCHOOL CHILDREN	AVERAGE NUTRIENT CONTENT OF SCHOOL MEALS IN RELATION TO NUTRIENT GOALS	
	LUNCH	BREAKFAST
GROWTH AND DEVELOPMENT:		
SHORT STATURE AND UNDERWEIGHT IN LOW-INCOME CHILDREN	OVER 1/3 RDA FOR PROTEIN	OVER 1/4 RDA FOR PROTEIN
OBESITY INCREASING WITH AGE	BELOW 1/3 RDA ENERGY	BELOW 1/4 RDA FOR ENERGY
DIETARY INTAKE:		
NUTRIENTS OF GENERAL CONCERN –		
CALCIUM	OVER 1/3 RDA	OVER 1/4 RDA
IRON	BELOW 1/3 RDA	BELOW 1/4 RDA
VITAMIN A	OVER 1/3 RDA*	BELOW 1/4 RDA
ASCORBIC ACID	OVER 1/3 RDA	OVER 1/4 RDA
NUTRIENTS OF POTENTIAL CONCERN –		
VITAMIN B_6	BELOW 1/3 RDA	NOT STUDIED
MAGNESIUM	BELOW 1/3 RDA	NOT STUDIED
ZINC	BELOW 1/3 RDA	NOT STUDIED
FOLIC ACID	NOT STUDIED	NOT STUDIED
POTENTIALLY EXCESSIVE INTAKES OF –		
ENERGY***	BELOW 1/3 RDA	BELOW 1/4 RDA
FAT	HIGH	HIGH**
SALT	HIGH	NOT STUDIED
CHOLESTEROL	NOT STUDIED	NOT STUDIED
SUGAR	NOT STUDIED	NOT STUDIED

* RESULTS ARE VARIABLE FOR DIFFERENT SCHOOLS.

** IN AUGMENTED AND FORMULATED FRUIT GRAIN BREAKFAST PATTERNS

*** THERE IS NO FORMAL GOAL FOR ENERGY. STUDIES HAVE CONSISTENTLY FOUND ENERGY CONTENT TO BE BELOW THE RESEARCH CRITERIA OF 1/3 RDA FOR LUNCH AND 1/4 RDA FOR BREAKFAST.

Only a few studies have assessed nutrients for which RDA have been established recently, such as vitamin B_6, zinc, folic acid, and magnesium. Two studies of the school lunch program (Murphy et al., 1969; Comptroller General of the United States, 1978) find magnesium below one-third of the RDA. The GAO study also finds zinc to be low.

There are indications that some school lunches are high in fat (Murphy et al., 1968; Head et al., 1973; USDA, FNS, 1979). Only one study (Murphy et al., 1969) determined the sodium content of Type A lunches. The broad range of reported values suggests that some school lunches may be contributing to high sodium intakes. These findings of high sodium intake are inconsistent with joint USDA/HHS recommendations to moderate intake of this dietary constituent.

The nutrition surveys of school-age children and studies of the nutritive value of school meals indicate that energy and iron levels in school meals may need to be increased to meet the nutrition problems of some children, and that vitamins A and C may require special attention from menu planners. The questions of how well the nutritional benefits of the school nutrition programs are targeted to nutritional needs cannot be answered at this time from the studies reviewed in this chapter. Many of the nutrients of concern in the diets of school-age children have not been analyzed in school meals. Furthermore, no study of school lunch or breakfast has analyzed consumption data for ethnic and income subgroups of the population who are at risk for specific nutrition problems, nor has any study consisting of a nationally representative sample of schools determined whether menus are planned with the special needs of these subgroups in mind. Equally important, it is questionable whether school meals should have the level of nutrients required to treat diagnosed nutritive deficiencies in children. The role of the school nutrition programs has traditionally been seen as preventive rather than therapeutic. Nevertheless, the studies to date give some indications of how the targeting of nutritional benefits might be improved.

C. *What Response Has USDA Made to the Findings of Nutritional Studies?*

The U.S. Department of Agriculture recognizes the implications of the studies reviewed in the previous sections for safeguarding the health of children and appreciates the need to develop policy alternatives that will improve the targeting of the school nutrition programs in that regard. Accordingly, USDA has adopted a number of policy alternatives that will improve the ability of the school nutrition programs to reach their legislative goals of safeguarding the health and well-being of the nation's children. USDA actions that are intended to improve the targeting of the school nutrition programs include sponsorship of pilot studies on nutrient standard alternatives to the Type A pattern, initiation of the "offer-versus-serve" provision for junior and senior high school students, regulation of the sale of competitive foods, and changes in the Type A meal pattern. Many of these actions increase the ability of local schools to meet the nutritional needs of their students. They are part of the ongoing process of improving the programs to carry out their legislative mandate.

Nutrient Standard Menus

The nutrient standard menu has been proposed as a way to increase flexibility in menu planning and, at the same time, to assure that current nutrient goals are met for the National School Lunch Program. Instead of using specified quantities of items in each of the food groups to select menu items (as is done when planning Type A lunches), the nutrient standard approach uses a menu consisting of standardized recipes for specific food items that have been analyzed for nutrient content per serving.

Jansen et al. (1975) report the results of a study comparing Type A menus with menus planned specifically to meet a nutrient standard of one-third RDA for energy and nine nutrients (protein, calcium, phosphorus, iron, vitamin A, vitamin C, riboflavin, thiamin, and niacin). The nutrient content of school lunches as served and as consumed was compared for these two menu planning approaches. The sample included 58 elementary and secondary schools. Each school tested both the Type A and nutrient standard menu planning methods at different times.

School lunch trays were sampled for two weeks: one week for the Type A meal and one week for the nutrient standard menu. Each day five trays were randomly selected from the lunch line as either fifth- or tenth-grade students were being served. The edible portion of each menu item on all of the trays was weighed in order to establish average serving sizes. Recipes were also available for each of the menus served. These data were used along with food composition tables to calculate the nutrient content of meals as served.

At the completion of the meal, lunch trays were collected from students (approximately 30 to 50 student trays were collected per school over the two weeks). Edible portions of wasted food were then weighed and the weight was subtracted from the average weight served to determine food consumed. Food composition tables were used to calculate the nutrient content of meals as consumed.

Jansen et al. find that nutrients in both Type A and nutrient standard menus as served in grades five and ten exceeded one-third of the 1968 RDA on average for protein, calcium, phosphorus, vitamin A, vitamin C, niacin, and riboflavin. Neither menu plan reached one-third RDA on average for iron, thiamin, and energy. The nutrient standard menus as served contained less fat on average (39.2 percent) than the Type A menus (42.5 percent), but the difference was not significant.

For both grades, nutrients in lunches as consumed met one-third of the RDA for vitamin A, vitamin C, riboflavin, and niacin in both menu plans. For grade five, average protein and calcium levels were slightly below one-third RDA in both plans. In grade ten, average protein in both plans exceeded the standard, but calcium was slightly below. Regardless of the type of menu plan, lunches consumed by fifth-grade students contained only 67 percent of the one-third RDA goal for iron, 59 percent for thiamin, and 66 percent for energy. Lunches consumed by the tenth-grade students on average supplied 77 percent, 75 percent and 78 percent, respectively, of the one-third RDA goal for iron, thiamin, and energy.

Two other studies examined menus planned by the computer-assisted nutrient standard (CANS) approach (Memphis City Schools, 1975; Dade County Public Schools, 1975). In order to test the CANS technique, USDA established the nutrient standard at approximately one-third of the 1968 RDA for energy, vitamins and minerals and one-half RDA for protein based on requirements for 10- to 12-year-old boys and girls (fifth grade). Furthermore, fat could supply no more than 35 percent of the total energy in the meal. One purpose of these studies was to compare CANS menus to the Type A lunches in terms of the nutrient content of meals as planned, served, and consumed. In calculating the nutrient content of the meals, procedures similar to those outlined in the previous studies were used to determine average serving sizes, measure plate waste, and calculate nutritive values from food composition tables.

Ten schools each in Memphis, Tennessee, and Dade County, Florida, planned and served CANS menus for a period of ten days. Ten other schools in each district acted as controls by continuing to serve menus based on the Type A pattern. In Memphis, data were collected from 989 fifth-grade students, while 1,190 fifth-grade students were included in the Dade County study. Although the CANS menus were not required to contain foods from the Type A categories, the authors of the Dade County Study noted that each menu contained a main dish, dessert and milk. The remaining starch, vegetable, salad and bread items were selected or omitted depending upon the focus required to meet the nutrient standard. As it turned out, 28 of the 46 menus planned by CANS in Dade County also met the Type A pattern requirements.

Results of the Memphis study indicate that there were no significant differences in nutritional value between menus planned using the Type A pattern and the CANS technique. Both methods met or exceeded the goal for energy and all nutrients studied: protein, calcium, iron, phosphorus, vitamin A, thiamin, riboflavin, niacin, and vitamin C. However, neither set of menus was able to meet the fat constraint; on the average, menus in both systems exceeded 35 percent of energy from fat.

When meals were actually served to students, there were often changes in the foods originally planned for the menus; therefore, nutrient contents of menus as served were not always the same as nutrient contents of menus as planned. In menus as served, both Type A and CANS provided less than the nutrient standard for energy, iron and thiamin. The CANS menus had significantly higher levels of protein, riboflavin, niacin, vitamin C and energy as compared with the Type A menus. CANS menus also provided a significantly lower percentage of energy from fat. Fifth-grade students tended to consume larger amounts of the Type A menus than the CANS menus; therefore, when the nutritive value of average intake was calculated, students consuming CANS menus had more vitamin C and riboflavin and a smaller percentage of energy from fat, while students consuming Type A lunches had greater intakes of the remaining nutrients.

Results of the Dade County study are somewhat different. In general, CANS menus came closer to meeting the nutrient standard than Type A menus for energy and all of the nutrients analyzed in the Memphis study. On average, all CANS menus as planned were within 10 percent of the nutrient standard for all nutrients, while the Type A menus were only within 28 percent of the goal. CANS menus as planned had significantly higher levels of energy, protein, iron, vitamin A, thiamin, riboflavin, and niacin than Type A menus. Fat in the Type A menus exceeded the 35 percent constraint more often than in menus planned by CANS. Energy, iron and thiamin levels were below the nutrient standard in both types of menus as planned although CANS menus were closer to the standards.

The analysis of the nutritional value of lunches as served shows that energy, iron, and thiamin were below the standard for the Type A lunch, while the CANS meal was deficient in energy and iron. Under both plans, phosphorus, vitamin A, riboflavin, niacin, and vitamin C exceeded the standard, while protein and calcium were closer to meeting the goal.

As in the Memphis study, students who were served the Type A meals consumed slightly more than students who were served meals planned with CANS. This affected the nutrient advantages shown for the CANS menus as planned and as served; however, intakes of energy and iron were significantly greater from CANS menus than from Type A, and CANS menus as consumed still had a significantly lower percentage of energy derived from fat.

These studies suggest that planning menus with a computer to meet a specified nutrient standard may yield better accuracy than the Type A pattern for some nutrients, but the nutrient standard approach does not improve the capability of school meals to provide one-third RDA for iron, thiamin, and energy. These nutrients continue to be problems no matter which system is used. Furthermore, lower acceptance by students of some CANS menus may negate part of the benefits of the nutrient standard approach. Although further experimentation with different systems may solve this problem, for the time being USDA has concluded that the nutrient standard approach is not superior to the Type A pattern as a means of planning school lunch menus. Iron, thiamin and energy remain below one-third RDA no matter what system is used. Furthermore, the complexity of manual calculations under the nutrient standard approach, given the range of backgrounds among school food service personnel, could lead to mistakes that would affect the nutritional value of the school lunch.

Offer-versus-Serve Provision

Effective in 1975, the National School Lunch Program regulations were amended to include the Type A offer-versus-serve (OVS) provision. Under this provision, senior high school students must be offered all food components in the Type A lunch (i.e., meat/meat alternate, milk, bread, fruit and/or vegetable in two servings), and if they select at least three of the items, the meal still qualifies for federal reimbursement. The purpose of the OVS provision is to decrease plate waste and allow students to exercise more choice in food selection. By improving food consumption, the nutrient intake of students may increase. In 1978, the OVS provision was extended as an option to junior high and middle schools.

In order to assess the OVS provision, USDA contracted with Colorado State University to compare the OVS provision with three alternative lunch patterns (Harper et al., 1978). The three alternative meal patterns selected for comparison with OVS were: (1) Type A, with students required to select all meal components, (2) Basic Four, in which students were required to select one food from each of the Basic Four Food Groups, and (3) Free Choice, in which students were offered at least two selections from an <u>a la carte</u> menu. In the free-choice option, the maximum number of selections from each food category was specified, but students were not required to select a specific number of categories and schools could provide second helpings.

Comparisons of the alternative menu patterns were made for effects on nutritive value of food served, nutritive value of food consumed, plate waste, labor requirements, labor costs, student satisfaction, and school lunch manager evaluations. Most relevant to the targeting question is whether students who were offered various types of lunches consumed meals that met the nutrient goal and whether any of the alternatives was successful in solving the problem of supplying adequate amounts of iron, thiamin and energy.

Forty-eight schools nationwide were selected to participate in the study. All schools served the OVS lunch for four weeks and then served one of the alternative patterns for four weeks. Data were collected from each school over two, five-day periods, one period during the four weeks when the OVS lunch was served and one during the four weeks when the alternate was served. The amount of each food item served was determined by weighing five standard servings from the cafeteria line each day. Ingredients used in the recipes were verified by the data collectors while food was being prepared. From these data, the average amounts of energy and nine nutrients (protein, iron, calcium, phosphorus, vitamin C, vitamin A, riboflavin, thiamin, and niacin) served in school lunches were calculated using food composition tables and were then compared with the goal for one-third of the 1974 RDA. The amount of food consumed by students was calculated by measuring plate waste and subtracting this from the average serving sizes; food composition tables were then used to estimate nutrient levels of food consumed.

For purposes of analysis, the investigators set the nutrient goal at one-third of the 1974 RDA. Separate analyses were provided for females and males of high school age. Results of the study showed that nutrient levels in lunches served were not significantly different when alternative meal patterns were served than when OVS was in effect. The menus for all schools averaged 100 percent or more of the goal for all nutrients except energy, iron, and thiamin. For males, energy, iron, and thiamin averaged 77 percent, 83 percent, and 98 percent of the goal, respectively. For females, only iron was below the one-third RDA goal. Iron in lunches served to females averaged 81 percent of the goal.

Harper et al. found that for tenth-grade males, regardless of meal pattern, lunches as consumed fell significantly below the one-third RDA goal for energy and iron, and thiamin fell signficantly below for the Basic Four and Type A patterns. Niacin was also low, but niacin equivalents from protein were not included in the calculations. Lunches consumed by girls met the one-third RDA goal for energy and thiamin on the average, but none of the meal patterns met the one-third RDA goal for iron. The percentages of energy from fat in meals as consumed by the students averaged 37 to 39 percent, regardless of the meal pattern. The study found that none of the meal pattern alternatives were significantly different in terms of the nutrient value of school lunches as served or as consumed. While the OVS provision currently remains in effect, the study results indicate that energy, iron, and thiamin present consistent problems for both the OVS and Type A pattern.

Competitive Food Rule

On July 6, 1979, USDA issued a proposed regulation affecting the sale of foods in competition with meals served under the National School Lunch Program and the School Breakfast Program. The objective was to help assure that foods consumed at school, whether under USDA auspices or not, are sufficiently nutritious to safeguard student health and well-being and are thus aligned with the goals of the school nutrition programs. The regulation established minimum nutrition standards for foods sold in competition with school lunch and school breakfast. In addition, it identified foods of minimal nutritional value and restricted their sale until after the last lunch period. "Minimal nutritional value" was defined as providing less than 5 percent of the USRDA* per 100 calories for each of eight specified nutrients, and less than 5 percent of the USRDA per serving for each of these same eight nutrients. The eight nutrients are protein, vitamin A, vitamin C, niacin, riboflavin, thiamin, calcium and iron. Final regulations on the competitive food rule were issued on January 29, 1980 and became effective on July 1, 1980 in schools serving USDA meals.

Changes in the Pattern

The fourth approach that USDA has explored in an effort to improve the targeting of nutritional benefits in the school lunch program has been to modify the Type A meal pattern itself. In fact, the meal pattern has been altered so much that the term "Type A" has been discontinued, and USDA publications now simply refer to the "school lunch pattern" or "reimbursable meal." The same amendment that authorized the OVS provision in 1976 also deleted the requirement that one teaspoon of butter or margarine be served. This action was taken to reduce the fat content of reimbursable meals.

Between 1977 and 1980 USDA issued a series of proposed, interim, and final regulations that altered the Type A pattern (USDA, September 9, 1977; USDA, August 22, 1978; USDA August 17, 1979; USDA, May 16, 1980). The purpose of these regulations was to have the meal pattern conform to the 1974 edition of the RDA and to improve the targeting of the school food programs to meet the nutritional needs of school children. In 1976 the Consumer and Food Economics Institute (CFEI) of USDA reviewed the Type A pattern and estimated the nutrients needed in the school lunch in order to meet the 1974 edition of the RDA, for each of five age groups. Recommendations were then developed

* The U.S. Recommended Daily Allowances (USRDA) should not be confused with the Recommended Dietary Allowances (RDA). For ten nutrients, the USRDA specifies the highest amount needed by any population group; it is generally used for labeling purposes.

for the amounts of meal components to be served in the school lunch in order to provide these nutrients. These recommendations, as well as other changes, were included in the revisions to the meal pattern regulations.

Proposed changes in the Type A meal pattern were published in the Federal Register on September 9, 1977. These proposed changes included the following:

- The quantities of food required for each of the Type A meal components were altered, and minimum portion sizes were specified for each of five age/grade groups: ages 1 to 2, ages 3 to 4, ages 5 to 8, ages 9 to 11 and ages 12 and over. The original Type A pattern was based on the RDA for a 10- to 12-year-old child. In the past, regulations have allowed variations in portion sizes for school children of different ages upon approval of the administering agency (state or FNSRO), but USDA officials observed that such variations were rarely made. In comparison with the standard Type A pattern, the adjustments in portion sizes would reduce the amounts of meat/meat alternate and fruits and vegetables for children in grades K to 3. The required amounts of meat/ meat alternate would increase for grades 7 to 12, while the amounts of fruits and vegetables remained the same. The bread requirement would increase for all age groups. The reason for increasing the amount of bread required in the meal pattern was to increase the level of iron supplied by school lunches and to account for the increased RDA for niacin, riboflavin, thiamin and vitamin B_6 in the 1974 edition (USDA, FNS, OPPE, 1980). Increasing the meat/meat alternate was also expected to raise the iron content of lunches served to the older children.

- The list of acceptable bread alternates would be expanded to include enriched or whole grain rice and pasta products.

- The number of servings of bread or bread alternate would be specified on a weekly basis rather than on a daily basis, as in the past.

- The amount of dry beans and peanut butter that can be used to satisfy the meat/meat alternate and the fruit/vegetable requirements would be defined, and the number of eggs used to satisfy the meat/meat alternate requirement would be specified. In addition, the combination of quantities of alternates that could be used to satisfy the meat requirement was outlined.

- Unflavored low-fat, skim or buttermilk would have to be offered.

- If they thought that they would not eat all of the lunch, children 12 years and older would be encouraged to ask for smaller servings.

- Schools would be required to involve students in various aspects of the lunch program including, for example, menu planning, the improvement of the school food service, and nutrition education activities.

- Parent and facility involvement in the program was to be encouraged.

- The following recommendations for meal planning and preparation were provided: keep fat, sugar, and salt at a moderate level; include several foods for iron each day; include a food rich in vitamin A at least twice a week; include a food rich in vitamin C several times a week; and use no more than three eggs per five school lunches per child.

In addition, a regulation relating to food service in preschool settings was included in the proposed regulations. The proposed regulations also asked schools to consider allowing students to come back for second helpings. The USDA never formally specified a goal for energy in the school lunch, and lunches meeting the minimum one-third of the RDA goal for other nutrients were likely to provide less than this for energy. The provision of second helpings would allow some children, especially those from low-income families, to increase their energy intake.

After a period of public comment, the proposed regulations were issued on August 22, 1978 as interim regulations. Schools were not required to change the meal pattern immediately. Instead, the interim regulations authorized two types of field testing of the meal pattern changes: voluntary field testing by school food authorities (SFAs) and a comprehensive evaluation of the proposed changes by USDA. The SFAs were required to obtain approval from their administering agency (state or regional) before initiating a field test of the meal pattern changes. In order to evaluate the proposed changes systematically, FNS, initiated two pilot projects and a series of four studies to examine several issues raised by the interim regulations, including:

- The effects of changes in the school lunch meal pattern requirements;
- Methods for involving students, faculty and parents in the school lunch program;
- Methods for controlling sugar, fat and salt in school lunches;
- Methods for providing one-third of the Recommended Dietary Allowances (RDA) for food energy in school lunches;
- The use of extension service specialists in training school food service managers;
- The nutritional, food quality, and plate waste impacts of using cash in lieu of commodities in school lunches.

Results from these studies are currently being examined. The anticipated revision in 1979 of the RDA caused USDA to issue final regulations on the meal pattern changes in two parts. The first part, which would not be affected by study results or RDA revisions, was issued on August 17, 1979. These regulations made final the following provisions of the interim regulations:

- Expanding the list of bread alternates to include additional cereal products such as bulgur, corn grits, pasta, and enriched or whole-grain rice, in order to increase the variety in school meals, and to allow many traditional ethnic cereal products to be reimbursable.

- Requiring the unflavored low-fat, skim, or buttermilk be offered in addition to whole or flavored milk, in order to provide students the option of reducing fat by choosing these alternatives.

- Requiring that students and parents be involved in the planning of the school food program, since such involvement is usually associated with higher student participation, greater program acceptability, and lower plate waste.

- Recommending several goals for menu planning, in keeping with current nutritional advice:

  - To include several foods containing iron each day; to include a vitamin A food at least twice a week; and to include a vitamin C food several times a week.

  - To offer a selection of foods, including types of milk, from which children may choose a lunch; in schools unable or unwilling to offer a choice of meat or meat alternates each day, to serve no single form of meat or meat alternate more than three times per week.

  - To keep fat, sugar, and salt at a moderate level.

The first three of these provisions were required, while the final provision was a recommendation. Implementation of these regulations occurred in the 1979-80 school year. USDA issued a series of Fact Sheets explaining each of these provisions to assist local food authorities with menu planning and student/parent involvement.

Following the release of the first set of final regulations, the revised RDA were published. In the 1979 edition of the RDA, only ascorbic acid and vitamin B_6 allowances were increased over the 1974 allowances for school-age groups. Using the 1979 RDA, vitamin C in the proposed meal pattern would still exceed one-third RDA, but vitamin B_6 would be slightly below the standard.

The second part of the final regulations was released on May 16, 1980, after study of the 1980 RDA, preliminary results of the FNS studies, and public comments on the changes. The changes were:

- Encouraging schools to vary portion sizes for children of various ages;
- For schools that varied portion sizes, allowing children 12 years and older to request smaller portion sizes.
- Increasing the required quantities of certain meat alternates (eggs, beans, and peas) so that they will provide the same protein as the required quantities for meat and the other meat alternates.
- Changing the bread requirement to specify the number of weekly (instead of daily) servings required and increasing the total number of servings required from five to eight slices per week, with the aim of increasing the amounts of iron, thiamin, riboflavin, niacin, and vitamin B_6 in the meals; USDA recognized that this might increase energy intake, but it was felt that the advantages outweighed the disadvantages.

No action was taken on the regulations pertaining to the service of second helpings or monitoring meal pattern requirements. In addition, the service of lunch to preschool children in two service periods was allowed but not required. These regulations will become effective in the 1980-81 school year.

For those schools choosing to vary portion sizes, the regulations contain guidelines for portions to be served to children in different age groups. Those specified for younger children are considered minimums, i.e., schools may not serve less than these amounts and still be eligible for federal reimbursement. The amounts specified for older children are considered targets, i.e., schools do not have to serve these amounts as long as they meet the basic pattern requirements for the 10- to 12-year-old child. If larger portions are offered, children are allowed to request smaller servings if they feel they will not eat all of the meal.

The cumulative effect of changes in nutritional regulations issued between 1976 to 1980 has substantially altered the school lunch pattern. The quantities required for federal reimbursement beginning in the 1980-81 school year are shown under Group IV in Table V-6. Minimum and recommended quantities that may be served to younger and older children are also specified along with explanations of foods qualifying in each food group.

Discussion of Recent Meal Pattern Changes

Throughout the efforts to improve the programs, insufficient iron relative to the one-third RDA goal has consistently been a problem that has not been solved by various alterations in the lunch pattern. Energy consumption below one-third of the RDA has also been consistently found in studies of the lunch program, but this is not considered a deficiency of the program. Energy levels in the range of 20 to 25 percent of the RDA may be appropriate as an overall goal for the school lunch program.

It is unlikely that one-third RDA for iron can be supplied by the school lunch unless the energy level of the lunch or the iron fortification levels of specific foods are increased. According to the estimates supplied by CFEI, the iron density in lunches meeting the requirements to vary portion sizes is 8 mg per 1000 calories. This is greater than the density of 6 mg of iron per 1000 calories that is typical of a well-balanced American diet; thus, the problem of insufficient iron in the school lunch is not due to poor food choices, but instead is related to the energy levels in lunches which

Table V-6. School Lunch Patterns

SCHOOL LUNCH PATTERNS FOR VARIOUS AGE/GRADE GROUPS

U.S. Department of Agriculture, National School Lunch Program

USDA recommends, but does not require, that you adjust portions by age/grade group to better meet the food and nutritional needs of children according to their ages. If you adjust portions, Groups I-IV are minimum requirements for the age/grade groups specified. If you do not adjust portions, the Group IV portions in the shaded column are the portions to serve all children.

COMPONENTS		MINIMUM QUANTITIES: Preschool ages 1-2 (Group I)	Preschool ages 3-4 (Group II)	Grades K-3 ages 5-8 (Group III)	Grades 4-12[1] ages 9 & over (Group IV)	RECOMMENDED QUANTITIES*: Grades 7-12 ages 12 & over (Group V)	SPECIFIC REQUIREMENTS
MEAT OR MEAT ALTERNATE	A serving of one of the following or a combination to give an equivalent quantity:						• Must be served in the main dish or the main dish and one other menu item • Textured vegetable protein products, cheese alternate products, and enriched macaroni with fortified protein may be used to meet part of the meat/meat alternate requirement. Fact sheets on each of these alternate foods give detailed instructions for use. NOTE: The amount you must serve of a single meat alternate may seem too large for the particular age group you are serving. To make the quantity of that meat alternate more reasonable, use a smaller amount to meet part of the requirement and supplement with another meat or meat alternate to meet the full requirement.
	Lean meat, poultry, or fish (edible portion as served)	1 oz.	1½ oz.	1½ oz.	2 oz.	3 oz.	
	Cheese	1 oz.	1½ oz.	1½ oz.	2 oz.	3 oz.	
	Large egg(s)	1	1½	1½	2	3	
	Cooked dry beans or peas	½ cup	¾ cup	¾ cup	1 cup	1½ cup	
	Peanut butter	2 Tbsp.	3 Tbsp.	3 Tbsp.	4 Tbsp.	6 Tbsp.	
VEGETABLE AND/OR FRUIT	Two or more servings of vegetable or fruit or both to total	½ cup	½ cup	½ cup	¾ cup	¾ cup	• No more than one-half of the total requirement may be met with full-strength fruit or vegetable juice • Cooked dry beans or peas may be used as a meat alternate or as a vegetable but not as both in the same meal.
BREAD OR BREAD ALTERNATE	Servings of bread or bread alternate A serving is: • 1 slice of whole-grain or enriched bread • A whole-grain or enriched biscuit, roll, muffin, etc. • ½ cup of cooked whole-grain or enriched rice, macaroni, noodles, whole-grain or enriched pasta products, or other cereal grains such as bulgur or corn grits • A combination of any of the above	5 per week	8 per week	8 per week	8 per week	10 per week	• At least ½ serving of bread or an equivalent quantity of bread alternate for Group I, and 1 serving for Groups II-V, must be served daily • Enriched macaroni with fortified protein may be used as a meat alternate or as a bread alternate but not as both in the same meal NOTE: *Food Buying Guide for School Food Service* PA-1257 (1980) provides the information for the minimum weight of a serving
MILK	A serving of fluid milk	¾ cup (6 fl. oz.)	¾ cup (6 fl. oz.)	½ pint (8 fl. oz.)	½ pint (8 fl. oz.)	½ pint (8 fl. oz.)	At least one of the following forms of milk must be offered: • Unflavored lowfat milk • Unflavored skim milk • Unflavored buttermilk NOTE: This requirement does not prohibit offering other milks, such as whole milk or flavored milk, along with one or more of the above

May 1980

[1]Group IV is shaded because it is the one meal pattern which will satisfy all requ[illegible]ments if no portion size adjustments are made

*Group V specified recommended, not required, quantities for students 12 years and older. These students may request smaller portions, but not smaller than those specified in Group IV provide only 20 to 25 percent of the RDA. The lowest levels of iron relative to the RDA are for children over 12 years of age. In order to reach the iron goal for older children, USDA considered tradeoffs between raising the bread requirement and raising the meat requirement (USDA, FNS, OPPE, 1980). Under the lunch pattern in effect for the 1980-81 school year, children age 12 and over will receive only 24 percent of their RDA for iron. Raising the iron percentage further by adding more bread or meat would add to the energy and/or fat levels in the lunch. There is a need to balance concern for iron in school lunches with a concern about excessive energy and fat in the diets of school children. USDA noted that although the levels of iron are lower than levels of other nutrients, the total iron content of the meal is a poor indicator of iron availability. Availability depends upon the total composition of the meal. Ascorbic acid and the so-called "meat factor" present in meat, poultry, and fish can produce a four-fold increase in the absorption of nonheme iron. Both ascorbic acid and meat are adequately supplied by the school lunch pattern.

Considerable attention has been given to the fat content of school lunches and the percent of energy derived from fat. The elimination of butter and margarine as a required Type A component in 1976 and the regulation in 1979 requiring schools to offer low-fat, skim or buttermilk should reduce the fat content well below values reported in some of the earlier studies and bring the lunch pattern into compliance with USDA/HHS guidelines. The Fact Sheet issued by USDA to assist schools in controlling fat, sugar and salt in the lunch has specific suggestions for food purchasing, menu evaluation and modifying quantity recipes. Foods high in sugar, fat and salt are also identified.

Results of ongoing USDA studies will indicate whether these recommendations are feasible, and acceptable to students. Follow-up research will be needed to determine how many schools voluntarily comply.

The single study conducted to date on the nutrient content of school breakfasts raises issues that should also be subjects of further research (Opinion

Research Corporation, 1979). USDA has not published nutrient goals for the various breakfast patterns; however, the 25 percent RDA selected by the investigators appears to be a "reasonable yardstick" for purposes of program evaluation. The study shows, however, that none of the breakfast patterns provided this goal for energy. The basic pattern was particularly low, supplying on average only 56 to 66 percent of the goal in elementary schools. Iron and vitamin A were also consistently below the goal.

Consequences of these deficiencies in terms of the program's ability to provide adequate nutritional benefits may be important, since the breakfast program has been encouraged in the past in schools serving large numbers of low-income children. These children could benefit substantially from the combined effects of school breakfast and lunch, but neither program alone supplies adequate amounts of several nutrients for which low-income children are in greatest need. Therefore, we must continue to explore ways to achieve adequate nutritional benefits.

220

CHAPTER VI. INFORMATION REQUIREMENTS

Jean B. Wellisch
Lawrence A. Jordan
Joyce Vermeersch
Jane Green

INTRODUCTION

The preceding chapters present findings from the review of research on the operation, effects and targeting of the school nutrition programs. Chapter I describes the school nutrition programs and their operations based upon legislation and directives. Chapter II provides an assessment of the measures that have been used to determine the nutritional status of children, and Chapter III discusses research findings on the nutritional status of school-age children. The research reviewed in Chapters II and III provides background information needed to evaluate the results of studies on program effects reviewed in Chapter. IV, and the targeting of program benefits discussed in Chapter V.

The review of research, the first phase of the National Evaluation of School Nutrition Programs (NESNP), was undertaken to guide the design of the NESNP and help FNS plan future evaluations of the school nutrition programs. In this chapter, the findings of the review of research are summarized in order to point out where existing information on the school nutrition programs is incomplete and to identify what future research is needed to better assess the effects of the programs and improve their targeting capability. In addition, this chapter indicates how the NESNP will meet some of these information requirements.

The first section of this chapter, on program effects, is organized around the questions that guided the review of research. These are:

1. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS?*

2. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON FAMILIES?*

3. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS?*

The major findings from the review pertaining to each question are presented, along with a discussion of the kinds of additional research that are needed to fully understand the impacts of the programs. Two related kinds of research are discussed, one to provide more conclusive information on program effects through the use of representative samples and rigorously designed studies, the other to improve the techniques used in the measurement of nutritional status.

The second section of this chapter, on targeting of program benefits, is organized around the following questions:

1. *HOW ARE SCHOOL NUTRITION PROGRAMS TARGETED?*

2. *DO THE SCHOOL NUTRITION PROGRAMS MEET THE NUTRITIONAL NEEDS OF SCHOOL-AGE CHILDREN?*

As in the preceding section, major findings from the review are presented, along with a discussion of requirements for additional information. The requirements for additional information are specified for targeting studies and for studies that identify the nutritional problems of school-age children.

The third and last section of this chapter provides an overview of the National Evaluation of the School Nutrition Programs, and highlights the information requirements that will be met by this study.

EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS, FAMILIES AND SCHOOL AND SCHOOL DISTRICTS

While the major emphasis of the school nutrition programs is safeguarding the health and well-being of the nation's children, the effects of the programs on children's families and on the institutions that provide the nutritional services are also of interest. The questions that we attempted to answer through previous research, and the kinds of additional information that are needed concerning program effects on students, families, schools and districts are discussed below.

1. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON STUDENTS?*

The review of research, reported in Chapter IV, focused on studies that assessed program effects on the students' nutritional status (in terms of dietary, biochemical and anthropometric measures), milk consumption, and performance and behavior in school.

NUTRITIONAL STATUS

Investigations of the effects of the school nutrition programs on the nutritional status of students have employed four types of measures: dietary intake, biochemical, anthropometric and clinical. Dietary intake measures provide information about the kinds and quantities of foods consumed by individuals and groups of subjects. Biochemical analyses of blood, urine, hair and saliva can provide evidence of specific nutrient levels and metabolic activities in the body. Anthropometric measures (measurements of height, weight, circumferences and thickness of subcutaneous fat measured at various sites) assess the growth and development of children as reflected by body size and body composition. Clinical signs are used to detect the occurrence of disease conditions caused by the inadequate intake, absorption or utilization of nutrients.

A conclusion of the review of nutritional status measures presented in Chapter II is that there is no single method that will give a complete picture of the nutritional status of children. A combination of different methods must be used depending on the objectives of the study. Many of the studies that assessed program effects on the nutritional status of students employed combinations of these measures. Findings on dietary intake, biochemical and anthropometric measures (as discussed in Chapter IV) are summarized below.

Dietary Intake

Research suggests that lunches consumed by NSLP participants have higher values for several nutrients than the lunches consumed by nonparticipants. The 24-hour intakes of participants and nonparticipants are similar for most nutrients, except that the intake of participants was greater for vitamin A (Price et al., 1975), calcium (Howe et al., 1980; Price et al., 1975, 1978), protein, riboflavin and phosphorus (Price et al., 1978). There are also indications from several studies that some children who are from low-income families or who are otherwise judged to be nutritionally needy receive substantial portions of their total daily intake of nutrients from the NSLP (Emmons et al., 1972; Price et al., 1975; U.S. DHEW, HRA, CDC, 1972).

The findings concerning the effects of the school breakfast program are mixed and difficult to evaluate. One study found that participants in the school breakfast program had higher intakes of many nutrients than students to whom the program was not available, but the number of breakfast program participants in the sample was small, and 91 percent of breakfast participants were also lunch participants (U.S. Congress, Congressional Budget Office, 1980). In the study by Price et al. (1975), vitamin C was the only nutrient that showed a significant difference that could be attributed to participation in the school breakfast program.

Two studies have looked at the effects of participation in multiple school nutrition programs on dietary intake (Emmons et al., 1972; Congressional Budget Office, 1980). Emmons et al. showed that children who received both lunch and breakfast at school had better nutrient intakes than children who received only school lunch and morning milk. The Congressional Budget Office study also showed that children participating in both the school lunch and school breakfast programs had higher nutrient intakes than children participating in only one of the three school nutrition programs.

Biochemical Measures

The relatively few studies that used biochemical measures encountered technical problems that make it difficult to draw definitive conclusions from the results. The most commonly used biochemical measures have been hemoglobin and hematocrit measures. In most studies (Emmons et al., 1972; Price et al., 1975; and Lieberman et al., 1976), there were so few low hemoglobin or hematocrit values that it was difficult to distinguish program effects. Even when the occurrence of low hemoglobin or hematocrit values was more frequent, no discernible effects of program participation could be demonstrated (Paige, 1972). Studies that evaluated other biochemical indices in addition to hemoglobin and hematocrit did not yield meaningful indications of program effects (U.S. Congress, Congressional Budget Office, 1980; Price et al., 1975).

Anthropometric Measures

A cross-sectional study of children selected to be representative of school-age children in Washington State (Price et al., 1975) showed some differences in anthropometric measures between participants and nonparticipants. There was a trend for weight (as a percent of Ten State

Nutrition Survey standards) to be greater among school meal participants than nonparticipants. The greatest difference was observed between male participants and nonparticipants in the below-poverty group. This study found no differences by participation status in height, head circumference, or number of children classified as obese.

None of the longitudinal studies that explored anthropometric changes over a school year found significant differences that could be attributed to the influence of school meals (Lieberman et al., 1976; Paige, 1972; Emmons et al., 1972). As discussed in Chapter II, unless the children are severely malnourished to begin with, the period from fall to spring may be too short to show program effects on anthropometric assessments of nutritional status.

MILK CONSUMPTION

Because students receive milk from the NSLP and often receive additional milk from the SMP, it is possible that milk largely accounts for the higher intakes of specific nutrients by NSLP participants. Accordingly, we reviewed studies that examined milk consumption. Of particular interest were studies that looked at the factors that affect the amount of milk consumed by school children, i.e., participation in the SMP, lactose intolerance, and the inclusion of flavored and low-fat milk options in the nutrition services.

Children attending schools with the SMP have been found to consume more milk in a 24-hour period than children in schools without the program (Anderson & Hoofnagle, 1960; Robinson, 1975). Since 90 percent of the schools with the SMP also have the NSLP, some of this increased consumption may be due to milk provided with the NSLP. According to Robinson, both programs increase student milk consumption; however, the joint effects of the programs on milk consumption have not been analyzed adequately.

In order to obtain indirect evidence of the effects of lactose intolerance, two investigators have explored differences in milk consumption of black and white children who participated in school lunch programs. The studies obtained contradictory results: Paige et al. (1971, 1972, 1974) found that higher percentages of black students, compared to white students, drank less than half of the milk served to them at lunch, whereas Stephenson et al. (1977) found no relationship between race and milk consumption.

Three studies have looked at the effects on milk consumption of flavored and/or low-fat milk options in school feeding programs. While flavored milk appears to reduce milk waste (Guthrie, 1977; Robinson, 1975), there is evidence that the decrease in milk waste is accompanied by increased food waste among the other meal pattern components (Guthrie, 1977). Low-fat milk appears to be as acceptable to children as unflavored whole milk (Godfrey & Schutz, 1972).

SCHOOL PERFORMANCE, BEHAVIOR AND NUTRITIONAL KNOWLEDGE

A few studies have looked at the short-term effects of midmorning feedings (e.g., Dwyer, et al., 1973; Keisler, 1950) and eating breakfast (Arvedson, 1969; Tuttle et al., 1954). These studies produced different results depending on the types of meals that were provided and the types of behaviors that were measured. No research was reviewed that explored the immediate or short-term effects of the federally sponsored school nutrition programs on emotional, cognitive and physical dimensions of school performance and behavior. Some investigators have looked at the long-term effects of these programs on variables such as school grades, attendance and cognitive performance but failed to demonstrate significant relationships (e.g., Koonce, 1972; Lieberman et al., 1976; Pinkus, 1970).

Although exposing children to nutritious meals by means of school meal participation may improve their attitudes toward nutrition and increase their knowledge of nutrition, no studies were found that explored this aspect of participation.

DISCUSSION

Information Requirements on Program Effects

The review of research on the nutritional and behavioral effects of the school nutrition programs left many important questions unanswered or answered inconclusively. More information is needed on questions such as the following:

- What effects do school nutrition programs have on the nutrient intake of participating students?

- What effects does participation in more than one program have on the nutrient intake of students?

- What is the additional contribution of the SMP to the milk intake of students who participate in either the school lunch or school breakfast program?

- Do the effects of the school nutrition programs differ for students with different socioeconomic characteristics?

- What effects does participation in school nutrition programs have on the prevention of nutritional deficiencies such as growth retardation and iron deficiency anemia?

- Do the school nutrition programs contribute to problems of lactose or milk intolerance?

- What effects do the school nutrition programs have on the prevalence of obesity in the school-age population?

- Is participation in school nutrition programs related to the development of high-risk conditions such as high blood pressure, or high values for serum cholesterol and other blood lipid levels?

- Can provision of school meals, particularly school breakfast, reduce behavior problems and improve students' academic performance?

- What effects on general health and well-being can be attributed to participation in school nutrition programs?

Several of these questions have been addressed by the studies cited in the review of research; however, all of the studies suffer from small sample sizes or methodological problems which limit the confidence that can be placed in their results. As discussed in the last section of this chapter, many of these questions will be addressed by the NESNP.

Generally, more research has been conducted on the effects of the NSLP than on the SBP or SMP. Information is lacking on the combined nutrient effects of all three school nutrition programs and on differences in effects for students of different socioeconomic status. There are indications that participation in both the breakfast and lunch programs is particularly beneficial to low-income students but this possibility needs more systematic investigation.

Other common defects which limit the conclusions that can be drawn from previous research are related to the definitions used for program participation, the diffusion of treatment, and the study design and data analysis. These definitional and design defects are discussed below.

- Definition of Participation. Children were usually classified as participants or nonparticipants based on the frequency of their participation in the program. Different studies used different cutoff points to distinguish participants from nonparticipants.

- Diffusion of Treatment. While many investigators reported using the frequency of participation over a specified time period as the criterion for identifying participants, dietary intake data were obtained cross-sectionally using a 24-hour dietary recall. Generally, the researchers provided no assurance that students identified as participants actually participated in the school nutrition program on the day for which dietary information was obtained or that students identified as nonparticipants did not participate in the program on that day. Therefore, many children may have been misclassified as participants or nonparticipants with respect to the 24-hour recall obtained. More generally, participation status is not a simple binary variable, since many students may change status from day to day or from month to month.

  Similar problems affected analyses of anthropometric measures. In cross-sectional studies (e.g., Price et al., 1975) that attempted to relate anthropometric findings to program participation, participation was defined as the number of times per week students consistently consumed the school meals. None of the studies considered the possibility that participation status of students may have fluctuated over the years that students attended school. Such diffusion of treatment can weaken the observed effects on long-term measures of nutritional status.

- Study Design and Data Analysis. Problems of design are particularly apparent in studies that have attempted to determine the effects of breakfast or morning food on the behavior and school performance of students. The studies of short-term effects on behavior did not provide sufficient controls to assure that persons rating the students' behavior were blind to their treatment status. The studies of more long-term effects on performance were flawed by inadequate attention to factors other than participation in the breakfast or lunch program that could have affected the students' academic progress. This problem is also seen in the studies on nutritional impacts. Of all these studies, only two (Congressional Budget Office, 1980; Price et al., 1975) controlled for some of these factors in analysis.

Because of the defects discussed above it is apparent that the relationships between participation in school nutrition programs and the nutritional status and behavior of students have not been sufficiently explored. Future studies need to select measures of participation status that will classify students logically in relation to the type of effects (i.e., 24-hour, short-term/current, and long-term/past) that are being assessed, and also need to control adequately for factors that might confound interpretation of results. In addition to these broad requirements there are some specific issues that must be considered in future research. These issues are concerned with the choice of foods and nutrients that are used to measure program impacts on dietary intake.

The nutrients that have been examined most often in previous research are calories, protein, thiamin, riboflavin, niacin, vitamin A, vitamin C, calcium and iron. Less work has been done to determine program impacts on vitamin B_6, folic acid, magnesium and zinc. Since studies reviewed in Chapter III suggest that some groups of children have low intakes of these nutrients, the school nutrition program could potentially be providing benefits that have not been shown by previous evaluations. Also, there is a need to examine the contribution of school meals to the intake of dietary constituents such as calories, salt, sugar, fat and cholesterol, which are consumed in excessive amounts by some children. Many health authorities believe that problems of overconsumption are of greater importance to the health of today's children than problems of underconsumption, yet little attention has been given to the analysis of overconsumption in evaluations of the school nutrition programs.

Of the specific foods that require further study, milk continues to be of primary interest. Policy alternatives regarding continuation of the SMP require further evidence about the contribution of the school nutrition programs to milk intake and the role that milk plays in the diets of children. Better understanding of how milk consumption contributes to lactose intolerance is a problem for clinical nutrition research, but future program evaluations can clarify whether milk consumption is increased by the federal programs and whether the effects are different for groups of students known to be susceptible to lactose intolerance.

The acceptability and effects of offering different types of milk in school nutrition programs also needs further research. The limited information to date suggests that offering flavored milk has undesirable effects on plate waste, but this conclusion is based on only one study in one state. The acceptability of the milk options that must now be offered in NSLP schools (i.e., low-fat, non-fat and buttermilk) should be further investigated for potential policy implications. If acceptable to children, buttermilk could be encouraged as an alternative for those who are lactose-intolerant. In addition, it should be determined whether offering low-fat, non-fat, and buttermilk options reduce the dietary intake of fat as intended by the regulations.

Information Requirements on Methods to Assess Nutritional Status

Both the findings of previous research on the effects of school nutrition programs and plans for future studies needed to answer the questions described above are influenced by the methods currently available to assess the nutritional status of children. As described in Chapter II, all of the methods exhibit certain weaknesses which affect their reliability and validity or their feasibility for use in large-scale field surveys of children. Therefore, in order to improve the quality of evaluation conducted on school program effects, it is necessary to conduct further research on ways to improve the various nutritional status measures.

Dietary Methods. Research on methods to assess dietary intake has led to general agreement that the 24-hour recall is the most practical and valid method currently available for population groups. However, some recent studies which have attempted to use the 24-hour recall specifically for the purpose of evaluating the impacts of food and nutrition programs have discovered that it has a tendency to produce false negative results (Madden et al., 1976) Gersovitz et al., 1978). There is a need for continued investigation of the extent to which the phenomenon and other problems occur when the 24-hour recal is used with different types of subjects.

It is also desirable to determine whether systematic errors due to age, sex, education or socioeconomic status affect the accuracy of the 24-hour recall when the subjects are children. There is only limited evidence in the literature concerning the age at which children are able to provide accurate dietary information, and there are no studies that indicate how measurement errors are affected by sex, education or socioeconomic status in research on children. Studies need to be conducted that compare children's recalls of their food consumption with data obtained by direct observation. Experiments also should be performed to determine the sorts of probes and/or visual aids that are most effective in helping children from different backgrounds recall the kinds and quantities of foods consumed.

Previous studies have not produced a consensus about which methods are most valid for assessing the dietary intake of an individual; however, it is generally agreed that a one-day record or recall cannot adequately reflect intraindividual variation. Most investigators who have studied ways of obtaining dietary information about individuals in large-scale field studies have focused on various modifications of the diet history or food frequency methods. Continued research will help improve these methods for use in longitudinal studies of school nutrition program effects. The food frequency method in particular requires more extensive investigation in use with children. To date, there is no indication whether children are capable of giving reliable and accurate information with this technique. The best method of quantifying food intake information when using the food frequency with children should also be studied.

<u>Biochemical Methods</u>. The issues that appear to be most critical in the selection of biochemical methods to assess the impacts of school nutrition programs are the feasibility of methods in large-scale field surveys and the interpretation of findings in relation to available standards.

Not all biochemical methods are suited to large-scale field studies. The biggest drawback is that the collection of biochemical samples is inconvenient and, in the case of blood, painful for the subjects. One area of research that has recently received attention is the use of samples such as hair and saliva, which may be easier to obtain from subjects than samples of urine and blood. Continued research should be done to evaluate the potential for using these and other noninvasive samples in field surveys.

The second major issue concerns the availability and use of standards. Further experimental and epidemiological data are needed to determine whether standards currently used to interpret biochemical findings from nutrition surveys of children are applicable to all segments of the population. A related question is the significance of cutoff points used to separate normal from abnormal values. The cutoffs currently used for most nutrients are arbitrary. According to Fomon (1977) this is inevitable until the significance of various levels can be related to acceptable physiological or medical criteria.

Anthropometric Methods. The development of standards for the interpretation of anthropometric data is also a priority. Because genetic differences may affect growth patterns and ultimate body size, it may be inappropriate to judge all children by the same standards. There is a need to examine anthropometric data from children to determine the extent to which differences in growth patterns are due to genetic influences, to nutritional and socioeconomic influences, or to interactions between genetic and non-genetic influences.

There is also uncertainty about where to set the cutoff levels that identify obesity in children. This problem is related to a number of unanswered questions concerning the measuremert and interpretation of findings on body composition. There is a need for more research to develop techniques for assessing body composition in children. Applications of these techniques are also required to obtain information on changes in body composition that are related to age, sex, racial background and nutritional status.

Another area of recommended research is the evaluation of indexes of relative body weight. These indexes, composed of height and weight only, have been used to predict body fat and diagnose obesity. There is a need to discover how the various indexes are affected by age, sex and racial characteristics of children to validate them with estimates of body composition obtained by laboratory or other field techniques.

Reliability problems plague all of the anthropometric measures to some extent. For most measures recommended in field surveys the error which produces unreliability is due mainly to interobserver and intraobserver differences. Fatfold measurements using calipers are subject to greater observer error than other kinds of anthropometric measures. The errors are particularly high when subjects are obese.

Other errors result from compressibility of the triceps fatfold, and differences in the shape of the arm and thickness of the arm bone. There is a need to determine how these problems affect the predictive validity of fatfold and arm circumference measurements in children.

Some of the newer field methods for determining body composition also need to be further explored. One of the most promising is the use of ultrasound to determine the thickness of subcutaneous fat, muscle and bone. To date, research suggests that ultrasound may be a more valid measure of body composition than fatfold and circumference measurements, but current ultrasound techniques are subject to greater errors of reliability (Haas, 1979).

2. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON FAMILIES?*

FAMILY FOOD EXPENDITURES AND FOOD CONSUMPTION

The review of research concerning program effects on families attempted to identify studies that had examined effects on family food expenditures, patterns of food consumption, and social interaction among family members. Only one study, which was conducted in Washington State, assessed school nutrition program effects on family food expenditures and food consumption (Price et al., 1975). This study found that free school meals had a fairly strong family income supplementation effect. Families with participating and nonparticipating children did not have distinctly different food consumption patterns.

A commonly mentioned barrier to the establishment of breakfast programs is that school breakfasts may interfere with a period traditionally set aside for families to be together and to "interact," but no previous research could be located that examines this supposed effect on families.

DISCUSSION

The existing research does not provide conclusive answers for any of the questions that guided this portion of the review. Only one study even looked at questions of food expenditure and consumption, and while the findings regarding the supplemental effects of free lunch are important in evaluating the benefits of the NSLP, the study is geographically limited and the results cannot be generalized to the nation. The extent to which school meals, particularly the SBP, interfere with intrafamily social interactions or with the family's traditional functions and responsibilities (as claimed by some) does not appear to have been explored.

3. *WHAT ARE THE EFFECTS OF PARTICIPATION IN THE SCHOOL NUTRITION PROGRAMS ON SCHOOLS AND DISTRICTS?*

The effects of the programs on schools and districts can be examined in various ways. Probably of greatest interest is the effect of federal subsidies and regulations on the ability of schools and districts to provide nutritious meals for all children, and to provide free or reduced-price meals to the economically needy. Two questions that the review of research attempted to answer in this connection were the following: what effect would changes in federal subsidies have on institutional decisions to participate, and what effect would they have on the quality of the meals served to students? Our review was not able to identify any studies that dealt with these questions, which are obviously important during this period when cutbacks to federal programs are being considered.

There are a few studies of factors influencing the institutional decision to participate, but they are primarily concerned with demographic characteristics of the institutions, and not with federal subsidy levels. We found no studies that considered either the effects of federal subsidy levels on institutional participation, or the direct effects of the programs on participating institutions. Since the federal subsidies influence institutional participation by reducing the cost of the programs to participating schools, studies of program costs can provide indirect information on the effects of the federal subsidy levels on participation. These studies can also provide information on the effects of the programs on schools and school districts, since the primary effects will be on expenditures, employment, and the use of facilities. We have reviewed several studies of the effects of planned variations in program operations or procedures on meal service costs, in order to illustrate the kind of information that is available. A final study examined the aggregate effects of the NSLP on the national economy, using an input-output model to show how the NSLP influences expenditures and employment by local schools and school districts.

FINDINGS ON OPERATIONAL VARIATIONS

Although there are many studies that provide information on the effects of planned variations in program operations and procedures on schools and districts, we chose to present only three in order to illustrate the kind of research previously conducted on the effects of operational changes. Two studies examined the effects of variations in food services. One of these looked at the effects on costs, quality and acceptability of school lunches that result from alternate food service delivery systems (Lough et al., 1978). The second study examined similar effects that result from alternative meal patterns (Harper et al., 1978). The third study included in this section comes closest to dealing with the question of the impact of federal subsidization, which we originally sought to answer, by looking at the effects of providing cash in lieu of commodities (USDA, FNS, 1980). The study examined effects on food selection and cost and quality.

The following results were obtained from the reviewed studies of school program variations:

- The labor, equipment, and food costs associated with different delivery systems (such as on-site preparation, central preparation, etc.) were found to vary significantly, even though no significant differences were found in per-meal costs across systems (Harper et al., 1978; Lough et al., 1978).

- Food and labor costs were reported to be significantly lower when students were allowed free choice in their food selection compared to the Type A offer-versus-serve menu pattern. However, the effort required for planning and serving meals under free choice was found to be higher (Harper et al., 1978).

- In the study comparing schools receiving commodities and those receiving cash in lieu of commodities, no significant differences were found. However, state administrative costs were lower in Kansas, where all schools received cash in lieu of commodities, than in neighboring Colorado, where no schools received cash in lieu of commodities (USDA, FNS, 1980).

FINDINGS ON EFFECTS OF THE NSLP ON THE ECONOMY

The final study that was reviewed in this section was selected to illustrate studies that examine the national economic impacts of the NSLP. This study (Nelson & Perrin, 1976) used input-output analysis to evaluate the effects of the NSLP on the national economy.

The authors examined the effects of the school lunch as currently defined, and compared its effects with the estimated effects of three alternative lunch programs: (1) universal free lunch to all students; (2) free lunch to all students currently eligible and reduced-price lunch for all other students; and (3) federal subsidies limited to those students currently eligible for free lunches.

The effects of the current lunch programs on the national economy were estimated for both calendar year 1972 and fiscal year 1974. These effects included the following:

- An increase in gross national product (GNP) of approximately $348 million in calendar 1972 and $448 million in fiscal 1974;

- An increase in business receipts of approximately $[illegible]38 million in calendar 1972 and $982 million in fiscal 1974; and

- An increase in total employment of approximately 33,000 jobs in calendar 1972 and 38,000 jobs in fiscal 1974.

The authors estimated that if the universal free lunch alternative had been in operation in fiscal 1974, an additional $1,163 million in business receipts, $809 million in GNP, and 54,000 jobs would have resulted. The universal reduced-price lunch with a free lunch option would have resulted in smaller gains, while the limitation of federal subsidies to the free lunch program would have reduced business receipts, GNP, and employment slightly.

There are two significant limitations on the results of this analysis. First, the input-output model does not consider the possibility that many schools and districts would continue to offer lunch programs in the absence of the federal subsidy; the analysis essentially assumes that the programs would disappear if federal subsidies were removed. Second, the increases in business receipts and gross national product attributed to the programs included both real increases in production and increases in the prices of the goods (primarily food) and services purchased by the programs.

DISCUSSION

Interpretation of the findings from studies of school program variations is hampered by three general problems: small sample sizes, self-selection of the sample (i.e., all schools were chosen from a relatively small number of schools that volunteered to paticipate in th studies), and short time period for experimental variations to have produced an effect. These problems limit the generality of the results obtained by these studies. Nevertheless, planned program variations can provide policy-relevant information, particularly for the lunch program. Because so many schools have the NSLP, differences in outcomes between program and no-program schools will be difficult. As shown by the few studies cited, it is possible to implement planned program variations on a small scale; however, large sample sizes are needed, particularly where schools are the unit of analysis. It is also important to study the effects of systematic changes in the programs, by treating reforms as experiments. Whenever systematic changes are made, an evaluation should also be conducted to determine whether the objectives that led to the changes were met.

Further investigation is warranted concerning the effects of institutional participation in the school nutrition programs on schools, districts and the national economy. In designing these studies, serious consideration should be given to the assumptions underlying the design and analyses employed. An implicit assumption in many studies looking at program impacts is that in the absence of federal programs, there would be no meal programs in the schools. However, the accuracy of this assumption needs to be examined by looking to see whether or not the schools would continue to provide meal service if the federal programs did not exist. The schools' decision would, in all likelihood, vary from continuing the meal service with no change in operation to dropping it entirely. For example, some schools would continue to maintain the meal service (obtaining funds from local rather than federal sources), and would continue purchasing the same quantities of commodities, employing the same number of people and serving the same number of meals. In other schools, the meal service would be drastically reduced without federal subsidy: smaller quantities of commodities would be purchased, and there would be fewer people employed and fewer meals served. For still other schools, the meal service would be discontinued. These institutional decisions naturally affect the availability of the programs for individual students. Thus, it is important to analyze student and institutional participation simultaneously, since institutional participation affects student participation and, conversely, the probability of student participation affects institutional participation.

TARGETING OF PROGRAM BENEFITS

This section focuses on research pertaining to the targeting of services by the school nutrition programs. There are two different, but related, ways in which the term "targeting" can be used. In one sense, the targets of the program are children who would not otherwise have adequate diets. In this sense, targeting refers to the goal of delivering program benefits to groups with particular economic or nutritional needs: all children need appetizing and nutritious food, but children obviously differ in terms of the extent to which their families and communities have the resources and nutritional knowledge to assure that attractive, well-balanced meals are available. In another sense, nutritious meals are the targets of the programs. In this sense, targeting refers to the goal of ensuring, through program regulations and policy guidance, that school meals meet the best standards of nutritional adequacy.

Two primary questions were posed to examine these separate issues of the targeting of the school nutrition programs: how are the programs targeted, and do the programs meet children's nutritional needs? Findings from the review of research on each of the questions is presented below.

1. *HOW ARE SCHOOL NUTRITION PROGRAMS TARGETED?*

The school nutrition programs have broad legislative mandates to serve the entire school-age population; recent program history, however, shows a program emphasis on meeting the nutritional needs of the poor. Each year, the Secretary of Agriculture issues eligibility criteria that are used by participating schools to determine which students are eligible for free or reduced-price meals or for free milk under the Special Milk Program. These eligibility criteria provide the principal means of ensuring that needy students have access to the programs. The eligibility criteria are based on the poverty income guidelines issued each year by the Office of Management and Budget (OMB) for families of various sizes. The current free and reduced-price eligibility criteria are set at 125 percent and 195 percent, respectively, of the OMB poverty income guidelines for non-farm families. (Prior to January 1, 1981, the USDA eligibility criteria included a semiannual cost-of-living adjustment for changes in the Consumer Price Index between the time that the OMB guidelines were issued and the time that school began; this adjustment was eliminated under P.L 96-499.)

CORRESPONDENCE BETWEEN ECONOMIC AND NUTRITIONAL NEEDS

An important question is whether or not the family size and income criteria for free and reduced-price meals identify children at nutritional risk. Since it is well known that indices of poverty and nutritional risk are correlated, as shown in Chapter III, the general answer to the research question is "Yes." However, the correspondence between economic and nutritional needs is not perfect. Two studies examined the match between the eligibility criteria existing in the early 1970s (when the studies were conducted) and indices of nutritional risk (Emmons et al., 1972; Paige, 1971). These studies found that the family size and income criteria did not invariably identify students at nutritional risk, and that many students from affluent or relatively affluent families were nutritionally needy. However, as reported by Emmons et al., a higher proportion of eligible students (36 percent) than ineligible students (26 percent) were found to be nutritionally needy. Since these two studies were conducted, eligibility criteria have been revised and made nationally uniform, but it is likely that any choice of cut-points would yield numerous false positives (nutritionally non-needy poor students) and false negatives (nutritionally needy affluent or relatively affluent students), owing to the intrinsically low correlation between indices of poverty and nutritional need.

DISCUSSION

Although economic criteria cannot be fully substituted for nutritional criteria in identifying the nutritionally needy, it may be possible to have a better match between the eligibility criteria and nutritional risk. It would be useful to answer a more difficult question: whether the current eligibility criteria are optimal in some sense--for example, whether they identify a higher proportion of children at nutritional risk than other kinds of income criteria. No research was found that bears on such a question; however, it is the kind of question that needs to be add. ssed for purposes of justifying or changing program policies on the eligibility criteria.

There is also a need for research that is aimed at optimizing the eligibility criteria. This research could determine how the distribution of economic and nutritional benefits would change if the present criteria were altered. This kind of determination would require information on the nutritional status of children with varying exposure to the school nutrition programs and varying incomes.

MULTIPLE PARTICIPATION IN FEDERAL FOOD ASSISTANCE PROGRAMS

An issue that is related to the eligibility criteria for free and reduced-price meals concerns multiple participation of families in federal food assistance programs other than the school nutrition programs. The school nutrition programs are not the only federal programs that provide assistance to needy families in obtaining adequate diets. The other programs include: Food Stamps; Supplemental Food Program for Women, Infants and Children (WIC): the Child Care Food Program (CCFP); Nutrition Program for the Elderly; and Summer Food Program for children. By law, individuals may participate in any food assistance programs for which they meet the eligibility criteria. Thus, those who satisfy the requirements may participate in more than one program.

Critics of federal assistance programs have complained that such multiple program participation may result in unintentionally excessive benefits for at least some individ'als. However, it should not be assumed, simply because family members obtain food benefits from more than one program, that the family as a whole is being assured an adequate diet. Thus, the legitimate targeting issues concerned with multiple program participation are (1) the extent to which it occurs, and (2) whether the combined package of nutritional benefits available to families of various types is adequate, less than adequate, or more than adequate. Congress obviously intends for the benefits to be adequate but has not defined how adequacy should be evaluated.

In assessing the extent to which families with children participating in school meals receive multiple food assistance benefits, most of the studies reviewed in Chapter V focused solely on examining the number of programs in which families participated. These studies reported that multiple program participation is very common. For example, a survey of food stamp families indicated that 38 percent had children receiving free or reduced-price lunches (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1974). Another survey of low-income families indicated that 66 percent participated in more than one assistance program (U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy, 1973). More examples could be cited, but these reports of multiple program participation do not address the more difficult questions of whether multiple program benefits complement or duplicate one another or whether multiple program participation improves the nutritional well-being of the participants.

Studies by the GAO (Comptroller General of the U.S., 1978) and Temple-West and Mueller (1978) have attempted to assess the nutritional adequacy of the benefits that could theoretically be received by families that participate in all of the federal assistance programs for which they qualify. As discussed in Chapter V, both studies are flawed because of small, unrepresentative samples and methodological problems in the way that nutritional need was defined. In the first study, GAO concluded that anywhere from 21 to 230 percent of a family's nutritional needs could be met by combinations of the existing programs (Comptroller General of the U.S., 1978). In the second study, Temple-West and Mueller concluded that healthy families with young children could meet their nutritional needs, but that families with adolescent children, adult males, elderly adults, or members needing nutritional supplementation could not meet their nutritional needs through the combination of federal food assistance programs available to them.

As discussed in Chapter V, however, it is not at all simple to "add up" benefits received from various programs or to establish the real price of an adequate diet for families of various kinds. In order to address this question, fundamental information is needed about the kinds of diets actually available to needy families and about the real nutritional benefits available from assistance programs. The Consumer and Food Economics Institute (CFEI) of USDA is currently analyzing data from the Nationwide Food Comsumption Survey of 1977-1978, an exhaustive survey of the food consumption and household expenses of the American population. The CFEI analyses are expected to provide estimates about the cost of nutritionally adequate diets that are more realistic than the ones currently available.

The information provided through these analyses could be employed in future research to assess the nutritional benefits provided by the several food assistance programs, singly and combined, as well as to determine whether multiple benefits are desirable and whether food assistance programs distribute benefits equitably among families of various kinds.

DISCUSSION

Based on the review of research pertaining to the targeting of school nutrition programs, it appears that several research questions remain unanswered. Previous studies have not generated sufficient information to assess fully either (1) the extent of which current family size and income criteria for free and reduced-price meals identify nutritionally needy children, or (2) the adequacy of nutritional benefits received by students of various types and their families through participation in more than one federal food assistance program. Additionally, studies are needed to supply answers to other research questions related to the issue of targeting. One of these questions is whether the school nutrition programs are meeting the nutritional needs of certain subgroups which may be at particular risk, such as Indians, migrant workers, and pregnant teenagers. There is evidence, reviewed in Chapter III, that certain kinds of nutritional problems are more prevalent among blacks, teenagers, or other identified subgroups. However, we found no studies that focused specifically on the targeting of the programs to such subgroups.

Another question remaining to be answered is how alterations in federal subsidies affect school and school district participation on how changes in meal prices affect student participation. Although this research question was outside the scope of this review of research, its importance is highlighted by recently proposed changes in admininstrative policies.

A final question which was not addressed by the literature review concerns the identification and evaluation of alternative operating strategies that enhance the success of the school nutrition programs. The importance of this task to the issue of targeting lies in optimizing the delivery of the program to its intended recipients. There have been reports of projects achieving some degree of "success" by employing innovative operating procedures. However, the reports have not been based on systematic evaluations of the characteristics of the projects that have satisfied some predetermined criterion of success.

2. *DO THE SCHOOL NUTRITION PROGRAMS MEET THE NUTRITIONAL NEEDS OF SCHOOL-AGE CHILDREN?*

For this question, the targets of the program are considered to be the meals that serve the nutritional needs and meet the nutritional problems of school-age children. Targeting in this sense concerns the overall nutritional quality of the food service provided in connection with the programs and the extent to which school meals provide those nutrients that have been found to deficient in the diets of school-age children.

The review of research identified studies that have assessed the nutrient content of school meals, as served or consumed, and have determined whether they meet the established USDA goal of one-third of the RDA for school lunches, and an unofficial research goal of one-fourth of the RDA for school breakfasts. The nutrients that these studies determined to be inadequate or deficient in school meals were reviewed in relation to the major nutritional problems of school-age children.

NUTRITION PROBLEMS OF SCHOOL-AGE CHILDREN

Nutrients that are most often found to be below the RDA in the diets of school-age children include calcium, iron, vitamin A and vitamin C. More limited data also suggest that some children fall short of dietary standards for vitamin B_6, magnesium, folic acid, and zinc.

Not many studies have measured the levels of fat, cholesterol, sugar and salt in children's diets. However, there are some indications from HANES and the National Food Consumption Survey that children consume foods which are high in these constituents.

Overconsumption of food by children has been shown to contribute to obesity. Although there is a consensus that obesity is becoming a serious problem among American school children, factors related to obesity have not been clearly identified. Generally, there is a trend for greater obesity among children from upper income groups.

Undernutrition, which is manifested by retarded growth in height, is also found among school-age children. The highest prevalence of growth retardation is found in the low-income groups.

Biochemical and clinical deficiences are less prevalent than dietary and anthropometric problems. However, a large proportion of children have low iron stores which predisposes them to develop iron deficiency anemia. Deficiencies of other nutrients based on biochemical measurements have been noted in selected subgroups. For example, low serum levels of vitamin A have been observed among low-income Mexican-American children. Low-income children, especially Hispanics and blacks, may also have poor riboflavin status.

Clinical signs of classical nutritional diseases such as scurvy, beriberi and pellagra are not common among school-age children in the United States. Malnutrition in this country consists largely of subclinical deficiencies, mild growth retardation or overconsumption. The immediate consequences of some of these problems, such as overconsumption of sugar, may be seen in the high prevalance of dental caries which affect school-age population. The consequences of other problems, such as overconsumption of salt, cholesterol and fat, may only become apparent in later life when associated with chronic diseases such as hypertension, cancer and diabetes.

NUTRIENT CONTENT OF SCHOOL MEALS

In order to be eligible for federal reimbursement, participating schools must serve meals that meet guidelines prescribed by the Secretary of Agriculture. The guidelines for the school lunch pattern specify the quantities of food in four basic groups that are expected to provide one-third of the RDA for all nutrients (except energy) for children of various ages. The guidelines for the school breakfast pattern do not establish an RDA goal.

Studies assessing the nutrient content of the school lunch, as served or as consumed, have used the goal of one-third RDA to evaluate nutritional adequacy. Values have been obtained either by chemical analysis or by calculation from food composition tables. These studies found that iron, thiamin, and energy were the nutrients most often deficient in lunches as served and as consumed. Vitamin A and vitamin C were also below one-third RDA in lunches as served and as consumed in some schools. Vitamin B_6, zinc or magnesium have also been found to fall below one-third of the RDA in lunches as served, but no studies report levels for these nutrients in lunches as consumed. It is likely that the levels of these nutrients in lunches as consumed by students would be lower. For those nutrients that meet one-third of the RDA in lunches as served, there is usually enough of a margin to allow an average adequate intake of these nutrients even when 15 to 25 percent of the food is not consumed.

USDA has no formal RDA goal for the nutrient content of school breakfasts. In the single study of the school breakfast, the researchers adopted one-fourth of the RDA as a "reasonable yardstick," with the rationale perhaps that while breakfast is one of the traditional three meals in our culture, it is often lighter than the lunch or evening meal (Opinion Research Corporation, 1979). At the time this study was conducted, program regulations allowed three different breakfast patterns that qualified for reimbursement, and the focus of the study was as much on comparing the three patterns as on assessing the general adequacy of the breakfasts.

- Overall, the breakfasts as consumed did not meet the one-fourth goal set for vitamin A and iron, and for elementary students, they did not meet the goal for thiamin, calcium (females only), or phosphorus.

- One of the three breakfast patterns--the "grain-fruit" pattern which consists of a fortified cake-like product and milk--provided one-fourth RDA for all indicator nutrients and less than one-fourth RDA for energy, with little plate waste.

DISCUSSION

These studies suggest that the school nutrition programs do not contain adequate levels of some of the nutrients which have been shown to be problems for school-age children in the United States. However, the question of how well nutritional benefits of the school nutrition programs are targeted to the nutritional needs of school-age children cannot be answered from the studies summarized by the literature review, partly because the definition of nutritional needs is incomplete. All surveys of the nutritional status of school-age children are limited by problems which have already been discussed in relation to nutritional assessment methodology. In addition, some specific nutrients and/or problems have not been adequately assessed in children. For example, not enough is known about the dietary intake and biochemical levels of vitamin B_6, folic acid, magnesium and zinc to draw conclusions about their status in the school-age population. Also, while some of the local surveys have suggested that ethnic subgroups, such as Hispanic and native American children, may be at higher risk for certain problems, the national surveys have not had adequate representation of these subgroups in their samples. In addition, there is a need for continued research to determine the relationships between health status and the consumption of sugar, salt, fat and cholesterol, so that policy decisions about the desirable levels of these constituents in school meals can be made.

A second problem which complicates finding answers to the targeting question is whether the general goal of providing one-third of the RDA in school meals is appropriate for all students This level may not be adequate to provide therapeutic intervention for children who are at risk of developing nutritional deficiencies. Since the school nutrition programs have traditionally been considered preventive rather than therapeutic, it would appear that further investigation is required to clarify what nutrient goal is most appropriate for the majority of children.

Finally, many of the nutrients of concern in the diets of school-age children have not been analyzed in school meals. Nutrients such as iron, vitamin A, vitamin C and calcium have been analyzed in most studies of the NSLP but there are few reports of available levels of nutrients such as vitamin B_6, magnesium and zinc and other dietary constituents such as sugar, salt, fat and cholesterol. This is, in part, because of the scarcity of nutrient information in food composition tables and other sources that would permit appropriate assessment.

For maximum benefit from nutritional analyses, continued work needs to be done to upgrade the information continued in tables of food composition and computerized nutrient data bases, and to improve the analytical methods used to obtain data on the nutrient composition of foods.

The nutritional content of meals served in the SBP is particularly in need of further investigation since only one study of this program has been conducted. To evaluate the nutritional adequacy of school breakfasts, however, a nutrient goal or criterion must first be established.

NATIONAL EVALUATION OF SCHOOL NUTRITION PROGRAMS

NESNP OVERVIEW

This section briefly describes the National Evaluation of School Nutrition Programs (NESNP) and its aims. The NESNP was designed as five complementary substudies, which are described below:

- Review of Research. This first substudy began in October 1979, and this report is its major product. The review has guided each step in sampling, design, and instrument selection and development for the NESNP field surveys.

- Cross-Sectional Survey of Students (CSS) and Household Survey of Parents (HSP). In the fall of 1980, approximately 7,500 public school students in grades 1 though 12 were surveyed, using a stratified, multi-stage, nationally representative sample of 83 school districts and a comparison sample of seven nonparticipating school districts. The parents or guardians of these students were also surveyed. The CSS and HSP will provide: a description of participating and nonparticipating students and their families; an analysis of factors that influence student participation, including family income and composition; models to forecast participation levels under various conditions; an assessment of the impact of the programs on students, in terms of dietary intake, anthropometrics, and physical and social well-being; an assessment of the impact of the programs on families in terms of food expenditure; and an analysis of current targeting and changes in targeting that would probably result from different federal policies.

- Food Administrator Survey (FAS). This substudy is a mail survey of approximately 1,000 districts and 1,300 schools, conducted in the spring of 1981. The FAS includes all districts and schools that were in the CSS, and provides a stratified, multi-stage, nationally representative sample of the public school districts and schools in the United States. It will provide a national picture of the operation of the school nutrition programs using information provided by state, district, and school food program administrators. The information to be obtained includes: participation statistics for districts and schools; the demographic characteristics of participating and nonparticepating institutions; the incidence of various food service configurations; prices and costs for meals and milk, state and district subsidies to the food programs; staffing for food services, state emphasis on management review and technical assistance, and inputs to food service decisions at the district and school levels.

- Longitudinal Survey of Students (LSS). This final substudy will be designed on the basis of findings from the CSS and HSP. Its primary objective will be to explicate the relationships observed during the CSS and HSP. This substudy will probably take the form of an in-depth study of successful local projects, and will attempt to identify and describe processes that are associated with the successful operation of school nutrition programs.

NESNP OBJECTIVES

The NESNP was designed to meet the following major objectives:

1. Describe the characteristics of the states, the districts, the schools, the school nutrition programs, and participating and nonparticipating students and their families.

a. Determine the characteristics (socioeconomic and nutritional status) of participating and nonparticipating students and their families.

b. Describe the school nutrition programs and their school contexts.

c. Describe the characteristics of state administrative agencies, and of participating and nonparticipating school districts and schools (e.g., size, urbanicity, organization, operations, need, etc.).

2. Describe the actual operations (organization, administration, management, resources and their allocation, and service delivery) of the school nutrition programs.

3. Describe how program operations differ from standards provided by legislation, regulations and guidelines.

4. Identify the determinants of participation in the school nutrition programs and develop a model for forecasting student participation rates.

a. Determine the factors associated with student participation in each of the three school nutrition programs.

b. Develop student-level models for forecasting participation rates.

c. Assess the accuracy of participation model projections.

5. Identify the determinants of participation in the school nutrition programs and develop a model for forecasting participation rates of districts and schools.

a. Identify factors associated with district, school and aggregate student participation in each of the three school nutrition programs.

b. Develop district- and school-level models for forecasting participation rates.

6. Determine the impact of the school nutrition programs upon students and their families.

   a. Detail the effect of participation in one or more of the school nutrition programs on dietary intake, anthropometric measurements, and general well-being, and performance of students from various socioeconomic levels.

   b. Assess program impacts on families of participating students (e.g., on food expenditures).

7. Determine if student and family benefit levels are appropriate to their needs.

8. Determine if regional, state, school district, and school benefit levels are appropriate to their needs.

9. Identify and document unusually successful school nutrition projects, strategies, and procedures.

Because the NESNP provides large, nationally representative samples of students, school, and school districts, it should provide definitive answers to many of the outstanding questions about the determinants and effects of participation in the school nutrition programs. The following points should be particularly noted:

- Participation in the three programs will be assessed both for the current school year and also for past years, in order to provide an estimate of total exposure to the three programs. The sample will include participants, nonparticipants who have the program available, and nonparticipants who do not have the program available, in order to provide refined estimates of joint and marginal program effects.

- The NESNP has larger school-age samples than comparable national studies with a nutritional component, such as the Health Examination and Nutrition Survey and the National Food Consumption Survey, and thus provides an exceptional data base for developmental work on the dietary intake and anthropometric outcome measures. A separate substudy is being conducted to estimate the variance on dietary intake measures that is attributable to different sources, e.g., differences in students' daily intake, differences between interviewers, and coder errors.

- For the dietary intake data, each food item will be identified by source, so that contributions of specific programs or of specific food groups to total diet can be obtained.

- The NESNP will be the first national study in which family income and composition data can be related both to detailed program participation information and to the characteristics of local schools and programs. The data will provide detailed answers to questions about the distribution of income levels for families receiving free or reduced-price meals, on the food expenditure patterns of families, and on the extent to which school meals supplement or substitute for food from home or other sources.

- Based on the income data provided by the families, we can study the joint effects of participation in the school nutrition programs and in other food assistance programs such as WIC and other cash assistance programs such as AFDC.

- The participation model will include equations for factors influencing both individual and institutional participation decisions. Since institutional decisions affect the availability of the programs to individual students, we plan to model institutional and individual participation using simultaneous equation systems.

- The NESNP will contribute to a better understanding of the ways in which various policy decisions will affect the targeting of benefits to groups with economic and nutritional needs. The NESNP data base and model will allow simulations to show how the effects of policy alternatives (e.g., reduction of federal subsidies or alteration of free and reduced-price eligibility criteria) will affect institutional and individual participation, and through participation, how they will affect the distribution of the economic and nutritional program benefits to students.

APPENDIX A

OMNIBUS BUDGET RECONCILIATION ACT OF 1981 (PL 97-35)

OMNIBUS BUDGET RECONCILIATION ACT OF 1981 (PL 97-35)

(Highlights of Major Provisions Affecting the School Nutrition Programs)

Provision	Highlights	Effective Date
1. National Average Payment Factor (NAPF); Section 4	NAPF for each lunch (free, reduced-price, or paid) served in school districts in which less than 60 percent of the lunches served during the second preceding school year were served free or at a reduced price is 10.5 cents. This rate is to be adjusted on July 1, 1982, and each July 1 thereafter. The Section 4 NAPF in "60 percent-or-more" school districts is two cents more than the above rate.	September 1, 1981
2. National Average Payment Factor (NAPF); Section 11	NAPF for each free lunch is 98.75 cents. This rate is to be adjusted on July 1, 1982, and each July 1 thereafter. The Section 11 NAPF for each reduced-price lunch is 40 cents less than the free rate.	September 1, 1981
3. National Average Payment Factor (NAPF); Breakfast	NAPF for each free breakfast is 57.0 cents. This rate is to be adjusted on July 1, 1982, and each July 1 thereafter. The NAPF for each reduced-price breakfast is one-half the free rate, or 30 cents less than the free rate, whichever is greater. The NAPF for each paid breakfast is 8.25 cents. This rate is to be adjusted on July 1, 1982, and each July 1 thereafter.	September 1, 1981
4. Severe-Need Eligiblity	Severe-need eligibility is limited to those schools in which during the second preceding school year, 40 percent or more of the lunches served in that school were served free or at a reduced-price, and for which the regular breakfast reimbursement is insufficient to cover the costs of the breakfast program; except that schools with a State mandate to operate the program are also, for a while, eligible for severe-need reimbursement if the regular breakfast reimbursement is insufficient to cover the costs of the breakfast program. In States where the legislatures meet annually, the State mandate exception would be allowed until July 1, 1984.	September 1, 1981

OMNIBUS BUDGET RECONCILIATION ACT OF 1981 (PL 97-35)

(Highlights of Major Provisions Affecting the School Nutrition Programs)

Provision	Highlights	Effective Date
5. Commodity Assistance	The national average value of donated foods (or cash payments in lieu thereof) is 11.0 cents. This rate is to be adjusted on July 1, 1982, and each July 1 thereafter.	July 1, 1981
6. Income Eligibility Guidelines (IEGs)	IEGs for free meals for the school years 1981-82 and 1982-83 are 130 percent of the Office of Management and Budget's nonfarm income poverty guidelines, as adjusted. For school year 1983-84, and each subsequent school year, the IEGs for free meals will be the same as the gross income eligiblity standards (for the appropriate year) in the Food Stamp Program. The IEGs for reduced-price meals for any school year are 185 percent of the Office of Management and Budget's nonfarm income poverty guidelines. The IEGs are to be adjusted annually each July 1.	Date of enactment
7. 3-1 Matching Requirement	This requirement is eliminated as the reduction of the Section 4 subsidy makes this superfluous.	July 1, 1981
8. State Revenue Matching Requirement (SRMR)	SRMR is reworded to be equal to 30 percent of all Section 4 funds made available to a State in school year 1980-81. (The SRMR for each school year, ~~beginning~~ with school year 1981-82, would be based on school year 1980-81). Allowances are made for States where the per capita income is less than the average per capita income of all the States. The State revenues provided by any State to meet the SRMR shall, to the extent the State deems practicable, be disbursed to schools participating in the NSLP. States may target State revenues to schools in greater need.	July 1, 1981

OMNIBUS BUDGET RECONCILIATION ACT OF 1981 (PL 97-35)

(Highlights of Major Provisions Affecting the School Nutrition Programs)

Provision	Highlights	Effective Date
9. Exemption from State Revenue Matching Requirement (SRMR)	No State in which the State educational agency is prohibited by law from disbursing State appropriated funds to private schools shall be required to match Federal funds made available for meals served in such schools, or to disburse to such schools, any of the State revenues required to meet the SRMR.	July 1, 1981
10. Foodservice Equipment Assistance Program	This program is terminated.	October 1, 1981
11. Special Milk Program	Participation in the Special Milk Program is limited to schools that do not participate in a meal service program authorized under the National School Lunch Act or the Child Nutrition Act of 1966.	October 1, 1981
12. Commodity-Only School	These schools are now eligible to receive donated commodities equal in value to the sum of Section 6 and Section 4, except that up to five (5) cents of this amount may be received in cash for processing and handling commodities. Commodity-only schools are now eligible for Section 11 reimbursement for free and reduced-price lunches, but are ineligible to participate in the Special Milk Program. The nutritional requirements are now the same as under the NSLP, and all free and reduced-price requirements and overt identification prohibitions apply.	90 days after enactment

OMNIBUS BUDGET RECONCILIATION ACT OF 1981 (PL 97-35)

(Highlights of Major Provisions Affecting the School Nutrition Programs)

Provision	Highlights	Effective Date
13. State Administrative Expenses	The grant available to any State for State Administrative Expenses (non-discretionary monies) for School Programs is to be no less than the grant made in fiscal year 1981 (used to be fiscal year 1978), or $100,000, whichever is greater. State Administrative Expense funds made available to any State are to remain available to any State for obligation and expenditure by that State during the fiscal year immediately following the fiscal year for which the funds were made available.	October 1, 1981
14. Cost and Cost-Based Accounting	All reference to cost and cost-based accountability is eliminated for the NSLP and the SBP (except for severe-need breakfasts). Cost accountability would still be required for severe-need reimbursement, the Special Milk Program and the Summer Program.	October 1, 1981

NATIONAL EVALUATION OF SCHOOL NUTRITION PROGRAMS

REVIEW OF RESEARCH

BIBLIOGRAPHY

BIBLIOGRAPHY

This bibliography includes all references that were reviewed for the NESNP Review of Research, whether cited or not.

Abbreviations used in the bibilography include the following:

ARS	Agricultural Research Service
CFEI	Consumer and Food Economics Institute
DHEW	Department of Health, Education and Welfare
ESCS	Economics, Statistics, and Cooperatives Service
FNS	Food and Nutrition Service
ERS	Economic Research Service
GAO	Government Accounting Office
HRA	Health Resources Administration
NCES	National Center for Educational Statistics
NCHS	National Center for Health Statistics
OPPE	Office of Policy, Planning and Evaluation
SEA	Science and Education Administration
USDA	U.S. Department of Agriculture

As a general rule, we tried to follow the reference format of the Publication Manual of the American Psychological Association. In citing government agencies, the usual rule followed is that parent bodies precede subdivisions (e.g., USDA, FNS, OPPE is the citation for OPPE publications, and USDA, ARS, CFEI is the citation for CFEI publications). An exception was made for NCHS (which should be U.S. DHEW, HRA, NCHS), owing to the large number of NCHS publications listed. For publications or agencies likely to be cited in different ways in the research literature, we have tried to include cross-references in the reference list.

Abdel-Ghany, M. Evaluation of household diets by the index of nutritional quality. Journal of Nutrition Education, 1978, 10, 79-81.

Abraham, S., Carroll, M. D., Dresser, C. M., & Johnson, C. L. Dietary intake findings United States, 1973-1974. (DHEW Publication No. HRA 77-1647) Hyattsville, MD.: Vital and Health Statistics, 1977. Use NCHS V&H Statistics (11, 202).

Abraham, S., Lowenstein, F. W., & O'Connell, D. E. Preliminary findings of the first Health and Nutrition Examination Survey, United States, 1971-1972: Anthropometric and clinical findings. Washington, D.C.: DHEW Pub. No. (HRA) 75-1229, 1975.

Abraham, S., & Johnson, C. L. Overweight adults in the United States. Advancedata, 1979, 51, 1-11.

Abraham, S., Lowenstein, F. W., & Johnson, C. L. Preliminary findings of the first Health and Nutrition Examination Survey 1971-1972: Dietary intake and biochemical findings. Washington, D.C.: DHEW Pub. No. (HRA) 74-1219-1, 1974.

Abraham, S., & Nordsieck, M. Relationship of excess weight in children and adults. Public Health Reports, 1960, 75, 263-273.

Abramson, J. H., et al. Food frequency interview as an epidemiological tool. American Journal of Public Health, 1963, 53, 1093-1101.

Acheson, K. J., et al. The measurement of food and energy intake in man - An evaluation of some techniques. Ame[illegible]can Journal of Clinical Nutrition, 1980, 33, 1147.

Acosta, P. B., et al. Nutritional status of Mexican American preschool children in a border town. The American Journal of Clinical Nutrition, 1974, 27, 1359-1368.

Adams, C. F. Nutritive value of American foods in common units (Agricultural Handbook No. 456). See USDA, ARS, CFEI.

Addison, G. M., et al. An immunoradiometric assay for ferritin in the serum of normal subjects and patients with iron deficiency and iron overload. Journal Clinical Pathology, 1972, 25, 326-329.

Adelson, S. F., Some pr[illegible]lems in collecting dietary data from individuals. Journal of the Ame[illegible]n Dietetic Association, 1960, 36, 453.

Albritton, E. C. (Ed.). Standard values of blood. Philadelphia: W. B. Saunders Co., 1952.

Altman, P. L., & Dittmer, D. S. (Eds.). Blood and other body fluids. Washington, D.C.: Federation of the American Society of Experimental Biology, 1961.

Altschul, A. M. Studies in school lunch waste: A literature review and evaluation. Washington, D.C.: Georgetown University School of Medicine, 1976.

American Academy of Pediatrics, Ad Hoc Committee to Review the Ten-State Nutrition Survey. See papers by Garn & Clark; Lowe et al.; and Rowe et al.

American Academy of Pediatrics, Committee on Nutrition. Measurement of skin-fold thickness in childhood. Pediatrics, 1968, 42, 538-543.

American Academy of Pediatrics, Task Force on Blood Pressure in Children. Report. Pediatrics, 1977, 59, 797-820.

American Association of School Administrators, Office of Governmental Relations. Impact of changes in school lunch prices on pupil participation. Arlington, VA: Author, 1980.

American Dietetic Association. Position paper: Lactose, milk intolerance, and feeding programs. Journal of the American Dietetic Association, 1972, 61, 241.

Anderson, K., & Hoofnagle, W. S. Milk consumption by children at school and at home in relation to Special Milk Program (Marketing Research Report No. 408). Washington, D.C.: USDA, Agricultural Marketing Service, 1960.

Anderson, M. A. Use of height-arm circumference measurement for nutritional selectivity in Sri Lanka school feeding. American Journal of Clinical Nutrition, 1975, 28, 775-781.

Arizona Department of Education, Food and Nutrition Division. Arizona state plan 1979: Child nutrition operations. Phoenix: Author, 1979.

Arnhold, R. The QUAC stick: A field measure used by the Quaker Service Team, Nigeria. Journal of Tropical Pediatrics, 1969, 15, 243.

Arvedson, I., Sterky, G., & Tjernstrom, K. Breakfast habits of Swedish school children. Journal of the American Dietetic Association, 1969, 55, 257-261.

Austin, J. E. Evaluation research priorities for federal nutrition programs. Talk presented at the National Food and Agriculture Outl Conference, November 1978.

Austin, J. E. The perilous journey of nutrition evaluation. Paper presented at the Panama Conference, August 1977.

Austin, J. E., & Hitt, C. Nutrition intervention in the United States: Cases and concepts. Cambridge, MA: Ballinger Publishing, 1979.

Avens, J. S., et al. Food safety hazards associated with school food service delivery systems. Journal of Food Science, 1978, 43, 453-456.

Baker, I. A., et al. Temporal variation in the height of children during the day. Lancet, 1978, 1320.

Balogh, M., et al. The development of a dietary questionnaire for an ischemic heart disease survey. Israel Journal of Medical Science, 1968, 4, 195-203.

Balogh, M., et al. Random repeat 24-hour dietary recalls. American Journal of Clinical Nutrition, 1971, 24, 304.

Barr, G. D., Allen, C. M., & Shinefield, H. R. Height and weight of 7,500 children of three skin colors. American Journal of Diseases of Childhood, 1972, 124, 866-872.

Bayless, T. M., & Paige, D. M. Lactose tolerance by lactose-malabsorbing Indians. Gastroeneterology, 1978, 74, 153.

Beal, V. A. The nutritional history in longitudinal research. Journal of the American Dietetic Association, 1957, 51, 426.

Beaton, G. H., et al. Sources of variance in 24-hour dietary recall data: Implications for nutrition study design and interpretation. American Journal of Clinical Nutrition, 1979, 32, 2546-2559.

Beebout, H., & Kendall, A. Final report: Estimate of the number of children eligible for free or reduced-price meals and free milk during the 1975-76 and the 1976-77 school years. Washington, D.C.: Mathematica Policy Research, 1976 (rev. 1976, 1978.)

Bell, C. C. A social and nutritional survey of the population of Children and Youth Center of Meharry Medical College of North Nashville, Tennessee. Journal of the National Medical Association, 1971, 63, 397-398.

Bengoa, J. M. Recent trends in the public health aspects of protein-calorie malnutrition. WHO Chronicle, 1970, 24, 552.

Bentley, J. T., Kuhn, M., & Tiffany, F. Student participation, meal costs and meal production in school foodservice programs: A literature review. Princeton, NJ: Mathtech, Inc., 1980.

Berenson, G. S. Cardiovascular risk factors in children. New York: Oxford University Press, 1980.

Blackburn, M. L., & Calloway, D. H. Energy expenditure of pregnant adolescents. Journal of the American Dietetic Association, 1974, 65, 24.

Blakeway, S. F., & Knickrehm, M. E. Nutrition education in the Little Rock school lunch program. Journal of the American Dietetic Association, 1978, 72, 389-391.

Bloom, B. J. Stability and change in human characteristics. New York: John Wiley & Sons, Inc., 1964.

Booth, R. A. D., et al. Measurement of fat thickness in man: A comparison of ultrasound, Harpenden calipers and electrical conductivity. Journal of Nutrition, 1966, 20, 719.

Bosley, B. A practical approach to nutrition education for children. Journal of the American Dietetic Association, 1947, 23, 304.

Boss, D. Fulton County: Back to natural? Food Management, July 1978, 43-48, 60.

Bowering, J., Sanchez, A. M., & Irwin, M. I. A conspectus of research on iron requirements of man. Journal of Nutrition, 1976, 106, 985-1974.

Boysen, S. C., & Ahrens, R. A. Nutrition instruction and lunch surveys with second graders. Journal of Nutrition Education, 1972, 4, 172-174.

Braley, G. A. School lunch and breakfast program price and participation--Fairfax County, Virginia. Washington, D.C.: Unpublished manuscript, USDA, FNS, 1976.

Braley, G. A., & Nelson, P. E., Jr. Effect of a controlled price increase on school lunch participation: Pittsburgh 1973. American Journal of Agricultural Economics, 1975, pp. 90-96.

Bransby, E. R., et al. Comparison of results obtained by different methods of individual dietary survey. British Journal of Nutrition, 1948, 2, 89.

Bray, G. A. (Ed.). Obesity in Perspective, (Fogarty International Center Series on Preventive Medicine, DHEW (NIH) 75-708). Washington, D.C.: U. S. Government Printing Office, 1975.

Briggs, G. M., & Calloway, D. H. Bogert's nutrition and physical fitness. Philadelphia: W. B. Saunders Company, 1979.

Browe, J. H., et al. Diet and heart disease study in the Cardiovascular Health Center. I. A questionnaire and its application in assessing dietary intake. Journal of the American Dietetic Association, 1966, 48, 95.

Brunswick, A. F., & Josephson, E. Adolescent health in Harlem. American Journal of Public Health, 1972, Supplement, Oct.

Brunswick, A. F. Health needs of adolescents: How the adolescent sees them. American Journal of Public Health, 1969, 59, 1730-1745.

Bullen, B. A., Reed, R. B., & Mayer, J. Physical activity of obese adolescent girls measured by motion picture sampling. American Journal of Clinical Nutrition, 1964, 14, 211.

Burk, M. C., & Pao, E. M. Methodology for large-scale surveys of household and individual diets. Washington, D.C.: U.S. Government Printing Office, 1976.

Burke, B. The dietary history as a tool in research. Journal of the American Dietetic Association, 1947, 23, 1041-1046.

Burroughs, A. L., & Huenemann, R. L. Iron deficiency in rural infants and children. Journal of the American Dietetic Association, 1970, 57, 122-128.

Buzina, R. Assessment of nutritional status and food composition surveys: Anthropometric measurements and indices. Bibl. Nutr. Diet., 1974, 20, 24.

Buzina, R., & Uemura, K. Selection of the minimum anthropometric characteristics to assess nutritional status. Advances in Experimental Medicine and Biology, 1975, 49, 271.

California State, Department of Education, Bureau of Child Nutrition Services. State plan for management of child nutrition programs, school year 1978-79. Sacramento: Author, 1978.

California State, Department of Finance, Program Evaluation Unit. School nutrition eligibility: A staff reference report (Report No. E606S). Sacramento: Author, 1977.

Callahan, D. L. Focus on nutrition: You can't teach a hungry child. School Lunch Journal, March 1971.

Callahan, D. L. You Can't Teach a Hungry Child. Boston: Massachusetts Department of Education, Bureau of Nutrition Education and School Food Services, March 1971.

Cameron, N. In F. Falkner & J. M. Tanner (Eds.), The methods of auxological anthropometry in human growth (Vol. 2). New York: Plenum Press, 1978.

Campbell, V. A., & Dodds, M. L. Collecting dietary information from groups of older people. Journal of the American Dietetic Association, 1967, 51, 29-33.

Carol, R. The universal computer system for calculating nutrients from diets (TUNICS). Great Neck, N.Y.: Nutrition Computer & Statistical Service, 1979.

Carr, J. J., & Drekter, I. J. Simplified rapid technic for the extraction and determination of serum cholesterol without saponification. Clinical Chemistry, 1956, 2, 353.

Cartwright, G. E. Diagnostic Laboratory Hematology (4th ed.) New York: Grune and Stratton, 1968.

Cartwright, G. E., and Lee, G. R. Annotation: The anemia of chronic disorders. British Journal Hematology, 1971, 21, 147.

Carver, A. F., & Patton, M. B. Plate waste in a school lunch. Journal of the American Dietetic Association, 1958, 34, 615-618.

Center for Disease Control. See U.S. DHEW, Health and Mental Services Administration, Center for Disease Control.

Cereal Institute, Inc. A complete summary of the Iowa Breakfast Studies. Chicago: Author, 1962 (rev. 1976).

Chai, J. C. School food procurement: Procurement models and guides. School Food Service Research Review, 1979, 3, 33-38.

Chalmers, F. W., et al. The dietary record--How many and which days? Journal of the American Dietetic Association, 1952, 28, 711-717.

Chapman, J. M., & Massey, J. T. The interrelationship of serum cholesterol, hypertension, body weight and risk of coronary disease. Journal of Chronic Disease, 1964, 17, 933-949.

Chappell, G. M. Long-term individual dietary surveys. British Journal of Nutrition, 1955, 9, 323-339.

The Children's Foundation. Barriers to school breakfast. Washington, D.C.: Author, 1978.

The Children's Foundation--miscellaneous materials.

Chilton Research Services, Inc. The "Chilton Study." See U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy. Studies in public welfare (Paper No. 17).

Chmielinski, H., & White, M. A. Plate waste index: An observational measure of school food waste. An unpublished paper, 1979.

Christakis, G., et al. A nutritional epidemiologic investigation of 642 New York City children. American Journal of Clinical Nutrition, 1968, 21, 107-125.

Christakis, G. (ed.) Nutritional assessment in health programs. American Journal of Public Health (Suppl.), 1973, 63, 1-82.

Chung Ja Lee. Nutritional status of selected teenagers in Kentucky. American Journal of Clinical Nutrition, 1978, 31, 1453-1464.

Clarke, W. R., et al. Tracking of blood lipids and blood pressures in school age children: The Muscatine Study. Circulation, 1978, 58, 626.

Cochrane, W. A. Overnutrition in prenatal and neonatal life: A problem? Canadian Medical Association Journal, 1965, 93, 893.

Colorado State University, Departments of Agricultural and Chemical Engineering and Food Science and Nutrition. Pilot study to compare Type A lunches with alternative subsidized lunches among high school students. See Harper, J. M., et al.

Committee on School Lunch Participation. Their daily bread. Atlanta: McNelley-Rudd Printing Service, Inc., 1968.

Community Nutrition Institute, CNI Weekly Report.

Comptroller General of the United States. Efforts to control fraud, abuse, and mismanagement in domestic food assistance programs: Progress made -- More needed (CED-80-33). Washington, D.C.: General Accounting Office, 1980.

Comptroller General of the United States. Federal domestic food assistance programs--A time for assessment and change (CED-78-113). Washington, D.C.: General Accounting Office, 1978.

Comptroller General of the United States. How good are school lunches? (CED-78-22). Washington, D.C.: General Accounting Office, 1978.

Comptroller General of the United States. Inventory of federal food, nutrition, and agriculture programs (CED-79-1250. Washington, D.C.: General Accounting Office, 1979.

Comptroller General of the United States. Major factors inhibit expansion of the School Breakfast program (CED-80-35). Washington, D.C.: General Accounting Office, 1980.

Comptroller General of the United States. Progress and problems in achieving objectives of the School Lunch program (USDA/FNS B178564). Washington, D.C.: General Accounting Office, 1973.

Comptroller General of the United States. The impact of federal commodity donations on the School Lunch Program (CED-77-32). Washington, D.C.: General Accounting Office, 1977.

Comptroller General of the United States. The National School Lunch Program--Is it working? (Report to Congress; PB 270 182). Washington D.C.: General Accounting Office, 1977.

Comptroller General of the United States. Nationwide Food Consumption Survey: Need for improvement and expansion (CED-77-56). Washington, D.C.: General Accounting.

Congress and the Nation. Vol. I. - Vol. IV. Washington, D.C.: Congressional Quarterly Service, 1965-1977.

Congressional hearings--miscellaneous.

Conners, C. K. Food additives and hyperactive children. New York: Plenum Press, 1980.

Cook J., et al. School means and the nutrition of school children. British Journal of Preventive Social Medicine, 1975, 29, 182-189.

Cook, J. D., & Finch, C. A. Assessing iron status of a population. American Journal of Clinical Nutrition, 1979, 2115-2119.

Cook, J. D., Finch, C. A., & Smith, N. J. Evaluation of Iron Status of a Population. Blood, 1976, 48, 499-455.

Cook, T. D., & Campbell, D. T. Quasi-experimentation: Design and analysis issues in filed settings. Chicago: Rand-McNally, 1979.

Cook, T. D., et al. Assessing determinants of participation in the school lunch program in New York State from 1976 to 1979. Cambridge, MA: Abt Associates, 1980.

Cooking for Profit. (Journal, miscellaneous articles.)

Cosper, B. A. Personal and social factors related to food choices and eating behavior of selected yong to middle-aged adults (Unpublished doctoral dissertation, Kansas State University, 1972).

Cronin, F. J. Changes in nutrient levels and food used by households in the United States, Spring 1965 and 1977. Talk given at the 1980 Agricultural Outlook Conference, Session 11, Washington, D.C., November 1979.

Dade County Public Schools, Food and Nutrition Department. Comparison of Type A Pattern and Nutrient Standard Menus (USDA-FNS Contract No. 12-35-600-116). Miami: Author, June 1975.

Dallman, P. R., Barr, G. D., Allen, C. M., & Shinefield, H. R. Hemoglobin concentration in white, black and oriental children: Is there a need for separate criteria in screening for anemia? American Journal of Clinical Nutrition, 1978, 31, 377-380.

Dallman, P. R., & Siimes, M. A. Percentile curves for hemoglobin and red cell volume in infancy and childhood. Journal of Pediatrics, 1979, 94, 26-31.

Dallman, P. R., et al. Iron deficiency in infancy and childhood. American Journal of Clinical Nutrition, 1980, 33, 86-118.

Daniel, W. A., Jr., Gaines, E. G., & Bennett, D. L. Dietary intakes and plasma concentrations of folate in healthy adolescents. American Journal of Clinical Nutrition, 1975, 28, 363-370.

Daniel, W. A., Jr., & Rowland, A. M. Hemoglobin and hematocrit values of adolescents: Nutritional survey of low income groups. Clinical Pediatrics, 1969, 8, 181-184.

Daniel, W. A., Jr., et al. Nutrition in adolescence. Birmingham: University of Alabama Medical Center, n.d.

Davis, B., et al. Participation in the National School Lunch Program in Washington school districts. Pullman: College of Agriculture Research Center, Washington State University, 1974.

Dawber, T. R., et al. Dietary assessment in the epidemiologic study of coronary heart disease: The Framingham Study II. Reliability of measurement. American Journal of Clinical Nutrition, 1962, 11, 226-234.

Defares, P. B., et al. Schoolmilk and intellectual achievements: the effect of schoolmilk consumption on intellectual achievements. Netherlands: Van Gorcum & Comp. N.V., 1967.

Demirjian, A. Dentition. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Den Hartog, C., et al. The diet of volunteers participating in a long-term epidemiological field survey of coronary heart disease at Zutphen, Netherlands. Voediz, 1965, 26, 184.

Dierks, E. C., & Morse, L. M. Food habits and nutrient intakes of pre-school children. Journal of the American Dietetic Association, 1965, 47, 292

Doucette, S. W. What's wrong with the school lunch? School Lunch Journal, May 1971, 42-51.

Drazga, L. S. Statistical sampling in the Summer Food Service Program: A case study evaluation (Final Report 7390-910). Washington, D.C.: Mathematica Policy Research, Inc., 1980.

Dugdale, A. E., & Griffiths, M. Estimating fat body mass from anthropometric data. American Journal of Clinical Nutrition, 1979, 32, 2400-2403.

Duncan, B., Smith, A. N., & Briese, F. W. A comparison of growth: Spanish-surnamed with non-Spanish-surnamed children. American Journal of Public Health, 1979, 69, 903-907.

Dungan, A. L. An economic analysis of commercially provided meals and services and their role in the national school lunch program. Unpublished doctoral dissertation, Cornell University, 1974.

DuRant, H., & Linder, C. W. An evaluation of five indexes of relative body weight for use with children. Journal of the American Dietetic Association, 1981, 78, 35-41.

Durnin, J. V. G., & Rahaman, N. M. Assessment of the amount of fat in the human body from skinfold thickness. British Journal of Nutrition, 1967, 21, 681-689.

Dwyer, J. Food for Thought Project: Literature review. Cambridge, MA: American Institutes for Research, March 18, 1979. (Preliminary Draft)

Dwyer, J. A., Elias, M. F., & Warren, J. H. Effects of an exprimental breakfast program on behavior in the late morning. Unpublished manuscript, Department of Nutrition, Harvard School of Public Health, 1973.

Eagles, J. A., et al. Dietary appraisal: Problems in processing dietary data. American Journal of Clinical Nutrition, 1966, 19, 1-9.

Earnest, O. Buffet and salad bars team up. School Food Service Journal, January 1980, 76.

Edozien, J. C., et al. Medical evaluation of the special supplemental food program for women, infants and children. (Vol. 1). Study design, methods and performance data. Raleigh: University of North Carolina, Department of Nutrition, School of Public Health, 1976.

Education Daily. USDA sets proverty guidelines for school meals. Education Daily, June 18, 1979, pp. 5-6.

Ehrenberg, A. S. C. The elements of law-like relationships. Journal of the Royal Statistical Society (Series A), 1968, 131, 288.

Emmons, L., et al. Summary and conclusions from the final report of a study to determine the nutritional and economic need for free lunches and to measure the effect of receiving school breakfasts and/or lunches on the nutritional status of children: The lunch bunch study. Unpublished manuscript, New York: Cornell University, 1972.

Emmons, L., et al. A study of school feeding programs. Journal of the American Dietetic Association, 1972, 61, 262-275.

Emmons, L., & Hayes, M. Accuracy of 24-hour recalls of young children. Journal of the American Dietetic Association, 1973, 62, 409-415.

Emmons, L., Hayes, M., & Call, D. L. The Lunch Bunch Study. School Food Service Journal, September 1972, pp. 25-29.

Endres, J. M., et al. Nutrient Diet Data Analysis Guide. Carbondale, Ill.: Southern Illinois University Press, 1979.

Eppright, E. S., et al. Dietary study methods. V. Some problems in collecting dietary information about grups of children. Journal of the American Dietetic Association, 1952, 28, 43-48.

Eppright, E. S., et al. Nutrition of infants and preschool children in the north central region of the United States of America. World Review of Nutrition and Dietetics 1972, 14, 269.

Eppright, E. S., Marlatt, A. L., & Patton, M. B. Nutrition of 9-, 10-, and 11-year old public school children in Iowa, Kansas and Ohio. 1. Dietary Findings (North-Central Regional Pub. No. 59). Iowa Experimental Station Bulletin 434, 1955.

Epps, W. B. The child feeding program population: Estimates of eligibles and participation rates. Washington, D.C.: USDA, ERS, 1974.

Epps, W. B. Factors affecting participation in the School Lunch Program. Unpublished manuscript, 1971.

Epstein, L. M., et al. Validity of a short dietary questionnaire. Israel Journal of Medical Science, 1970, 6, 589-597.

Ershoff, B. H. Comparative microhematocrit values of Spanish-Americans and whites attending Los Angeles County youth clinics. Public Health Reports, 1975, 90, 58-61.

Fabry, P. S., et al. Effect of meal frequency in school children: changes in weight/height proportion and skinfold thickness. American Journal of Clinical Nutrition, 1966, 18, 358.

Failing, J. F., Jr., Buckley, M. W., & Zak, B. A study on ultramicro and automated procedure for serum proteins. American Journal of Medical Tecnology, 1961, 27, 177.

Falkner, F. Office measurement of physical growth. Pediatric Clinics of North America, 1961, 8, 13-18.

Farmer, J. Recipe for the best school lunch in the U.S.A. The PTA Magazine, September 1974, 24-26.

292

Feeley, R. M., Criner, P. E., & Watt, B. K. Cholesterol Content of Foods. Journal of the American Dietetic Association, 1972, 61, 134.

Fellers, S. A. A study of the effects of breakfast on scholastic attainment, drop-out rate, and knowledge of nutrition. Unpublished doctoral dissertation, Boston University, 1967.

Fischer, D. S., & Price, D. C. A simple serum iron method using the new sensitive chromogen tripyridyl-s-triazine, Clinical Chemistry, 1964, 10, 21.

Fisher, T. Nutrient database survey update. In G. Petot & H. B. Hoover (Eds.) Proceedings of the Fourth Nutrient Data Bank Conference, April 23-24, 1979. Cleveland, Ohio: Case Western Reserve University, 1979.

Fiske, C. H., & Subba Row, Y. The colorimetric determination of phosphorous. Journal of Biological Chemistry, 1925, 66, 373.

Florey, C. D. V. The use and interpretation of ponderal index and other weight-height ratios in epidemiological studies. Journal of Chronic Disease, 1970, 23, 93-103.

Fomon, S. J. Nutritional disorders of children: Prevention, screening, and followup (Publication No. (HSA) 77-5104). Rockville, MD: U.S. DHEW, PHS, HSA, BCHS, 1977.

Fomon, S. J., Filer, L. J., Jr., Thomas, L. N., & Rogers, R. R. Growth and serum chemical values of normal breastfed infants. Acta Paediatrica Scandinavica (Suppl. 202), 1970.

Food and Nutrition. Food to follow through. Food and Nutrition, 1971, pp. 8-13.

Food and Nutrition. (Journal, miscellaneous articles).

Food Management. (Journal, miscellaneous articles).

Food Research and Action Center. Guide to the School Lunch and Breakfast Programs. Washington, D.C.: Author, 1978.

Food Research and Action Center, Inc. FRAC's guide to quality school lunch and breakfast programs. Washington, D.C.: Author, 1979.

Forbes, G. B., & Amirhakimi, G. H. Skinfold thickness and body fat in children. Human Biology, 1970, 42, 401-418.

Foster, T. A., et al. Anthropometric and maturation measurements of children, ages 5 to 14 years, in a biracial community--The Bogalusa Heart Study. The American Journal of Clinic Nutrition, 1977, 30, 582-591.

Frank, G. C., et al. Adapting the 24-hr. recall for epidemiologic studies of school children. Journal of the American Dietetic Association, 1977, 71, 26-31.

Frank, G. C., et al. Dietary studies and the relationship of diet to cardiovascular disease risk factor variables in 10-year-old children--The Bogalusa Heart Study. American Journal of Clinical Nutrition, 1978, 31, 328-340.

Frank, G. C., et al. Dietary studies of rural school children in a cardiovascular survey. Journal of the American Dietetic Association, 1977, 71, 31-35.

Frank, G. C., et al. In-house 24-hour dietary recall protocol and the school lunch measurement protocol (Ed. 1). New Orleans: Spec. Center for Research, LSU Medical Center, 1977.

Franklin, B. A., et al. Validity of skinfold predictive equations on lean and obese subjects. American Journal of Clinical Nutrition, 1978, 31, 563-565.

Frederick, L. Fast food and the now generation are as inseparable as government and taxes. Speech presented at symposium conducted by the National Security Industrial Association in coordination with the U.S. Military Services, Washington, D.C., March, 1979.

Frederick, L. Fast food gets an "A" in school lunch. Boston: Cahners Books International, Inc., 1977.

Frerichs, R. R., et al. Equations for estimating percentage of body fat in children 10-14 years old. Pediatric Research, 1979, 13, 170-174.

Frerichs, R. R., et al. Cardiovascular disease risk factor variables in children at two successive years--The Bogalusa Heart Study. Journal of Chronic Disease, 1979, 32, 251-262.

Frerichs, R. R., et al. Hemoglobin levels in children from biracial community. American Journal of Public Health, 1977, 69, 841-845.

Frerichs, R. R., et al. Relation of serum lipids and lipoproteins to obesity and sexual maturity in white and black children. American Journal of Epidemiology, 1978, 108, 486-495.

Frerichs, R. R., et al. Serum cholesterol and triglyceride levels in 3,446 children from a biracial community: The Bogalusa Heart Study. Circulation, 1976, 54, 302-309.

Freund, W. H. Lunch programs in the nation's schools (Agricultural Economic Report No. 210, USDA, ERS). Washington, D.C.: U.S. Government Printing Office, 1971.

Frey, A. L., et al. Comparison of Type A and nutrient standard menus for school lunch. Journal of the American Dietetic Association, 1975, 66, 242-261.

Frisancho, A. R. Triceps skinfold and upper arm muscle size norms for assessment of nutritional status. American Journal of Clinical Nutrition, 1974, 27, 1052-1058.

Frisancho, A. R., & Garn, S. M. Skinfold thickness and muscle size: Implications for developmental status and nutritional evaluation of children from Honduras. American Journal of Clinical Nutrition, 1971, 24, 541-546.

Gargano, T. M., and Vaden, G. High school students' intended and actual entree selections. School Foodservice Research Review, 1978, 2, 86-91.

Garn, S. M., Clark, D. C., & Guire, L. E. Level of fatness and size attainment. American Journal of Physical Anthropology, 1974, 40, 447.

Garn, S. M., Clark, D. C., & Guire, K. E. Growth, body composition, and development of obese and lean children. In M. Winick (Ed.) Childhood Obesity, New York: Wiley, 1795.

Garn, S. M. The measurement of obesity. Ecology of Food and Nutrition, 1972, 1, 333-335.

Garn, S. M. Optimal nutritional assessment. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise. (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Garn, S. M., & Clark, D. C. Nutrition, growth, development, and maturation: Findings from the Ten-State Nutrition Survey of 1968-1970. Pediatrics, 1975, 56, 306-319.

Garn, S. M., & Clark, D. C. Problems in the nutritional assessment of black individuals. American Journal of Public Health, 1976, 66, 262-267.

Garn, S. M., & Clark, D. C. Trends in fatness and the origins of obesity. Pediatrics, 1976, 57, 443-456.

Garn, S. M., Clark, D. C., & Trowbridge, F. L. Tendency toward greater stature in American black children. American Journal of Diseases of Childhood, 1973, 126, 164-167.

Garn, S. M., et al. The real problem with 1-day diet records. American Journal of Clinical Nutrition, 1978, 31, 1114-1116.

Garrett, P. W., & Vaden, A. G. Influence of student-selected menus on participation, plate waste, and student activities. School Foodservice Research Review, 1976, 2, 28-33.

Garry, P. J., & Owen, G. M. Automated micro determination (100 microliters) of serum iron and total iron binding capacity. In Technicon Symposium, Automation in Analytical Chemistry (Vol. I). New York: Mediad, Inc., 1968.

Garry, P. J., Owen, G. M., Lashley, D. W., & Ford, P. C. Automated analysis of plasma and whole blood ascorbic acid. Clinical Biochemistry, 1974, 7, 131.

Garry, P. J., Pollack, D., & Owen, G. M. Plasma vitamin A assay by fluorometry and use of a silicic acid column technique. Clinical Chemistry, 1970, 16, 766.

Garza, C., & Scrimshaw, N. S. Relationship of lactose intolerance to milk intolerance in your children. American Journal of Clinical Nutrition, 1976, 29, 192-196.

Gavan, J. A. The consistency of anthropometric measurements. American Journal of Physical Anthropology, 1950, 8, 417-426.

General Accounting Office. See Comptroller General of the United States.

Gersovitz, M., et al. Validity of the 24-hr. dietary recall and seven-day record for group comparisons. Journal of the American Dietetic Association, 1978, 73, 48-55.

Gietzen, D., & Vermeersch, J. A. Health status and school achievement of children from Head Start and free school lunch programs. Public Health Reports, 1980, 95, 362-368.

Gilroy, S. K. CANS: A cost effective alternative to Type A. School Food Service Journal, December 1979, 42-46.

Glass, G. V. Primary, secondary, and meta-analysis of research. Educational Researcher. 1976, 5, 3-8.

Glover, J., & Jacobs, A. Activity patterns in iron deficient rats. British Journal of Medicine, 1972, 2, 627.

Gluck, D. K., & Baker, M. E. A study of school lunch programs in Pennsylvania. Pittsburgh: Carnegie-Mellon University, Educational management Development Center, School of Urban and Public Affairs, 1977.

Godfrey, M., & Schutz, H. B. Acceptability of low-fat milk by school children. Journal of the American Dietetic Association, 1972, 61, 525-528.

Goldstein, H. Factors influencing the height of seven year old children--results from the national child development study. Human Biology, 1971, 43, 93-111.

Goodhart, R. S., & Shils, M. E. (Eds.). Modern nutrition in health and disease (6th ed.). Philadelphia: Lea & Febiger, 1980.

Gopalan, C., & Rao, K. S. Nutrient needs. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise (Vol. 2), D. B. Jelliffe & E.F.P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Press, 1979.

Goyette, C. H., Connors, C. K., & Ulrich, R. F. Normative data on revised Connors Parent and Teacher Rating Scales. Journal of Abnormal Child Psychology, 1978, 6, 221-236.

Graham, G. Protein advisory group's recommendations deplored. Pediatrics, 1975, 55, 295.

Gray, G. E., & Gray, L. K. Anthropometric measurements and their interpretation: Principles, practices, and problems. Journal of the American Dietetic Association, 1980, 77, 534-539.

Greenstein, R. Why your school district probably can't afford not to participate in the School Lunch program. The American School Board Journal, 1975, pp. 21-22.

Greenwood, C. T., & Richardson, D. P. Nutrition during adolescence. World Review of Nutrition and Dietetics, 1979, 33, 1-41.

Greger, J. L., et al. Nutritional status of adolescent girls in regard to zinc, copper, and iron. American Journal of Clinical Nutrition, 1978, 31, 269-275.

Groover, M. E., et al. Problems in the quantitation of dietary surveys. Journal of the American Medical Association, 1967, 201, 8.

Gurney, J. M., & Jelliffe, D. B. Arm anthropometry in nutritional assessment: Nomogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. American Journal of Clinical Nutrition, 1973, 26, 912-915.

Gussow, J. D. Bodies, brains and poverty: Poor children and the schools. IRCD Bulletin, 1970, 6, 3-4; 9-12.

Guthrie, H. A. The concept of a nutritious food. Journal of the American Dietetic Association, 1977, 71, 14.

Guthrie, H. A. Effect of a flavored milk option in a school lunch program. Journal of the American Dietetic Association, 1977, 71, 35-40.

Guthrie, H. A., et al. Factor analysis of measures of nutritional status of preschool children. American Journal of Clinical Nutrition, 1973, 26, 497-502.

Guthrie, H. A. Nutritional status measures as predictors of nutritional risk in preschool children. American Journal of Clinical Nutrition, 1976, 29, 1048-1050.

Guthrie, H. A., & Guthrie, G. M. Factor analysis of nutritional status data from Ten State nutrition s veys. American Journal of Clinical Nutrition, 1976, 29, 1238- 41.

Haas, J. D., et al. The reliability of a portable ultrasonic device to measure body composition in humans. (Final Report of Phase I of the Project - Ultrasonic Assessment of Nutritional Status, Contract No. N01-CP-85652). Washington, D.C.: National Cancer Institute, October, 1979.

Habicht, J., et al. Anthropometric field methods: Criteria for selection. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Habicht, J. P., Yarborough, C., Martrell, R., Malina, R. M., & Klein, R. E. Height and weight standards for preschool children. Lancet, 1974, 1, 611.

Hair Changes in Human Malnutrition. Nutrition Reviews, 1971, 29, 4.

Hall, John C., et al. Upper limb anthropometry: The value of measurement variance studies. American Journal of Clinical Nutrition, 1980, 33, 1846-1851.

Hama, M. Y. Changes in household food consumption in the United States, spring 1965 and 1977. Talk given at the 1980 Agricultural Outlook Conference, Session 11, Washington, D.C., November 1979.

Hambidge, K. M. Increase in hair copper concentration with increasing distance from the scalp. American Journal of Clinical Nutrition, 1973, 26, 1212-1215.

Hambidge, K. M. The role of zinc deficiency in acrodermatitis enteropathica. International Journal of Dermatology, 1976, 15, 38-39.

Hamill, P. V. V., et al. Physical growth: National Center for Health Statistics percentiles. American Journal of Clinical Nutrition, 1979, 32, 607-629.

Hamill, P. V. V., Drizd, T. A., Johnson, C. L., et al. Physical growth: National Center for Health Statistics percentiles, American Journal of Clinical Nutrition, 1979, 32, 607-629.

Hamill, P. V. V., & Moore, W. M. Contemporary growth charts: Needs, construction and application. Dietetic Currents, 1976, 3, 21-24.

Hammond, W. H. Measurement and interpretation of subcutaneous fat with norms for children and young adult males. British Journal of Preventive and Social Medicine, 1955, 9, 201.

Hampton, M. C., Huenemann, R. L., Shapiro, L. R., Mitchell, B. W., & Behnke, A. R. A longitudinal study of gross body composition and body confirmation and their association with food and activity in a teenage population. American Journal of Clinical Nutrition, 1966, 19, 422-435.

Hampton, M. C., et al. Caloric and nutrient intakes of teen-agers. Journal of the American Dietetic Association, 1967, 50, 385-396.

Hankin, J. H. Critical factors in obtaining reliable and accurate food intake data. Honolulu: University of Hawaii, School of Public Health, n.d.

Hankin, J. H., et al. A short dietary method for epidemiologic studies. II. Variability of measured nutrient intakes. American Journal of Clinical Nutrition, 1967, 9, 935-945.

Hansen, R. G. An index of food quality. Nutrition Reviews, 1973, 31, 1-7.

Hard, M. M., Esselbausch, N. C., & Donald, E. A. Nutritional status of selected adolescent children. III. Ascorbic acid nutriture assessed by serum level and subclinical symptoms in relation to daily intake. American Journal of Clinical Nutrition, 1958, 6, 401-408.

Harkin, J. H., et al. A short dietary method for epidemiologic surveys. II. Variability of measured nutrient intakes. American Journal of Clinical Nutrition, 1967, 20, 935.

Harper, J. M., et al. Pilot study to compare Type A lunches with alternate subsidized lunches among high school students. Fort Collins: Colorado State University, Departments of Agricultural and Chemical Engineering and Food Science and Nutrition, 1978.

Harper, J. M., et al. Pilot study to evaluate food delivery systems used in school lunch programs. I. Menu item acceptability. School Foodservice Research Review, 1977, 1, 20-23.

Harsha, D. W., et al. Densitometry and anthropometry of black and white children. Human Biology, 1978, 50, 261-280.

Haverberg, L., Kwon, P. H., & Scrimshaw, N. S. Comparative tolerance of adolescents of differing ethnic backgrounds to lactose-containing and lactose-free dairy drinks. 1. Initial experience with a double-blind procedure. American Journal on Clinical Nutrition, 1980, 33, 17-21.

Head, M. K., & Weeks, R. J. Conventional vs. formulated foods in school lunches. Journal of the American Dietetic Association, 1977, 71, 116-123.

Head, M. K., & Weeks, R. J. Major nutrients in the Type A lunch. Journal of the American Dietetic Association, 1975, 67, 356-359.

Head, M. K., Weeks, R. J., & Gibbs, E. Major Nutrients in the Type A lunch. I. Analyzed and calculated values in the meals as served. Journal of the American Dietetic Association, 1973, 63, 620-625.

Heald, F. P. The adolescent in human nutrition. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise. (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Heald, F. P, et al. Measures of body fat and hydration in adolescent boys. Pediatrics, 1963, 31, 226-239.

Heald, F. P., & Roeder, L. M. Nutrition of the school child and adolescent. In D. S. McLaren & D. Burman (Eds.), Textbook of pediatric nutrition. London: Churchill-Livingstone, 1976.

Healy, J. J. R. Variations within individuals in human biology. Human Biology, 1958, 30, 210.

Hegsted, D. M. Calcium and phosphorus. In R. S. Goodhart & M. E. Shils (eds.), Modern nutrition in health and disease (5th ed.) Philadelphia: Lea & Febiger, 1976.

Hegsted, D. M. Dietary standards. Journal of the American Dietetic Association, 1975, 66, 13-21.

Hegsted, D. M. Nationwide food consumption survey--implications. Talk given at the National Agricultural Outlook Conference, Session 11, Washington, D.C., November 1979.

Hegsted, D. M. On Dietary Standards. Nutrition Reviews, 1978, 36, 33-36.

Heller, C. A., Scott, E. M., & Hammer, L. M. Height, weight and growth of Alaskan Eskimos. American Journal of the Diseases of Childhood, 1967, 118, 338-345.

Heyden, S., Bartel A. G., Hames C. G., & McDonough, J. R. Elevated blood pressure levels in adolescents, Evans County, Georgia: Seven-year follow-up of 30 patients and 30 controls. Journal of the American Medical Association, 1969, 209, 1683-1689.

Hidiroglou, M. A., Fuller, W. A., & Hickman, R. D. Super CARP (5th ed.) Ames, IO: Iowa State University, Statistical Laboratory, 1979.

Hiemstra, S. J. Economic importance of the National School Lunch Program. School Foodservice Research Review, 1977, 1, 11-14.

Hiemstra, S. J. Child Nutrition Review. See USDA, FNS, Economic Analysis and Program Evaluation Staff (same title).

Hiemstra, S. J. Research in action: Cash in lieu of commodities in school food service programs. School Food Service Research Review, 1979, 3, 29-32.

Hillman, R. W., & Smith, H. S. Hemoglobin patterns in low-income families. Public Health Reports, 1968, 83, 61-66.

Himes, J. H., et al. Compressibility of skinfolds and the measurement of subcutaneous fatness. American Journal of Clinical Nutrition, 1979, 32, 1734-1740.

Himes, J. H., et al. Fat areas as estimates of total body fat. American Journal of Clinical Nutrition, 1980, 33, 2093-2100.

Hoagland, G. W. The impact of federal child nutrition programs on the nutritional status of children. Paper presented at the meeting of the Southern Economic Association Meeting, Washington, D.C., November 1978.

Hoagland, G. W. The nutritional effectiveness of three federal child nutrition programs: United States 1971-1974. Paper presented at the meeting of the American Agricultural Economics Association Meeting, Pullman, Washington, July 1979.

Hoagland, G. W. Feeding children: Federal child nutrition policies in the 1980s. Washington, D.C.: U.S. Government Printing Office, 1980.

Hodges, R. E., & Krehl, W. A. Nutritional status of teenagers in Iowa. American Journal of Clinical Nutrition, 1965, 17, 200-209.

Hoepfner, R., Zagorski, H., & Wellisch, J. B. The sample for the Sustaining Effects Study and projections of its characteristics to the national population (Tech. Rep. No. 1). Santa Monica, CA: System Development Corp., 1977.

Hollander, D., et al. The mechanism and kinetics of vitamin D-3 intestinal absorption in vivo. The influence of intraluminal fatty acids, bile salts, perfusate pH, and unstirred water layer thickness on absorption. American Journal of Clinical Nutrition, 1978, 31, 710.

Hoover, L. W. Data base comparisons. In K. J. Morgan (Ed.) Proceedings of the Fifth National Data Bank Conference, April 28-29, 1980. East Lansing, Michigan: Michigan State University, 1980.

Horwitz, W. (Ed). Official methods of analysis of the Association of Official Analytical Chemists (11th ed.). Washington, D.C.: Association of Official Analytical Chemists, 1970.

Howe, S. M., & Vaden, A. G. Factors differentiating participants and non-participants of the National School Lunch Program. I. Nutrient intake of high school students. Journal of the American Dietetic Association, 1980, 76, 451-458.

Howell, D. Significance of iron deficiencies; Consequences of mild deficiency in children; Extent and meaning of iron deficiency in the United States. Washington, D.C.: Summary Proceedings of Workshop of Food and Nutrition Board, Academy of Sciences, 1971.

Huenemann, R. L., et al. Food and eating practices of teen-agers. Journal of the American Dietetic Association, 1968, 53, 17-24.

Huenemann, R. L., & Turner, D. Methods of dietary investigation. Journal of the American Dietetic Association 1942, 18, 562.

Hunt, E. E., Jr., & Heald, F. P. Physique, body composition, and sexual maturation in adolescent boys. Annals of the New York Academy of Science, 1953, 110, 532-544.

Hunt, I. F. Nutrient estimates from computerized questionnaires vs. 24-hr. recall interviews. Journal of the American Dietetic Association, 1979, 74, 656-659.

Hunt, I. F., et al. Effect of nutrition education on the nutritional status of low-income pregnant women of Mexican descent. American Journal of Clinical Nutrition, 1976, 29, 675-684.

Hunt, I. F., et al. Effect of a breakfast program on the nutrient intake of black children. Ecology of Food and Nutrition, 1979, 8, 21-28.

Hutcheson, R. H., & Hutcheson, J. K. Iron and vitamin C deficiencies in a large population of children. Health Services Reports, 1972, 87, 232-235.

Information Planning Associates, Inc. A profile of School food service personnel (Contract No. 12-35-600-254, USDA, FNS). Gaithersburg, MD: Author, February 1977.

Interdepartmental Committee on Nutrition for National Defense (ICNND). Manual for nutrition surveys, (2nd ed.) Bethesda, MD: Author, 1963.

International Union of Nutritional Sciences. The creation of growth standards: A committee report. American Journal of Clinical Nutrition, 1972, 25, 218.

Jackson, G. B. Methods for integrative reviews. Review of Educational Research, 1980, 50, 438-460

Jacob, M., et al. Biochemical assessment of the nutritional status of low-income pregnant women of Mexican descent. American Journal of Clinical Nutrition, 1976, 29, 650-656.

Jacobson, H. N., & Schorin, M. Ultransound and assessment of body composition. American Journal of Clinical Nutrition, 1978, 31, 710.

Jamison, P. L., & Zegura, S. L. A univariate and multivariate examination of measurement error in anthropometry. American Journal of Physical Anthropology, 1974, 40, 197-204.

Jansen, G. R., & Harper, J. M. Consumption and plate waste of menu items served in the National School Lunch Program. Journal of the American Dietetic Association, 1978, 73, 395-400.

Jansen, G. R., et al. Comparison of Type A nutritional standard menus for school lunch. III. Nutritive content of menus and acceptability. Journal of the American Dietetic Association, 1975, 66, 254.

Jansen, G. R., et al. Pilot study to evaluate food delivery systems used in school lunch programs. II. Nutritional value. School Foodservice Research Review, 1977, 1(1), 24-29.

Jansen, G. R., et al. Alternate lunch patterns in high schools. III. Food acceptability. Journal of the American Dietetic Association, 1980, 77, 443-449.

Jansen, G. R., et al. Alternate lunch patterns in high schools. IV. Nutritive value. Journal of the American Dietetic Association, 1980, 77, 546-551.

Jelliffe, D. B. The assessment of the nutritional status of the community (WHO Monograph No. 53). Geneva: WHO, 1966.

Jelliffe, D. B. Weight scales for developing regions. Lancet, 1968, 2, 359.

Jelliffe, D. B., & Jelliffe, E. F. P. Age-independent anthropometry. American Journal of Clinical Nutrition, 1971, 24, 1377-1379.

Jelliffe, E. F. P., & Jelliffe, D. B. The arm circumference as a public health index of protein-calorie malnutrition of early childhood. Journal of Tropical Pediatrics, 1969, 15, 176.

Jenicek, M., & Demirjian, A. Triceps and subscapular skinfold thickness in French-Canadian school-age children in Montreal. American Journal of Clinical Nutrition, 1972, 25, 576.

Johnson, C. L., & Abraham, S. Hemoglobin and selected iron-related findings of persons 1-74 years of age: United States 1971-74. Advancedata, 1979, 46, 1-12.

Johnston, F. E., McKigney, J. I., Hopwood, S., & Smelker, J. Physical growth and development of urban native Americans: A study in urbanization and its implecations for nutritional status. American Journal of Clinical Nutrition, 1978, 31, 946-954.

Jones, D. L. New South Wales, Australia, Department of Health. Personal Communication, 1973.

Jordan, J., et al. The 1972 Cuban National Child Growth Study as an example of population health monitoring: Design and methods. Annals of Human Biology, 1975, 2, 153.

Kannel, W. B., et al. Serum cholesterol, lipoproteins and the risk of coronary heart disease: The Framingham Study. Annuals of Internal Medicine, 1971, 74, 1-12.

Karp, R. J., Nuchpakdee, M., Fairorth, J., & Gorman, J. M. The school health service as a means of entry into the inner-city family for the identification of malnourished children. American Journal of Clinical Nutrition, 1976, 29, 216-218.

Kearney Management. Study of school food procurement practices. See USDA, FNS (same title).

Kearney Management Consultants. Study of school food procurement practices. Final Report, 1978.

Keister, M. Relation of mid-morning feeding to behavior of nursery school children. Journal of the American Dietetic Association, 1950, 26, 25-29.

Kelsay, J. L. A compendium of nutritional status studies and dietary evaluation studies conducted in the United States, 1957-1967. The Journal of Nutrition, 1969, Suppl. 1, Pt. II, 99, 123-160.

Kemper, H. C. G., & Pieters, J. J. L. Comparative study of anthropometric measurements of the same subjects in two different institutes. American Journal of Physical Anthropology, 1974, 40, 341-344.

Keys, A. Dietary survey methods. In R. Levy, B. Rifkind, B. Dennis, and N. Ernst (Eds.) Nutrition, lipids, and coronary heart disease. New York: Raven Press, 1979.

Keys, A., et al. Indices of relative weight and obesity. Journal of Chronic Disease, 1972, 25, 329-343.

King, J. C. Assessment of nutritional status of teenage pregnant girls. I. Nutrient intake and pregnancy. American Journal of Clinical Nutrition, 1972, 25, 916-925.

King, J. C., Calloway, D. H., & Margen, S. Nitrogen retention, total body mass and weight gain in teenage pregnant girls. Journal of Nutrition, 1973, 103, 772.

King, J. C., et al. Evaluation and modification of the basic four food guide. Journal of Nutrition Education, 1978, 10, 27.

Kirchhoff, P. Breakfast: A warm touch. School Food Service Journal, April 1980, 56.

Kirksey, A., Keaton, K., Abernathy, R. P., & Greger, J. L. Vitamin B_6 nutritional status of a group of female adolescents. Americal Journal of Clinical Nutrition, 1978, 31, 946-954.

Klerks, V. Quoted in D. B. Jelliffe & E. F. P. Jelliffe (Monograph No. 8). Journal of Tropical Pediatrics, 1956, 15, 253-260.

Klevay, L. M. Hair as biopsy material: II. Assessment of copper nutriture. American Journal of Clinical Nutrition, 1970, 23, 1194-1202.

Koerper, M. A., & Dallman, P. R. Serum iron concentration and transferrin saturation in the diagnosis of iron deficiency in children: Normal developmental changes. Journal of Pediatrics, 1977, 91, 870-874.

Koh, E. T. Selected blood components and urinary B vitamins as related to age and sex of black populations in Southwest Mississippi. American Journal of Clinical Nutrition, 1980, 33, 670-676.

Kondo, S., & Eto, M. Physical growth studies on Japanese-American children in comparison with native Japanese. Kyoto, May 1972.

Koonce, T. M. Does breakfast help? School Food Service Journal, 1972, pp. 51-54.

Kotz, N. Hunger in America: The federal response. New York: The Field Foundation, 1979.

Krehl, W. A. in Adolescent nutrition and growth. New York: Appleton Century Crofts, 1969.

Krehl, W. A., & Hodges, R. E. The interpretation of nutrition survey data. American Journal of Clinical Nutrition, 1965, 17, 191-199.

Kreisman, L. 1977 Minnesota student breakfast survey. Unpublished paper, 1978.

Kretchmer, N. Obesity in childhood. Washington, D.C.: National Institute of Child Health & Human Development, n.d.

Krietzman, S. W. Evaluation of the Craddock Breakfast Study. Atlanta: Unpublished manuscript, Emory University, Atlanta School of Dentistry, 1973.

Krogman, W. M. Growth of head, face, trunk, and limbs in Philadelphia white and negro children of elementary and high school age. Monographs of the Society for Research in Child Development, 1970, 35 (Ser. No. 136).

Krzywicki, H. J., et al. A comparison of methods for estimating human body composition. American Journal of Clinical Nurtition, 1974, 27, 1380-1385.

Kupietz, S., Bialer, I., & Winsberg, B. G. A behavior rating scale for assessing improvement in behaviorally deviant children: A preliminary investigation. American Journal of Psychiatry, 1972, 128, 1432-1436.

Kwon, P. H., Rorick, M. H., & Scrimshaw, N. S. Comparative tolerance of adolescents of differing ethnic backgrounds to lactose-containing and lactose-free dairy drinks. II. Improvement of a double-blind test. Americal Journal of Clinical Nutrition, 1980, 33, 22-26.

Laboratory Methods Committee, Lipid Research Clinics Program. Manual of laboratory operations (Vol. I). Lipid and lipoprotein analysis (DHEW Publ. No. (NIH) 75-628). Bethesda, Maryland: National Heart and Lung Institute, 1974.

Lachance, P. A. U.S. school foodservice: Problems and prospects. School Foodservice Research Review, 1978, 2, 73-77.

Laird, D. A., Levitan, M., & Wilson, V. A. Nervousness in school children as related to hunger and diet. Medical Journal of Research, 1931, 134, 494.

Lane, J. P. Who uses food stamps--Evidence from sample surveys of 1973 and 1974. (Technical Note No. 1) Washington, D.C.: USDA, 1975.

Lane, S. Food distribution and food stamp program effects on food consumption and nutritional "achievement" of low income persons in Kern County, California. American Journal of Agricultural Economy, 1978, 108-116.

Larson, L. B., et al. Nutritional status of children of Mexican-American migrant families. Journal of the American Dietetic Association, 1974, 64, 29-35.

Laskarzewsky, P., et al. Parent-child nutrient intake interrelationships in school children ages 6 to 19: The Princeton School District Study. American Journal of Clinical Nutrition, 1980, 33, 2350-2355.

Lauer, R. M., Conner, W. E., Leaverton, P. E., Reiter, M., & Clarke, W. R. Coronary heart desease risk factors in school children: The Muscatine study. Journal of Pediatrics, 1975, 86, 697-706.

Layzer, J., & Horowitz, G. Child impact report. Cambridge, MA: Abt Associates, February 26, 1980 (draft).

Lechtig, A., et al. The one-day recall dietary survey: A review of its usefulness to estimate protein and calorie intake. Archivos Latinoamericanos de Nutricion, n.d., pp. 243-271.

Lee, C. J. Nutritional status of selected teenagers in Kentucky. American Journal of Clinical Nutrition, 1978, 31, 1453-1464.

Leibel, R. L. Behavioral and biochemical correlates of iron deficiency. Journal of the American Dietetic Association, 1977, 71, 398-404.

Levine, J. B., & Zak, B. Automated determination of serum total cholesterol. Clinica Chimica Acta, 1964, 10, 381.

Library of Congress, Congressional Research Service. Legislative history of the child feeding programs. See Michelman, K.C.

Lieberman, H. M., et al. Evaluation of a ghetto school breakfast program. Journal of the American Dietetic Association, 1976, 68, 132-138.

Lieberman, H. M., et al. The impact of a ghetto school food program as nutrition, health and education (Final Report, Grant No. CC/0/000018/0/01). U.S. DHEW, HRA, Center for Disease Control, April 15, 1972.

298

Lindquist, B. Nutritional needs in preschool and school age: General survey. Symposia of the Swedish Nutrition Foundation. Uppsala: Almquist & Wiksells, 1969.

Lininger, F. Relation of the use of milk to physical and scholastic progress of undernourished school children. American Journal of Public Health, 1933, 23, 555-560.

Lipschitz, D. A., et al. A clinical evaluation of serum ferritin as an index of iron stores. New England Journal of Medicine, 1974, 290, 1213-1216.

Litschauer, J. G., et al. Meal quality and costs in the summer foodservice program. School Foodservice Research Review, 1978, 2, 106-109.

Litschauer, J. G., & Canevello, V. A. Cost economies of scale in school lunch service. School Foodservice Research Review, 1977, 1, 37-39.

Lockwood, M. J., et al. The spoonful as a dietary measure. Nutrition, 1968, 22, 7.

Lopez, R., et al. Riboflavin deficiency in a pediatric population of low socioeconomic status in New York City. The Journal of Pediatrics, 1975, 87, 420-422.

Lopez, R., Schwartz, J. V., & Cooperman, J. M. Riboflavin deficiency in an adolescent population in New York City. American Journal of Clinical Nutrition, 1980, 33, 1283-1286.

Lough, J. B., et al. Pilot study to evaluate food delivery systems used in school lunch programs. III. Physical facilities. School Foodservice Research Review, 1978, 2(1), 18-22.

Lough, J. B., et al. Pilot study to evaluate food delivery systems used in school lunch programs. IV. Meal costs. School Foodservice Research Review, 1978, 2(1), 23-27.

Lowe, C. U., et al. Reflections of dietary studies with children in the Ten-State Nutrition Survey of 1968-1970. Pediatrics, 1975, 56, 320-325.

Lowenstein, F. W. Preliminary clinical and anthropometric findings from the first Health and Nutrition Examination Survey, USA, 1971-1972. American Journal of Clinical Nutrition, 1976, 29, 918-927.

Lowry, O. H., Lopez, J. H., & Bessey, O. A. The determination of ascorbic acid in small amounts of blood serum. Journal of Biological Chemistry, 1945, 160, 609.

Lubbe, A. M. A survey of the nutritional status of white school children in Pretoria: Description and comparative study of two dietary survey techniques. South African Medical Journal, 1968, 43, 616.

Lund, L. A., & Burk, M. C. A multidisciplinary analysis of children's food consumption behavior. St. Paul: University of Minnesota, Agricultural Experiment Station, 1969.

MacKinney, L. G. Statement before the U.S. Congress, Senate, Select Committee on Nutrition and Human Needs. Nutrition and Human Needs. Hearing, 90th Congress, 2759-2764, May 8 and May 9, 1969.

Madden, J. P., Goodman, S. J., & Guthrie, H. A. Validity of the 24-hour recall. Journal of the American Dietetic Association, 1976, 68, 143-147.

Malina, R. M. Growth of muscle tissue and muscle mass. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise. (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Malina, R. M. Patterns of development in skinfolds of negro and white Philadelphia children. Human Biology, 1966, 38, 89.

Malina, R. M. Skinfolds in American negro and white children. Journal of the American Dietetic American Association, 1971, 59, 34-40.

Mann, G. V., et al. Diet and Cardiovascular disease in the Framingham Study I. Measurement of dietary intake. American Journal of Clinical Nutrition, 1962, 11, 200.

Maretzki, A. N., & Chung, C. An evaluation of the school lunch program in five public schools in Honolulu, Hawaii. School Lunch Journal, 1971, 25, 42.

Marks, H. Influence of obesity or morbidity and mortality. Bulletin of the New York Academy of Medicine, 1960, 36, 296.

Marr, J. W., Individual dietary surveys: Purposes and methods. World Review of Nutrition and Dietetics, 1971, 13, 105-164.

300

Marsh, W. H., Fingerhut, B., & Miller, H. Automated and manual direct methods for the determination of blood urea. Clinical Chemistry, 1965, 11, 624.

Martilotta, M., & Guthrie, H. A. Impact of providing milk options and nutrient information in school lunch programs. Journal of the American Dietetic Association, 1980, 77, 439-443.

Martin, E. A. Roberts' nutrition work with children. Chicago: University of Chicago Press, 1954.

Martin, E. A., & Beal, V. A. Roberts' work with children (Rev. ed.). Chicago: The University of Chicago Press, 1978.

Martin, J. School nutrition programs in perspective. Journal of the American Dietetic Association, 1978, 73, 389-392.

Martin, K. M. Nutritional adequacy, preference, acceptability, and food production aspects of hot and cold school lunches. (Doctoral dissertation, Pennsylvania State University, 1971).

Martorell, R., et al. The identification and evaluation of measurement variability in the anthropometry of preschool children. American Journal of Physical Anthropometry, 1975, 43, 347-352.

Martorell, R., et al. Upper arm anthropometric indicators of nutritional status. American Journal of Clinical Nutrition, 1976, 29, 46-53.

Matheson, N. E. Mid-morning nutrition and its effects on school type tasks. Unpublished doctoral dissertation, University of Southern California, 1970.

Mathtech, Inc. Best and final offer/responses made to FNS regarding clarification of our proposal 18-FNS-79 National School Food Service Equipment Study and Operational Model Development. Atlanta, Georgia: Mathematica, Inc., 1979.

Mayer, J. (ed.) The School Lunch Program: A factor in children's health. Postgraduate Medicine, 1966, pp. A101-A106.

McCance, R. A. Critical periods of growth. Proceedings of the Nutrition Society, 1976, 35, 309.

McLaren, D. S., & Burman, D. (Eds.) Textbook of pediatric nutrition. London: Churchill-Livingstone, 1976.

McLaughlin, P. J., & Weihrauch, J. B. Vitamin E content of foods. Journal of the American Dietetic Association, 1979, 75, 647.

Memphis City Schools, Division of Food Service. Comparison of Type A and Nutrient Standard Menus (USDA-FNS Contract No. 12-35-600-115). Memphis: Author, n.d.

Meredith, A., et al. How well do school children recall what they have eaten? Journal of the American Dietetic Association, 1951, 27, 749-751.

Meredith, H. V., & Knott, V. B. Joint Committee on Public Health Problems in Education of NEA-AMA, Height Weight Interpretation Folder. Ames: State University of Iowa, 1963.

Michael, E. D., & Katch, F. I. Prediction of body density from skinfold and girth measurements of 17-year old boys. Journal of Applied Physiology, 1968, 25, 747-750.

Michaelson, R., & Hansen, J. L. Take a fast food breakfast break. School Food Service Journal, March 1979, 34-35.

Michelman, K. C. Legislative history of the child feeding programs. Washington, D.C.: Library of Congress, Congressional Research Service, January 1976; rev. January 1978.

Miles, L. E. M., et al. Measurement of serum ferretin by a 2-site immunoradiometric assay. Analytical Biochemistry, 1974, 61, 209-224.

Miller, F. J. W., Court, S. D. M., Walton, W. S., & Knox, E. G. Growing up in New Castle-Upon-Tyne. London: OUP, 1960.

Ministry of Health. A pilot survey of the nutrition of young children in 1963. Reports on Public Health and Medical Subjects. (No. 118), London: H. M. Stationery Office, 1968.

Miscellaneous bibliographies.

Mongeau, E. Dietary Assessment of Nutritional Status. In The Assessment of Nutritional Status, Miles Symposium Proceedings. Saskatchewan University, Canada, June 25, 1973.

Monson, R. P. Root cellars: Working our way down. School Food Service Journal, February 1980, 48-51.

302

Montello, P. A., et al. The universal school lunch survey. Research report pursuant to contract with National School Food Service and Nutrition Education Financial Project. Tallahassee; Florida State University, Nutrition Education Financial Project, 1971.

Moore, M. C., et al. Dietary-atherosclerosis study on deceased persons. Journal of the American Dietetic Association, 1970, 56, 13-22.

Moore, M. C., et al. Extended Table of Nutrient Values (ETNV). Atlanta: International Dietary Information Foundation, INC., 1974

Moore, M. C., Judlin, B. C., & McA. Kennemur, P. Using graduated food models in taking dietary histories. Journal of the American Dietetic Association, 1967, 51, 447-450.

Morgan, K. J. (Ed.) Proceedings of Fifth National Nutrient Data Bank Conference, April 28-29, 1980. East Lansing: Michigan State University, Department of Food Science and Human Nutrition, 1980.

Morgenstern, S., Kessler, G., Auerbach, J., Flor, R. V. & Klein, B. An automated p-nitrophenylphosphate serum alkaline phosphatase procedure for the AutoAnalyzer. Clinical Chemistry, 1965, 11, 876.

Morse, E., et al. Comparison of the nutritional status of pregnant adolescents with adult pregnant women. I. Biochemical findings. The American Journal of Clinical Nutrition, 1975, 28, 1000-1013.

Murphy, E. W., Grossman, E., & Forziati, F. H. Nutritive content of Type A school lunches. School Lunch Journal, 1968, 22, 11.

Murphy, E. W., Willis, B. W., & Watt, B. K. Provisional tables on the zinc content of food. Journal of the American Dietetic Association, 1975, 66, 345.

Murphy, E. W., et al. Major mineral elements in Type A school lunches. Journal of the American Dietetic Association, 1970, 57, 239-245.

Murphy, E. W., et al. Vitamin content of Type A school lunches. Journal of the American Dietetic Association, 1969, 55, 372-378.

Myers, M. L., Mabel, J. A., & Stare, F. J. A nutrition study of school children in a depressed urban district. 2. Physical and biochemical findings. Journal of the American Dietetic Association, 1968, 53, 234-242.

Myers, M. L., O'Brien, S. C., Mabel, J. A., & Stare, F. J. A nutrition study of school children in a depressed urban district. 1. Dietary findings. Journal of the American Dietetic Association, 1968, 53, 226-233.

Natick Army Laboratory. See U.S. Army, Natick Research and Development Command.

National Catholic Education Association. A statistical report on U.S. Catholic schools, 1978-1979. Washington, D.C.: Author, 1979.

NCES. Selected public and private elementary and secondary education statistics, school years 1976-77 through 1978-79. NCES Bulletin B80-01, October 1979.

NCHS. Age at menarche, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 133)

NCHS. Anthropometric and clinical findings (U.S. DHEW Pub. No. (HRA) 75-1229). Washington, D.C.: U.S. Government Publishing Office, 1975. See Abraham et al., 1975.

NCHS. Appendix II: Data collection forms of the HANES II Survey. Vital & Health Statistics, N.D.

NCHS. Blood glucose levels in adults, United States--1960-1962. Vital & Health Statistics, 1966. (Ser. 11, No. 18)

NCHS. Blood pressure of persons 18-74 years, United States, 1971-72. Vital & Health Statistics, 1975. (Ser. 11, No. 150)

NCHS. Body proportions of children aged 6-11 years. Vital & Health Statistics, 1975. (Ser. 11, No. 143)

NCHS. Body weight, stature, and sitting height: White and negro youths 12-17 years, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 126)

NCHS. Cardiovascular conditions of children 6-11 years and youths 12-17 years, United States, 1963-65 and 1966-70. Vital & Health Statistics, 1978. (Ser. 11, No. 166)

NCHS. Caloric and selected nutrient values for persons 1-74 years of age: first health and nutrition examination survey; United States, 1971-1974. Vital & Health Statistics, 1979. (Ser. 11, No. 209)

NCHS. Children and youth: Selected health characteristics, United States 1958 and 1968. Vital & Health Statistics, 1971. (Ser. 10, No. 62)

NCHS. Current estimates from the Health Interview Survey, 1974. Vital & Health Statistics, 1975. (Ser. 10, No. 100)

NCHS. Current listing and topical index to the Vital and Health Statistics series, 1962-1976. DHEW Pub. No. (HRA) 77-1301.

NCHS. Decayed, missing and filled teeth among youths 12-17 years, United States, Vital & Health Statistics, 1974. (Ser. 11, No. 144)

NCHS. Dietary intake findings: United States 1971-1974. Vital & Health Statistics, 1977. (Ser. 11, No. 202)

NCHS. Dietary intake source data, United States, 1971-1974. DHEW Pub. No. (PHS) 79-1221.

NCHS. Examination and health history findings among children and youths, 6-17 years, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 129)

NCHS. Examination staff procedures manual for the Health and Nutrition Examination Survey, 1976-1979. Instruction Manual, Data Collection, Part 15a.

NCHS. Examination staff procedures manual for the Health Examination Survey, 1974-1975. Instruction Manual, Data Collection, Part 15c.

NCHS. Food consumption profiles of white and black persons aged 1-74 years: United States, 1971-74. Vital & Health Statistics, 1979. (Ser. 11, No. 210)

NCHS. Growth charts. Monthly Vital Statistics, 1976. (Rep. 25, Suppl. No. 3)

NCHS. Health attitudes and behavior of youths 12-17 years: Demographic and socioeconomic factors, United States. 1975. (Ser. 11, No. 153)

NCHS. Hearing sensitivity and related medical findings among youths 12-17 years, United States. Vital & Health Statistics, 1975. (Ser. 11, No. 154)

NCHS. Hearing status and ear examination: Findings among adults, United States--1960-1962. Vital & Health Statistics, 1968. (Ser. 11, No. 32)

NCHS. Height and weight of children, United States. Vital & Health Statistics, 1970. (Ser. 11, No. 104)

NCHS. Height and weight of children: Socioeconomic status, United States. Vital & Health Statustics, 1972. (Ser. 11, No. 119)

NCHS. Height and weight of youths 12-17 years, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 124)

NCHS. Hematocrit values of youths 12-17 years, United States. Vital & Health Statistics, 1974. (Ser. 11, No. 146)

NCHS. Literacy among youths 12-17 years, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 131)

NCHS. NCHS Growth curves for children: Birth-18 years, United States. Vital & Health Statistics, 1977. (Ser. 11, No. 165)

NCHS. Need for dental care among adults, United States, 1960-1962. Vital & Health Statistics, 1970. (Ser. 11, No. 36)

NCHS. Oral hygiene among youths 12-17 years: United States. Vital & Health Statistics, 1975. (Ser. 11, No. 151)

NCHS. Parity and hypertension. Vital & Health Statistics, 1973. (Ser. 11, No. 38)

NCHS. Plan and initial program of the health examination survey. Vital & Health Statistics, 1973. (Ser. 1, No. 4)

NCHS. Plan and operation of a health examination survey of U.S. youths 12-17 years of age. Vital & Health Statistics, 1974. (Ser. 1, No 8)

NCHS. Plan and operation of the health and nutrition examination survey: United States 1971-1973. Vital & Health Statistics, 1978. (Ser. 1, No. 10a)

NCHS. Plan and operation of the health and nutrition examination survey. Vital & Health Statistics, 1977. (Ser. 1, No. 10b)

NCHS. Preliminary findings of the first Health and Nutrition Examination Survey, United States, 1971-1972: Anthropometric and clinical findings. See Abraham et al., 1975.

NCHS. Preliminary findings of the first Health and Nutrition Examination Survey, United States, 1971-1972: Dietary intake and biochemical findings. See Abraham et al., 1974.

NCHS. Prevalence of Osteoarthritis in adults by age, sex, race, and geographic area, United States--1960-1962. Vital & Health Statistics, 1966. (Ser. 11, No. 15)

NCHS. Refraction status of youths 12-17 years, United States. Vital & Health Statistics, 1974. (Ser. 11, No. 148)

NCHS. Rheumatoid arthritis in adults, United States 1960-1962. Vital & Health Statistics, 1966. (Ser. 11, No. 17)

NCHS. Selected body measurements of children 6-11 years, United States. Vital & Health Statistics, 1973. (Ser. 11, No. 123)

NCHS. Selected examination findings related to periodontal disease among adults, United States--1960-1962. Vital & H alth Statistics, 1974. (Ser. 11, No. 33)

NCHS. Self-reported health behavior and attitudes of youths 12-17 years, United States. Vital & Health Statistics, 1975. (Ser. 11, No. 147)

NCHS. Serum cholesterol levels of persons 4-74 years of age, United States, 1971-1974. Vital & Health Statistics, 1980. (Ser. 11, No. 217)

NCHS. Serum uric acid values of youths 12-17 years, United States. Vital & Health Statistics, 1975. (Ser. 11, No. 152)

NCHS. Skeletal maturity of children 6-11 years, United States. Vital & Health Statistics, 1974. (Ser. 11, No. 140)

NCHS. Skinfold thickness of children 6-11 years. Vital & Health Statistics, 1971. (Ser. 11, No. 120)

NCHS. Skinfold thickness of youths 12-17 years, United States. Vital & Health Statistics, 1974. (Ser. 11, No. 132)

NCHS Total serum cholesterol levels of adults 18-74 years: Uniced States, 1971-1974. Vital & Health Statistics, 1978. (Ser. 11, No. 205)

NCHS. Weight by height and age for adults 18-74 years: United States, 1971-1974. Vital & Health Statistics, 1979. (Ser. 11, No. 208)

NCHS. Weight and height of adults 18-74 years of age: United States, 1971-1974. Vital & Health Statistics, 1979. (Ser. 11, No. 211)

National Research Council. Recommended dietary allowances (9th ed.). Washington, D.C.: National Academy of Sciences, 1980. Also, 7th ed., 1968, 8th ed., 1974.

National Research Council. 1980 revised recommended dietary allowances. Journal of the American Dietetic Association, 1979, 75, 123.

Nelson, M., et al. The consumption of the school lunch in an inner-city school. Manuscript submitted for publication, 1980.

Nelson, P. E., Jr., & Perrin, J. Economic effects of federal contributions to the U.S. School Lunch Program: Calendar year 1972 and Fiscal year 1974 (Agricultural Economic Report No. 350). Washington, D.C.: USDA, ERS, 1976.

Neumann, C. G. Reference data. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Nevada Department of Education. Child nutrition programs: State plan 1978-1979. Carson City, Nevada: Author, 1979.

Newman, R. G., & Martin, S. The National Nutrition Survey in New York City. Transactions New York Academy of Sciences, 1971, 33, 316-326.

Newspaper articles--miscellaneous.

Nichaman, M. Z., & Lane, J. M. Nutritional surveillance in developed countries: The United States experience. In R. B. Alfin-Slater & D. Kritchevsky (eds.), Human nutrition--A comprehensive treatise. (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Nicholson, R. H. Some economic aspects of the National School Lunch Program in North Carolina (Economics Information Report 32). Raleigh: North Carolina State University, Department of Economics, 1973.

North Carolina State Board of Health. North Carolina Nutrition Survey (Pt. 1). Raleigh, N.C.: Author, 1971.

Novak, L. P. Age and sex differences in body density and creatinine excretion of high school children. New York Academy of Science, 1963, 110, 545.

Nutrition Action. (Journal)

Nutrition Reviews. Hair changes in human malnutrition. Author, 1971, 29, 143-145.

Nutrition Reviews. The validity of 24-hour dietary recalls. Author, 1976, 34, 310-311.

Nutrition Reviews. Zinc deficiency in pregnant, fetal and young rats. Author, 1976, 34, 84-86.

O'Brien, D., Ibbott, F. A., & Rodgerson, D. O. Laboratory manual of pediatric micro-biochemical techniques (4th ed.). New York: Harper & Row, 1968.

Ohlson, M. A., et al. Nutrition and dietary habits of aging women. American journal of Public Health, 1950, 40, 1101

O'Leary, K. D., Rosenbaum, A., & Hughes, P. C. Fluorescent lighting: A purported source of hyperactive behavior. Journal of Abnormal Child Psychology, 1978, 6, 285-289.

O'Neal, R. M., et al. The incidence of anemia in residents in Missouri. American Journal of Clinical Nutrition, 1976, 29, 1158-1166.

Opinion Research Corporation. A study to evaluate the nutritional aspects of the school breakfast program: Draft report. Princeton, N.J.: Author, 1979.

Orr, M. L. Pantothenic acid, vitamin B6 and vitamin B12 in foods (Home Economics Research Report No. 36). Washington, D.C.: Agricultural Research Service, 1969.

Orshansky, M. The measure of poverty (Technical Paper I). Documentation of background information and rationale for current poverty matrix. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1977.

Owen, G. M. The assessment and recording of measurements of growth of children: Report of a small conference. Pediatrics, 1973, 51, 461-466.

Owen, G. M., et al. A study of nutritional status of preschool children in the United States, 1968-1970. Pediatrics, 1974, 53, 597-646.

Owen, G., & Lippman, G. Nutritional status of infants and young children: U.S.A. Pediatric Clinics of North America, 1977, 24, 211-227.

Owen, G. M., & Lubin, A. H. Anthropometric differences between black and white children. American Journal of Diseases of Childhood, 1973, 126, 168-169.

Owen, G. M., Lubin, A. H., & Garry, P. J. Preschool children in the United States 1968-1970: A study of nutritional status. Pediatrics, 1974, 53, 597.

Owen, G. M., et al. Nutrition survey of white mountain Apache preschool children. In W. M. Moore et al. (Eds), Nutrition, growth and development of North American Indian Children (DHEW Pub. No. (NIH) 72-26). Washington, D.C.: U.S. Government Printing Office, 1972.

Paige, D. M. The school feeding program: An underachiever. The Journal of School Health, 1972, 42, 392-395.

Paige, D. M. School feeding program: Who should receive what? The Journal of School Health, 1971, 41, 261-263.

Paige, D. M., Bayless, T. M., & Graham, G. G. Milk programs: Helpful or harmful to Negro children. American Journal of Public Health, 1972, 64, 1486.

Paige, D. M., & Graham, G. G. School milk programs and negro children: A nutritional dilemma. Journal of School Health, 1974, 44.

Paige, D. M., et al. Lactose malabsorption and milk rejection in Negro children. Johns Hopkins Medical Journal, 1971, 129, 163.

Paige, D. M., et al. Nutritional supplementation of disadvantaged elementary-school children. Pediatrics, 1976, 58, 697-703.

Pao, E. M. Eating patterns and food frequencies of children in the United States. Talk given at Fourth Annual Conference on Food, Nutrition, and Dental Health, Chicago, October 3, 1980.

Pao, E. M. Nutrient consumption patterns of individuals in 1977 and 1965. Talk given at the 1980 Agricultural Outlook Conference, Session 11, Washington, D.C., November 1979.

Parizkova, J. Total body fat and skinfold thickness in children. Metabolism, 1961, 10, 794-807.

Paul, O., et al. A longitudinal study of coronary heart disease. Circulation, 1963, 28, 201.

Payne, N. E., et al. The economics of alternative school feeding systems. Ithaca, N.Y.: Cornell University, Department of Agricultural Economics, Cornell University Agricultural Experiment Station, 1973.

Pearson, W. N. Biochemical appraisal of nutritional status in man. American Journal of Clinical Nutrition, 1962, 11, 462-476.

Peat, Marwick, Mitchell & Co. An assessment of the manpower and training requirements for state and local education agencies in implementing full cost accounting procedures (Final Report). Washington, D.C.: Author, 1976.

Pekkarinen, M. Methodology in the collection of food consumption data. World Review of Nutrition and Dietetics, 1970, 12, 145-171.

Pennington, J. A. Dietary nutrient guide. Westport: Avi Publishing Company, 1976.

Pennington, J. T., & Calloway, D. H. Copper content of foods. Journal of the American Dietetic Association, 1973, 63, 143.

Perloff, B. P., & Butrum, R. R. Folacin in selected foods. Journal of the American Dietetic Association, 1977, 70, 161.

Phillips, M. C. and Briggs, G. M. Milk and its role in the American diet. Journal of Dairy Science, 1975, 58, 1751-1763.

Phlegar, B. L., & Phlegar, F. L. Nutrition and learning. Radford, Virginia: Radford College, Department of Secondary Education, n.d.

Pinkus, M. S. A study of pupil breakfast habits and behavioral patterns in certain Louisiana elementary schools following implementation of the National School Breakfast Program. Unpublished M.S. thesis, Louisiana State University, 1970.

Piomelli, S., Brickman, A., & Carlos, E. Rapid diagnosis of iron deficiency by measurement of free erythrocyte prophyrins and hemoglobin: The FEP/hemoglobin ratio. Pediatrics, 1976, 57, 136.

Pollitt, E. Early childhood intervention programs in Latin America: A selective review. Report presented to the Office of Latin America and the Caribbean, International Division, Ford Foundation, 1978.

Pollitt, E. Effects of short-term fasting on school-related behaviors. Paper presented to The International Congress on Nutrition, Rio de Janiero, Brazil, August 1978.

Pollitt, E., et al. Educational benefits of the United States School Feeding Program: A critical review of the literature. American Journal of Public Health, 1978, 68, 477-481.

Pollitt, E., et al. The United States school feeding program: Modes of evaluating its effects on the behavior of recipients. (A report presented to the Ford Foundation.) 1976.

Pollitt, E., Leibel, R., & Greenfield, P. Brief fasting, stress and cognition. (A report presented to the Ford Foundation.) Houston: University of Texas, School of Public Health, Human Nutrition Center, 1980.

Popkin, B. The National School Lunch and School Breakfast Programs: An analysis of program participation and dietary impact. Draft proposal, May 1979.

Popkin, B. M., et al. Nutritional program options for maternal and child health: A report prepared for the Select Panel for the Promotion of Child Health. Chapel Hill, N.C.: University of North Carolina, Carolina Population Center, January 1980.

Prader, A., Tanner, J. M., & Von Harnack. G. A. Catch-up growth following illness or starvation. Journal of Pediatrics, 1963, 62, 646-659.

Prasad, A. S., et al. Effect of oral contraceptives agents on nutrients. 1. Minerals. American Journal of Clinical Nutrition, 1975, 28, 377-384.

Prasad, A. S., et al. Effect of oral contraceptives on nutrients. 2. Vitamins. American Journal of Clinical Nutrition, 1975, 28, 385-391.

Price, D. W., et al. Final report: Evaluation of school lunch and school breakfast programs in the State of Washington. (Pts. I and II). Pullman, WA: Washington State University, 1975.

Price, D. W., et al. Food delivery programs and other factors affecting nutrient intake of children. American Journal of Agricultural Economy, 1978, pp. 609-618.

Price, D. W. Food patterns of Washington households with 8-12 year old children (Bulletin 843). Pullman: Washington State University, College of Agriculture, Research Center, 1977.

Price, D. W., et al. Problems in the management of the National School Lunch Program in Washington school districts (Bulletin 817). Pullman: Washington State University, College of Agriculture, Research Center, 1975.

Price, D. Z., & Price D. W. Food preferences of 8-12 year old Washington children (Bulletin 840). Pullman: Washington State University, College of Agriculture, Research Center, 1977.

Price, D. W., & West, D. A. Socioeconomic and demographic characteristics of Washington households with school children by ethnic group and poverty level. Pullman: Washington State University, College of Agriculture, Research Center, 1977.

Prothro, J., Mickles, M., & Tolbert, B. Nutritional status of a population sample in Macon County, Alabama. American Journal of Clinical Nutrition, 1976, 29, 94-104.

Rao, K. V., & Singh, D. An evaluation of the relationship between nutritional status and anthropometric measurements. American Journal of Clinical Nutrition, 1970, 23, 83-93.

Rasanen, L. Nutrition study of Finnish rural children. VI. Methodological study comparing the 24-hour recall and the dietary history interview. The American Journal of Clinical Nutrition,, 1979, 32, 2560-2567.

Rauh, J. L., & Schumsky, D. A. An evaluation of triceps skinfold measures from urban school children. Human Biology, 1968, 40, 363-374.

Read, M. S. Malnutrition, hunger, and behavior. Journal of the American Dietetic Association, 1973, 63, 379-385.

Read, M. S. Malnutrition, learning and behavior (DHEW Publication No. (NIH) 76-1036). Washington, D.C.: USDA, PHS, NIH, National Institute of Child Health and Human Development, Center for Research for Mothers and Children, 1976.

Reddy, V., et al. Functional significance of growth retardation in malnutrition. American Journal of Clinical Nutrition, 1976, 29, 3-7.

Reisinger, K., Rogers, K., & Johnson, O. Nutrition survey of Lower Greasewood, Arizona Navajos. In W. M. Moore et al. (Eds.), Nutrition, Growth and Development of North American Indian Children (DHEW No. (NIH) 72-26). Washington, D.C.: U.S. Government Printing Office, 1972.

Research Triangle Institute. Evaluation of the Special Supplementary Feeding Program for Women, Infants and Children: Pre-test instruments and supporting statement. Research Triangle Park, NC: Author, Feb. 15, 1980.

Reshef, A., & Epstein, L. M. Reliability of a dietary questionnaire. The American Journal of Clinical Nutrition, 1972, 25, 91-95.

Response Analysis Corporation. Current nutrition beliefs and practives among health educators, students, parents: Research conducted for Hoffman-La Roche, Inc. Princeton: Author, 1978.

Riggs, S. NYC School food pulse quickens as new chief snips red tape, tries fast food. Institutions/Volume Feeding, March 1978, 27-28.

Robinson, J. S. Special Milk Program evaluation and National School Lunch Program su vey. Washington, D.C.: USDA, FNS, 1975.

Robinson, M. Metabolic anomalies, nutrition and growth. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise. (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Robson, J. R. K., et al. Ethnic difference in s n-fold thickness. American Journal of Clinical Nutrition, 1971, 24, 864-868.

Robson, J. R. K. The accuracy of measurement of weight in the well-baby clinic. Journal of Tropical Pediatrics, 1970, 16, 5.

Robson, J. R. K., Bazin, M., & Soderstrom, R. Ethnic differences in skinfold thickness. American Journal of Clinical Nutrition, 1971, 24, 864.

Roche, A. F., & Davila, G. H. Differences between recumbent length and stature within individuals, Growth, 1974, 38, 313-320.

Roche, A. F. & McKigney, J. I. Physical growth of ethnic groups comprising the US population. American Journal of the Diseases of Childhood, 1976, 130, 62-64.

Rogers, B., & Zorn, F. Factors influencing school and student participation in the School Breakfast Program 1977-78. See USDA, FNS, OPP & E, 1980.

Rowe, N. H., Garn, S. M., Clark, D. C., & Guire, K. E. The effect of age, sex, race, and economic status on dental caries experience of the permanent dentition. Pediatrics, April 1976, 57, 457-461.

Ruppenthal, B., & Gibbs, E. Treating childhood obesity in a public school setting. Journal of School Health, 1979, 569-571.

Ruppenthal, J. Playgrounds and platewaste revisited. School Food Service Journal, July-August 1978, 145-146.

Samuelson, G. An epidemiological study of child health and nutrition in a northern Swedish country. II. Methodological study of the recall technique. Nutrition and Medicine, 1970, 1?, 321.

 311

Sandstead, H. H., & Pearson, W. N. Clinical evaluation of nutrition status. In R. S. Goodhard & M. E. Shils (Eds.), Modern nutrition in health and disease (5th ed.) Philadelphia: Lea & Febiger, 1976.

Sandstead, H. H. Zinc nutrition in the United States. American Journal of Clinical Nutrition, 1973, 26, 1251-1260.

Sargent, D. W. Weight-height relationship of young men and women. American Journal of Clinical Nutrition, 1963, 13, 318-325.

Sauberlich, H. E., Skala, J. H., & Dowdy, R. P. Laboratory tests for the assessment of nutritional status. Cleveland: CRC Press, 1974.

Schaefer, A. E. The national nutrition survey. Journal of the American Dietetic Association, 1969, 54, 372-375.

Schaefer, A. E. Nutrition in the United States of America. In D.S. McLaren (Ed.) Nutrition in the community. New York: Wiley, 1976, pp. 269-384.

Schmidt, R. E., et al. Evaluability assessment: Making public programs work better (Contract Report 1217-50-01). Washington, D.C.: The Urban Institute, 1978.

Schnittker Associates. Improving federal food procurement and distribution programs: A report prepared for the National Frozen Food Association. Washington, D.C.: Author, November 1979.

School Food Service Journal. (Journal, miscellaneous articles.)

Shorr, B. C., Sanjur, D. & Erickson, E. C. Teenage food habits. Journal of the American Dietetics Association, 1972, 61, 415-420.

Schuchat, M. G. The school lunch and its cultural environment. Nutrition Education, 1973, 5, 116-118.

Schwerin, H. S., et al. Food eating patterns and health: A re-examination of the Ten-State and HANES-I surveys. American Journal on Clinical Nutrition, in press, 1980.

Scrimshaw, N. S. Malnutrition, learning and behavior. The American Journal of Clinical Nutrition, 1967, 20, 493-502.

Scrimshaw, N. S., Taylor, C. E., & Gordon, J. E. Interactions of nutrition and infection (WHO Monograph No. 57). Geneva: WHO, 1968.

Seltzer, C. C., et al. The triceps as a predictive measure of body density and body fat in obese adolescent girls. Pediatrics, 1965, 36, 212-218.

Seltzer, C. C., & Mayer, J. A simple criterion for obesity. Postgraduate Medicine, 1965, 28, 101.

Seltzer, C. C., & Mayer, J. Greater reliability of the triceps skin fold over the subscapular skin fold as an index of obesity. American Journal of Clinical Nutrition, 1967, 20, 950-953.

Shakir, A. Arm circumference in the surveillance of protein-calorie malnutrition in Baghdad. American Journal of Clinical Nutrition, 1975, 28, 661-665.

Shinn, J. E., & Loyd, J. N. Comparison of Type A and computer assisted nutrient standard menus. School Foodservice Research Review, 1977, 1(1) 30-33.

Singer, L., Ophaug, R. H., & Harland, B. F. Fluoride intake of young male adults in the United States. American Journal of Clinical Nutrition, 1980, 33, 328-332.

Sloan, S. A guide for Nutra Lunches and natural foods. Atlanta: SOS Printing, 1977.

Sloane, N., & Latham, M. C. Nutritional anthropometry in the identification of malnutrition in childhood. Journal of Tropical Pediatrics, 1971, 17, 98.

Society of Actuaries. Build and Blood Pressure Study (1). 1959.

Solomons, N. W. On the assessment of zinc and copper nutriture in man. American Journal of Clinical Nutrition, 1979, 32, 856-871.

Sonquist, J. A., & Morgan, J. N. The detection of interaction effects. Ann Arbor: University of Michigan, Survey Research Center, 1964.

Sorenson, A. W., & Hansen, R. G. Index of food quality. Journal of Nutrition Education, 1975, 7, 53.

Sorenson, A. W., et al. An index of nutritional quality for a balanced diet. Journal of the American Dietetic Association, 1976, 68, 236-242.

Southern Illinois University. Nutrient Dietary Data Analysis (NDDA) System. Carbondale, IL: Author, 1979.

Sprauve, M. E., & Dodds, M. L. Dietary survey of adolescents in the Virgin Islands. Journal of the American Dietetic Association, 1965, 47, 287-291.

Strain, W. H., Steachman, L. T., Lankau, C. A. Jr., Berliner, W. P., & Pories, W. J. Analysis of zinc levels in hair for the diagnosis of zinc deficiency in man. Journal of Laboratory and Clinical Medicine, 1966, 68, 244-249.

Stebbins, L., et al. Evaluation design and implementation plan for Head Start health evaluation. Cambridge: Abt Associates, Inc., 1978.

Stefanik, P. A., & Trulson, M. F. Determining the frequency of intakes of foods in large group studies. American Journal of Clinical Nutrition, 1962, 11, 335-343.

Steiner, M. M. Childhood obesity. Pediatric Digest, 1976, 18, 9.

Stephenson, L. S., Latham, M. C., & Jones, D. V. Milk consumption by black and white pupils in two primary schools. Journal of the American Dietetic Association, 1977, 71, 258-262.

Stephenson, S. Ethel Ott Schools. Food Management, May 1979, 52-53, 80.

Stevens, G. R. The hyperkinetic syndrome: A review. (Masters thesis, University of California at Riverside, 1977).

Stevens, H. A., Bleiler, R. E., & Ohlson, M. A. Dietary intake of five groups of subjects. Journal of the American Dietetic Association, 1963, 42, 387-393.

Stuart, H. C., & Meredith, H. V. Use of body measurements in the school health program. American Journal of Public Health, 1946, 36, 1365.

Stuart, H. C. & Stevenson, S. S. Physical growth and development. In Textbook of pediatrics (6th ed.). Philadelphia: W. B. Saunders Co., 1954.

Stunkard, A., d'Aquili, E., Fox, S., & Filion, R. D. L. Influence of social class on obesity and thinness in children. Journal of the American Medical Association, 1972, 221, 579-584.

Sulzer, J. L., Wesley, H. W., & Leonig, F. Nutrition and behavior in Head Start children results from Tulane Study. In D. J. Kallen (Ed.), Nutrition, development and social behavior. DHEW Pub. No. (NIH) 73-242, 1973.

Swanson, J. M., & Kinsbourne, M. Food dyes impair performance of hyperactive children on a laboratory learning test. Science, 1980, 207, 1485-1487.

Swartz, E., and Bachner, R. L. Diurnal variation of serum iron on infants and children. Acta Paediatrica Scandinavia, 1968, 57, 433.

Tanner, J. M. Growth as a monitor of nutritional status. Proceedings of the Nutrition Society, 1976, 35, 315.

Tanner, J. M. Growth at adolescence (2nd ed.). Oxford: Blackwell, 1962.

Tanner, J. M. Population differences in body size, shape, and growth rate. Archives of Disease in Childhood, 1976, 51, 1.

Tanner, J. M. Postnatal growth. In R. Mitchell (Ed.), Child life and health. London: J. & A. Churchill, 1970.

Tanner, J. M. The measurement of body fat in man. Proceedings of the Nutrition Society, 1959, 18, 148.

Tanner, J. M., Hiernaux, J., & Jarman, S. Growth and physique studies. In J. S. Weiner & J. A. Lourie (Eds.), Human biology, a guide to field methods (IBP Handbook No. 9). Philadelphia: F. A. Davis, 1969.

Tanner, J. M., & Whitehouse, R. H. Standards for subcutaneous fat in British children. British medical Journal, 1962, 1, 446.

Tanner, J. M., Whitehouse, R. H., & Takaishi, M. Standards from birth to maturity for heights, weights, height velocity and weight velocity: British children in 1965. Archives of the Diseases of Childhood, 1966, 41, 454.

Temple-West, P. F. E., & Mueller, C. Preliminary evaluation of the contribution of federal food assistance programs to low-income households. Philadelphia: Nutritional Development Services, 1978.

Ten State Nutrition Survey. See U.S. DHEW, Health and Mental Services Administration, Center for Disease Control.

Thatch, D. W. A survey of public school districts operation food service systems in New Jersey. New Brunswick, N.J.: Rutgers University, New Jersey Agricultural Experiment Station, August 1971.

318

Thatch, D. W. A survey of public school districts operating food service systems in New Jersey. New Brunswich, N. J.: School Feeding Effectiveness Research Program, Rutgers University, 1971.

Thomas, A. E., McKay, D. A., & Cutlip, M. B. A nomograph method for assessing body weight. American Journal of Clinical Nutrition, 1976, 29, 302-304.

Thompson, J. N., Erdody, P., Brien, R., & Murray, T. K. Fluorometric determination of vitamin A in human blood and liver. Biochemical Medicine, 1971, 5, 67.

Thomson, A. M. Diet in pregnancy. I. Dietary survey technique and the nutrient intake of primigravidae. British Journal of Nutrition, 1958, 12, 446.

Tisdall, F. F., et al. The Canadian Red Cross School Meals Study. Canadian Medical Association Journal, 1951, 64, 477-489.

Toepfer, E. W., et al. Folic acid content of foods (Agriculture Handbook No. 29). See USDA, ARS, CFEI.

Trites, R. L., Dugas, E., Lunch, G., & Ferguson, H. B. Prevalence of hyperactivity. Journal of Pediatric Psychology, 1979, 4, 179-188.

Trulson, M. F. Assessment of dietary study methods. I. Comparison of methods for obtaining data for clinical work. Journal of the American Dietetic Assoication, 1954, 30, 991-995.

Trulson, M. F., & McCann, M. B. Comparison of dietary survey methods. Journal of the American Dietetic Association, 1959, 35, 672-676.

Tukey, J. W. Methodology, and the statistician's responsibility for BOTH accuracy AND relevance. Journal of the American Statistical Association, 1979, 74, 786-793.

Tuttle, W. W., et al. Effect on school boys of omitting breakfast: Physiologic responses, attitudes and scholastic attainments. Journal of the American Dietetic Association, 1954, 30, 674.

U.S. Army, Natick Research and Development Command (NARADCOM). Plate waste study. Natick, MA: Preliminary report, author, 1979.

U.S. Congress. Child Nutrition Act of 1966, as amended. Washington, D.C.: U.S. Government Printing Office, 1979.

U.S. Congress. National School Lunch Act, as amended. Washington, D.C.: U.S. Government Printing Office, 1975.

U.S. Congress. Public Law 95-627. Washington, D.C.: U.S. Government Printing Office, 1978.

U.S. Congress, Congressional Budget Office. Feeding Children: Federal child nutrition policies in the 1980s. Washington, D.C.: U.S. Government Printing Office, 1980. See Hoagland, 1980.

U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy. Studies in public welfare (Paper No. 17). National survey of food stamp and food distribution program recipients: A summary of findings on income sources and amounts and incidence of multiple benefits. Washington, D.C.: U.S. Government Printing Office, 1974.

U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy. Studies in public welfare (Paper Nol 1). Public Income transfer programs: The incidence of multiple benefits and the issues raised by their receipt. Washington, D. C.: U.S. Government Printing Office, 1972.

U.S. Congress, Joint Economic Committee, Subcommittee on Fiscal Policy. Studies in public welfare (Paper No. 6). How public welfare benefits are distributed in low-income areas. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Congress, Office of Technology Assessment. Nutrition research alternatives. Washington, D.C.: U.S. Government Printing Office, 1978.

USDA. Comprehensive study of the child nutrition programs--July 1974. Washington, D.C.: U.S. Government Printing Office, Committee Print of the Committee on Agriculture and Forestry, U.S. Senate, 1974.

USDA. Food and nutrition for the 1980's: Moving ahead. (Comprehensive Plan for Implementing the National Food and Human Nutrition Research and Education and Information Programs.) Washington, D.C.: Author, 1979.

USDA. Miscellaneous publications.

USDA. Nutrition program staff study of state departments of education. (Submitted to Congress pursuant to Public Law 94-105). Washington, D.C.: Author, 1977.

320

USDA. Proposed assessment, improvement, and monitoring system (AIMS). Washington, D.C.: Author, 1979.

USDA. Response to the GAO report, "Federal domestic food assistance programs--A time for assessment and change." Memo from C.T. Foreman to H. Eschwege, January 16, 1978.

USDA, Agricultural Marketing Service, Market Development Research Division. Milk consumption by children at school and at home in relation to special milk program. See Anderson, K., & Hoofnagle, W.S.

USDA, ARS, CFEI. Composition of foods: Raw, processed and prepared (Agricultural Handbook No. 8). Washington, D.C.: U.S. Government Printing Office, 1963, rev. 1975.

USDA, ARS, CFEI. Folic acid content of foods (Agriculture Handbook No. 29). Washington, D.C.: U.S. Government Printing Office, 1951.

USDA, ARS, CFEI. Nutrient Intake of Individuals in the Food and United States, Spring, 1965. (Agriculture Report No. 12). Washington, D.C.: U.S. Government Printing Office, 1972.

USDA, ARS, CFEI. Nutritive value of American foods in common units (Agriculture Handbook No. 456). Washington, D.C.: U.S. Government Printing Office, 1975.

USDA, ARS, CFEI. Nutritive value of Foods (Home and Garden Bulletin No. 72). Washington D.C.: U.S. Government Printing Office, 1970, 1971

USDA, ARS, CFEI. The Thrifty Food Plan (CFE (Adm.) 326). Hyattsville, Md: CFEI, 1975.

USDA, ARS, CFEI. 1977-78 Nationwide Food Consumption Survey (Forms). Philadelphia: Author, 1978.

USDA, ERS. Costs of foods purchased by USDA and local school systems, 1973/74. Washington, D.C.: Author, 1975.

USDA, ERS. Lunch programs in the nation's schools (Agricultural Economic Report No. 210). See Freund, W. H.

USDA, ESCS. National Food Review. (Selected issues).

USDA, FNS. Advisory Committee on Nutrition Evaluation. Evaluating the nutrition and health benefits of the special supplemental food program for women, infants, and children. (USDA, FNS-165) Washington, D.C.: Author, n.d.

USDA, FNS. Characteristics of food stamp households, September 1975. Washington, D.C.: Author, 1976.

USDA, FNS. Food consumption and nutrition evaluation of the National School Lunch Program. Washington, D.C.: Author, n.d.

USDA, FNS. Food consumption and nutrition evaluation: The National School Lunch Program. Washington, D.C.: Author, 1979.

USDA, FNS. Free and reduced price meal and free milk policy handbook (Rev.) (Program Aid 1149). Washington, D.C.: U.S. Government Printing Office, 1978.

USDA, FNS. Menu planning guide for Type A school lunches (Rev.) (Program Aid 719). Washington, D.C.: U.S. Government Printing Office, 1978.

USDA, FNS. 1972 National School Lunch Program Survey. Washington, D.C.: Author, 1974.

USDA, FNS. Overlapping food programs--Alternatives. Washington, D.C.: Author, 1976.

USDA, FNS. Program participation data: Milk program. Washington, D.C.: Author. FY 1976--Vol. I. FY 1977--Vol. II. FY 1978--Vol. III. FY 1979--Vol. IV.

USDA, FNS. Program participation data: National School Breakfast program. Washington, D.C.: Author. FY 1976--Vol. I. FY 1977--Vol. II. FY 1978--Vol. III. FY 1979--Vol. IV.

USDA, FNS. Program participation data: National School Lunch Program. Washington, D.C.: Author. FY 1976--Vol. I. FY 1977--Vol. II. FY 1978--Vol. III. FY 1979--Vol. IV.

USDA, FNS. Regulations (7 CFR, Part 210). National School Lunch Program.

USDA, FNS. Regulations (7 CFR, Part 215). Special Milk Program for Children.

USDA, FNS. Regulations (7 CFR, Part 220). School Breakfast Program.

USDA, FNS. Regulations (7 CFR, Part 230). Nonfood Assistance Program.

USDA, FNS. Regulations (7 CFR, Part 235). State Administrative Expense Funds

USDA, FNS. Regulations (7 CFR, Part 240). Cash in Lieu of Commodities.

USDA, FNS. Regulations (7 CFR, Part 245). Determining Eligibility for Free and Reduced Price Meals and Free Milk in Schools.

USDA, FNS. Regulations (7 CFR 210). National School Lunch Program--Nutritional requirements. Interim rule. Federal Register, August 22, 1978 (43 F.R. 37165).

USDA, FNS. Regulations (7 CFR 210). National School Lunch Program--Nutritional requirements. Proposed rules. Federal Register, September 9, 1977 (42 F.R. 45328).

USDA, FNS. Regulations (7 CFR 210). National School Lunch Program--Nutritional requirements. Final regulation. Federal Register, August 17, 1979 (44 F.R. 48149).

USDA, FNS. Reporting Forms. n.d.

USDA, FNS. Response to GAO Report, Federal domestic assistance programs--A time for assessment and change. Washington, D.C.: Author, 1978.

USDA, FNS. RFP and Mathtech proposal for menu choice/food service equipment study. Mimeo, 1979.

USDA, FNS. Study of changes in the Type A pattern: Preliminary draft. Washington, D.C.: Author, n.d.

USDA, FNS. Study of school food procurement practices. Final Report: Volume II, Procurement models and guides. Washington, D.C.: U.S. Government Printing Office, 1978.

USDA, FNS, Budget and Planning Division. Chronological legislative history of child nutrition programs. Washington, D.C.: Author, 1970.

USDA, FNS, Child Nutrition Division. Income poverty guidelines for eligibility for free and reduced price meals and free milk. Washington, D.C.: Author, June 1980.

USDA, FNS, Child Nutrition Division. The USDA study on high school participation in child nutritional programs. Washington, D.C.: Author, n.d.

USDA, FNS, Consumer and Food Economics Research Division, and the National Marine Fisheries Service. Food buying guide for Type A school lunches. Washington, D.C. U.S. Government Printing Office, 1972.

USDA, FNS, Economic Analysis and Program Evaluation Staff. Child Nutrition Review. (Pts. 1A & 1B) Washington, D.C.: Author, 1978.

USDA, FNS, Economic Analysis and Program Evaluation Staff. Child Nutrition Review. (Pt. 2) Washington, D.C.: Author, 1978.

USDA, FNS, Economic Analysis and Program Evaluation Staff. Evaluation of the child nutrition programs. Unpublished manuscript, 1977.

USDA, FNS, Nutrition and Technical Services Staff. Evaluation of school lunch and school breakfast programs in the state of Washington. Washington, D.C.: Author, n.d.

USDA, FNS, Office of the Administrator. Program evaluation status reports: Completed studies. Washington, D.C.: Author, October 1978.

USDA, FNS, OPPE. Factors influencing school and student participation in the School Breakfast Program. Washington, D.C.: Author, 1980.

USDA, FNS, OPPE. Interim meal pattern study, 1978-1979. Washington, D. C.: Author, 1980.

USDA, FNS, OPPE. Position paper on lactose intolerance. Washington, D. C.: Unpublished Manuscript, 1980.

USDA, FNS, OPPE. Study 1: Interim regulations--Preliminary Report. Washington, D.C.: Unpublished manuscript, 1980.

USDA, FNS, OPPE. Study 6: A study of cash in lieu of commodities in school food service programs. Washington, D.C.: Unpublished manuscript, January 1980.

USDA, FNS, Program Reporting Staff. Program Cost Data, 1976, 1977, 1978, & 1979. Washington, D.C.: Author, 1980.

USDA, FNS, Program Reporting Staff. Urban public school feeding survey--March 1976. Washington, D.C.: Author, 1976.

USDA, FNS, School Programs Division. Management Evaluation '79. Washington, D.C.: Author, 1979.

USDA, FNS, School Programs Division. Management Evaluation '80. Washington, D.C.: Author, 1980.

USDA, FNS, School Programs Division. State Plan Guidance: School Year '80. Washington, D.C.: Author, 1979.

321

USDA, FNS, School Programs Division. State Plan Guidance: School Year '81. Washington, D.C.: Author, 1980.

USDA, FNS, School Programs Division, Special Nutrition Program. Summary of Management Evaluation and Office of Investigative Findings. Correspondence, 1979.

USDA, FNS, Southeast Regional Office. Report: Task force study, Virgin Islands school food service program. Atlanta: Author, 1972.

USDA, Office of Inspector General, Audit. FNS NSLP Nationwide audit of food service management companies and vendors (Audit report 27615-3-Hy). Hyattsville, MD.: Author, 1979.

USDA, Office of Inspector General, Audit. FNS NSLP New York, New York Office of School Food Service (Audit Report 2723-170-Hy). Hyattsville, MD.: Author, 1979.

USDA, SEA. Current food consumption practices and nutrient sources in the American diet. Hyattsville, MD: Consumer Nutrition Center, 1980.

USDA, SEA Money value of food used by households in the United States, Spring 1977 (Nationwide Food Consumption Survey, 1977-78, Preliminary Report No. 1). Hyattsville, MD: Consumer Nutrition Center, 1979.

USDA, SEA. Food and nutrient intakes of individuals in 1 day in the United States, Spring 1977. (Nationwide Food Consumption Survey, 1977-78, Preliminary Report No. 2). Hyattsville, MD: Consumer Nutrition Center, 1980.

USDA, SEA. Nutrient levels in food used in households in the United States, Spring 1977 (Nationwide Food Consumption Survey, Prelimanary Report No. 3). Hyattsville, MD: Consumer Nutrition Center, 1981.

USDA, & U.S. DHEW. Nutrition and your health: Dietary guidelines for Americans. Washington, D.C.: U.S. Government Printing Office, 1980.

U.S. DHEW. Nutrition, growth and development of North American Indian children. Washington, D.C.: U.S. DHEW (NIH) 72-26, 1972.

U.S. DHEW. Status of joint USDA-HEW efforts on nutrition: Status monitoring & surveillance implementation. Unpublished working papers of joint USDA-HEW committee, 1979.

32

U.S. DHEW, Education Division. Selected public and private elementary and secondary education statistics. National Center for Education Statistics Bulletin, 1979, (NCES 80-B01), 1-11.

U.S. DHEW, Health and Mental Services Administration, Center for Disease Control. Nutrition surveillance. Washington, D.C., March 1977.

U.S. DHEW, Health and Mental Services Administration, Center for Disease Control. Nutrition surveillance (DHEW Report No. 27). Washington, D.C.: January 1975.

U.S. DHEW, Health and Mental Services Administration, Center for Disease Control. Nutrition surveillance: Sources of error in weighing and measuring children. Washington, D.C.: September 1975.

U.S. DHEW, Health and Mental Services Administration, Center for Disease Control. Ten-State Nutritional Survey, 1968-1970 (DHEW Publication No. (HSM) 72-8130). (5 vols.) Washington, D.C.: U.S. Government Printing office, 1972.

U.S. Senate, Select Committee on Nutrition and Human Needs. Dietary goals for the United States (2nd ed.) Washington, D.C.: U.S. Government Printing Office, 1977.

U.S. Senate, Select Committee on Nutrition and Human Needs. First session on nutrition and human needs: Part 9--Universal school lunch program. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Senate, Select Committee on Nutrition and Human Needs. School food program needs--1975: State school food service, director's response. A working paper. Washington, D.C.: U.S. Government Printing Office, 1975.

The Urban Institute. Toward efficiency and effectiveness in the WIC delivery system. Washington, D.C.: Author, 1976.

Vaden, A. G. (ed.) Nutrition and the school age child: A collection of readings. Denver: American School Food Service Association, 1979.

Van de Mark, M. S., & Wright, A. C. Hemoglobin and folate levels of pregnant teen-agers. Journal of the American Dietetic Association, 1972, 61, 511-516.

Velat, C., et al. Evaluating school lunches and nutrition status of children. USDA Agricultural Research Administrative Circular 859, 1951.

326

Verghese, K. P., Scott, R. B., Teixeira, G., & Ferguson, A. D. Studies in growth and development. XII. Physical growth of North American Negro children. Pediatrics, 1969, 44, 243-247.

Villa-Dresser, C. M., et al. Selected findings: Food consumption profiles of white and black persons 1-74 years of age in the United States, 1971-1974. Advancedata, 1978, 21, 1-11.

Vermeersch, J. A., & Lane, S. Nutritional adequacy of Type A lunch menus in a Northern California school district under current and interim regulations. School Food Service Research Review, 1980, 4, 118-123.

Waddington, C. H. The strategy of the genes. London: Allen and Unwin, 1958.

Wait, B., et al. Energy intake of well-nourished children and adolescents. The American Journal of Clinical Nutrition, 1969, 22, 1383-1396.

Waterlow, J. C. Classification and definition of protein-calorie malnutrition. British Medical Journal, 1972, 3, 566.

Waterlow, J. C. Classification and definition of protein-energy malnutrition. In G. H. Beaton & J. M. Bengoa (Eds.), Nutrition in preventive medicine. Geneva: WHO, 1976.

Waterlow, J. C. The concept of "normal" in nutrition. In Metabolic adaptation and nutrition (Science Pub. 222). Pan American Health Organization, 1971.

Waterlow, J. C., et al. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. Bulletin of the World Health Organization, 1977, 55, 489-498.

Watt, B., & Merrill, A. L. Composition of foods: Raw, processed, prepared (Handbook No. 8) See USDA, ARS, CFEI.

Webb, T. E., & Oski, F. A. Iron deficiency anemia and scholastic achievement in young adolescents. Pediatrics, 1973, 82, 827.

Weil, W. B. Current controversies in childhood obesity. Journal of Pediatrics, 1977, 91, 175-187.

Weiss, B., Williams, J. H., Margen, S., et al. Behavioral responses to artificial food colors. Science, 1980, 207, 1487-1489.

Weiss, G., & Hechtman, L. The hyperactive child syndrome. Science, 1979, 205, 1348-1354.

Werry, J. S., Sprague, R. L., & Cohen, M. N. Connors' Teacher Rating Scale for use in drug studies with children--An emperical study. Journal of Abnormal Child Psychology, 1975, 3, 217-228.

West, D. A., et al. Impacts of the food stamp program on value of food consumed and nutrient intake among Washington households with 8-12 year old children. Western Journal of Agricultural Economics, 1978, pp. 131-144.

West, D. A., & Hoppe, R. A. Pricing and participation rates in the national School Lunch Programs in Washington public school districts. Pullman: Washington State University, Washington Agricultural Experiment Station, College of Agriculture, 1973.

West, D. A., & Price, D. W. The effects of income, assets, food programs, and household size on food consumption. American Journal of Agricultural Economy, 1976, pp. 725-730.

Wetzel, N. C. Physical fitness in terms of physique, development and basal metabolism. Journal of the American Medical Association, 1941, 116, 1187-1195.

Whalen, C. K., Henker, B., & Dotemoto, S. Methylphenidate and hyperactivity: Effects on teacher behaviors. Science, 1980, 208, 1280-1282.

Wheelock, G. C., & Warren, A. P. Community social structure and school free lunch participation. School Foodservice Research Review, 1978, 2, 92-97.

Wiehl, D. G., & Reed, R. Development of new or improved dietary methods for epidemiological investigations. American Journal of Public Health, 1960, 50, 824-828.

Williams, C. L., Carter, B. J., Wynder, E. L., & Blumenfeld, T. A. Selected chronic desease 'risk factors' in two elementary school populations. American Journal of Disease of Children, 1979, 133, 704-708.

Wingerd, J., Schoen, E. J., & Solomon, I. L. Growth standards in the first two years of life based on measurements of white and black children in a prepaid health care program. Pediatrics, 1971, 47, 818.

Woodruff, C. W. Iron deficiency in infancy and childhood. Pediatric Clinics of North America, 1977, 24, 85-94.

World Health Organization. Nutritional status of populations: A manual on anthropometric appraisal of trends. WHO Nutrition, 1970, 70, 129.

Yanochik-Owen, A., & White, M. Nutrition surveillance ir Arizona: Selected Anthropometric and laboratory observations among Mexican-American children. American Journal of Public Health, 1977, 67, 151-154.

Yarbrough, C., et al. Anthropometry as an index of nutritional status. In Roche & F. Falkner (eds.), Nutrition and malnutrition. New York: Plenum, 1974.

Yarbrough, C. Y., et al. Responses of indicators of nutritional status to nutrition intervention in populations and individuals. In Evaluation of child health services--The interface between research and medical practice (DHEW publication No. (NIH) 78-1066). Washington, D.C.: U.S. Government Printing Office, 1978.

Youland, D. M., & Engle, A. Dietary data methodology: Practices and problems in HANES. Journal of the American Dietetic Association, 1976, 68, 22-25.

Young, C. M., et al. Body composition of preadolescent and adolescent girls. I. De--ity and skinfold measurements. Journal of the American Dietetic Association, 1968, 53, 25-31.

Young, C. M., Chalmers, F. W., & Church, H. N. Cooperative nutritional status studies in the northeast region. III. Contributions to dietary methodology studies (North East Region Pub. No. 10). Massachusetts University Agriculture Experimental Station Bulletin 469, 95 pp., n.d.

Young, C. M., et al. Fall and spring diets of school children in New York State. Journal of the American Dietetic Association 1951, 27, 289-292.

Young, C. M., et al. A comparison of dietary study methods. I. Dietary history vs. seven-day-record. Journal of the American Dietetic Association, 1952, 28, 124-128.

Young, C. M., et al. Weekly variation in nutrient intake of young adults. Journal of the American Dietetic Association, 1953, 20, 459-464.

Young, C. M., et al. Subjects' estimation of food intake and calculated nutritive value of the diet. Journal of the American Dietetic Association, 1953, 29, 1216-1220.

Young, C. M., Hagan, G. C., Tucker, R. E., & Foster, W. D. A comparison of dietary study methods. II. Dietary history vs. seven-day-record vs. 24-hour recall. Journal of the American Dietetic Association, 1952, 28, 218-221.

Young, C. M., & Trulson, M. F. Methodology for dietary studies in epidemiological surveys. II. Strengths and weaknesses of existing methods. American Journal of Public Health, 1960, 50, 803-814.

Yperman, A. M., & Vermeersch, J. A. Factors associated with children's food habits. Journal of Nutrition Education, 1979, 11, 72.

Yudkin, J. Dietary surveys: Variation in the weekly intake of nutrients. British Journal of Nutrition, 1951, 5, 177-194.

Zack, P. M., Harlan, W. R., Leaverton, P. E., & Cornoni-Huntley. A longitudinal study of body fatness in childhood and adolescence. The Journal of Pediatrics, 1979, 95, 126-130.

Zerfas, A. J. Anthropometric field methods: General. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Human nutrition--A comprehensive treatise (Vol. 2), D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Publishing, 1979.

Zerfas, A. J. Anthropometric procedure--Nepal National Nutrition Survey Data. Unpublished document, 1975.

Zerfas, A. J. Quality control in anthropometry. Unpublished document, 1974.

Zerfas, A. J. The insertion tape: A new circumference tape for use in nutritional assessment. American Journal of Clinical Nutrition, 1975, 28, 782-787.

Zerfas, A. J., et al. Office assessment of nutritional status. Pediatric Clinics of North America, 1977, 24, 253-272.

Zavaleta, A. N., & Malina, R. M. Growth, fatness, and leanness in Mexican-American children. American Journal of Clinical Nutrition, 1980, 33, 2008-2020.