DOCUMENT RESUME

ED 418 934 SP 037 898

AUTHOR	Shier, Nathan W., Ed.; Torabi, Mohammad R., Ed.
TITLE	Recent Advances in Nutrition Education. The Health Education Monograph Series. Volume 15 Number 3.
INSTITUTION	Eta Sigma Gamma, Muncie, IN.
PUB DATE	1997-00-00
NOTE	73p.
AVAILABLE FROM	Eta Sigma Gamma, The National Professional Health Education Honorary, 2000 University Avenue, Muncie, IN 47306.
PUB TYPE	Reports - Research (143)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Athletes; Behavior Change; Blacks; *Child Health; Comprehensive School Health Education; Computers; Cost Effectiveness; *Dietetics; Eating Habits; Elementary Secondary Education; Females; Foods Instruction; Foreign Countries; *Health Promotion; *Nutrition Instruction; Older Adults
IDENTIFIERS	Africa; American Cancer Society; Australia; China; Glucose; Risk Reduction; Zinc

ABSTRACT

This monograph presents a collection of articles on nutrition education: "Using the DINE Score To Improve Food Choice Behavior" (Darwin Dennison and Kathryn F. Dennison); "Self-Reported Food Intake Patterns of Older Adults in Australia, China, and the United States" (Alyce D. Fly, Nathan W Shier, Barbara A. Hawkins, Susan J. Eklund, Yang Jingyi, and Anne L. Binkley); "Enhancing Effectiveness and Assessing Cost-Effectiveness of Nutrition Education Interventions" (Janet K. Grommet); "Nutrition Education for African-Americans: Challenges and Opportunities" (Delores C. S.James); "Do Women Athletes Need to Eat Differently from Men Athletes?" (Alice K. Lindeman); "Do Athletes Need Antioxidant Supplements?" (Susan Massad); "School Cafeteria: A Culture for Promoting Child Nutrition Education" (Kweethai Chin Neill, Thomas E. Dinero, and Diane Demuth Allensworth); "American Cancer Society's Guidelines on Diet and Cancer Risk Reduction" (John R. Seffrin); "Zinc Analyzes of Selected Western African Foods with Reference to Nutritional Status" (Nathan W. Shier, Isbatou Boukari, Mohammad R. Torabi, and Heather Chamberlin); and "Diet and Blood Sugar Control--The Glycemic Index in Older Persons" (John R. Warren, Nathan W. Shier, Alyce D. Fly, Susan J. Eklund, Mohammad R. Torabi, and David M. Koceja). (All papers contain references.) (SM)

Volume 15, Number 3
1997

The Health Education Monograph Series

Recent Advances In Nutrition Education

Eta Sigma Gamma

Published by Eta Sigma Gamma
National Professional Health Education Honorary

Volume 15, Number 3
1997

The Health Education Monograph Series

Guest Editor
Nathan W. Shier, Ph.D.
Department of Applied Health Science
Indiana University
Bloomington, Indiana 47405

Editor
Monograph Series
Mohammad R. Torabi, Ph.D., M.P.H., CHES
Chancellors' Professor and Assistant Chair
Department of Applied Health Science
Indiana University
Bloomington, Indiana 47405

Eta Sigma Gamma wishes to gratefully acknowledge the John P. McGovern Foundation for its generosity in helping to make this monograph series possible.

The Health Education Monograph Series is published by Eta Sigma Gamma, the National Professional Health Education Honorary, 2000 University Avenue, Muncie, Indiana 47306. A non-profit organization, Eta Sigma Gamma is dedicated to the elevation of standards, ideals, competence, and ethics of professionally trained men and women in the Health Science discipline. Third class, bulk-rate postage paid at Muncie, Indiana.

Recent Advances In Nutrition Education

VOLUME 15 NUMBER 3

1997

Published by Eta Sigma Gamma

National Professional Health Education Honorary

National Executive Committee
Eta Sigma Gamma

Dr. Kelli McCormack-Brown
Department of Community & Family Health
College of Public Health
13201 Bruce B. Downs Blvd.
Tampa, FL 33612
Immediate Past President (9/97-8/99)
Office - (813) 974-4867
FAX - (813) 974-5172
KMBROWN@COM1.MED.USF.EDU

Dr. Beverly Mahoney
P.O. Box 30
Lemont, PA 16851
President (9/97-8/99)
Office - (717)948-6730
Fax - (717)948-6209
BXM5@PSU.EDU

Dr. Susan Ward
Dept. of Health Studies
Texas Woman's University
P.O. Box 425499
Denton, TX 76204
Vice President (9/97-8/99)
Office - (940)898-2860
Fax - (940)898-3198
F_WARD@VENUS.TWU.EDU

Dr. James F. McKenzie (Secretary-Treasurer)
Department of Physiology and Health Science
2000 W. University Avenue
Ball State University
Secretary/Treasurer
Muncie, Indiana 47306
Office - (765) 285-5961
FAX - (765) 285-2351
00JFMCKENZIE@BSU.EDU

Dr. Mohammad R. Torabi
(Editor - *The Health Education Monograph Series*)
Department of Applied Health Science
Indiana University, HPER 116
Bloomington, Indiana 47405
Office - (812) 855-4808
FAX - (812) 855-3936
TORABI@INDIANA.EDU

Dr. Judith Luebke (Editor - *Health Educator*)
Department of Health Science
Mankato State University
Mankato, Minnesota 56002
Editor - The Health Educator
Office - (507) 389-1527
Home - (507) 388-7445
Fax - (507) 389-5932
JUDY_LUEBKE@MS1.MANKATO.MSUS.EDU

Dr. Roberta J. Ogletree (At Large)
Department of Health Education
Southern Illinois University
Carbondale, Illinois 62901
At-Large (9/95-9/98)
Office - (618) 453-2777
BOBBIE@SIU.EDU

Dr. Loren Bensley, Jr.
12551 Craker Road
Northport, MI 49670
Historian/Director of Chapter Development
Home - (616) 386-5812
L.BENSLEY@CMICH.EDU

Dr. Brian Colwell
Dept. of Health & Kinesiology
Texas A&M University
College Station, TX 77843-4243
At-Large (9/97-8/00)
Office - (409) 845-1756
Fax - (409)847-8987
B_COLWELL@TAMU.EDU

Ms. Nancy Koontz
29 Youngman Rd. #3
Murphrysboro, IL 62966
Student Representative (9/96 - 8/97)
Office - (618)453-2777
Home - (618)684-5547
NKOONTZ@SIU.EDU

Ms. Donna Ganion (Executive Director)
2000 W. University Avenue
Muncie, Indiana 47306
Office - (765) 285-2258 or 1-800-715-2559
FAX - (765) 285-2351
DGANION@BSU.EDU

Foreward

Scientific studies provide evidence that one's diet can influence risk for developing chronic disease, can impact on ability to learn, and to perform in sports; Therefore, dietary knowledge combined with behavior change must provide the framework for intervention programs. Within these nutrition education systems, interactive learning activities must be at the forefront to foster behavior change. Regardless of age, to be successful at positive behavior change, one must recognize (through assessment) that change is necessary and to believe that one is capable of making the change. This creates a positive attitude for learning new skills. Examples of interactive activities are: exposure of individuals to healthy yet tasty foods; using the school cafeteria as a teaching laboratory and incorporating students into its operation; the use of interactive computer software; involve subjects in problem solving concerning their health which may involve a personal health/dietary assessment; diet/menu planning; exposure of children to good role models including peers, teachers, and parents; and using the grocery store as a teaching laboratory for selecting healthy foods.

The present issue of ***The Health Education Monograph Series*** is dedicated to the improvement of health through dietary change brought about by education and intervention strategies focused on behavior change. To this end this issue includes articles on: interactive software; food intake patterns of older adults; assessment of intervention programs; adaptation of interactive learning programs to ethnic groups such as African Americans; nutrition education for athletic performance; using the school cafeteria as a "culture" for promoting education and behavior change; relationships between diet and cancer and how to lower risk; food composition; and the use of the glycemic index of foods as a tool for improving blood sugar control.

At this time I wish to thank all authors who have worked hard in prepartion of manuscripts. Without your interest and dedication, this monograph issue would not have been possible. I would like to thank Indiana University senior nutrition student, Jennifer Ward, for her excellent research and review of learning theories, and finally, I wish to personally thank Dr. Mohammad Torabi for extending the opportunity to me to edit this Monograph issue. These materials should be of great value to the nutrition educator as well as to the research scientist.

Sincerely,
Nathan W. Shier, Ph.D.
Guest Editor, ***The Health Education Monograph Series***
Indiana University

Preface

On behalf of the National Executive Committee of Eta Sigma Gamma, I would like to express my sincere appreciation to the Guest Editor of this issue, Nathan Shier, for the significant contribution he has made to the profession and Eta Sigma Gamma. He has done an excellent job in preparing and editing this timely, first-class monograph on nutrition education. He deserves our sincere thanks. Further, I would like to thank all of the authors who ultimately made this monograph possible. I genuinely appreciate their contributions to the **Health Education Monograph Series**.

Nutrition and diet play a significant role in disease prevention and health promotion. According to the National Center for Health Statistics(1990) "diet/inactivity" was the second actual cause of death in the United States accounting for 300,000 deaths. I hope that this monograph issue brings greater recognition to the significance of nutriton and diet as an integral part of comprehensive health education.

I would like to thank Ms. Kathy Finley for her assistance in preparing the publication and Ms. Joyce Arthur for her technical assistance. Also, the assistance of Ms. Donna Ganion from our National ESG office is appreciated. Last, but not least, I would like to offer my appreciation to each and every member of the National Executive Committee who are very committed to supporting these monograph series.

Finally, thank you for sharing your comments with me regarding the past Monograph series. As always, I am eager to hear your criticisms, comments and suggestions regarding these publications. Your input is essential in improving the publication and utlimately serving our members and the profession in the most effective way. I do hope that you, as loyal members of this National Professional Health Education Honorary, check your college/university libraries and make sure that they receive ***The Health Education Monograph Series***. If not, please request that they subscribe to these important publications by calling 1-800-715-2559. It is a privilege for me to serve the Eta Sigma Gamma members and our profession.

I look forward to hearing from you.

Mohammad R. Torabi, Ph.D., MPH, CHES
Editor, ***The Health Education Monograph Series***

7

THE HEALTH EDUCATION MONOGRAPH SERIES

Volume 15, Number 3 1997

8

THE HEALTH EDUCATION MONOGRAPH SERIES

Volume 15, Number 3 1997

9

Using the DINE Score to Improve Food Choice Behavior

Darwin Dennison, Ed.D., CHES; Kathryn F. Dennison, Ed.D.

Introduction

Currently, the Recommended Dietary Allowances, the Dietary Goals for the United States, and the Dietary Guidelines for Americans are the major standards used to assess the nutritional adequacy of the public's eating pattern. These guidelines contain suggested nutrient ranges and levels and recommended servings of foods. They are not presented as evaluation tools even though they address the composition of diet and provide insight for improved food choices. The DINE was developed to provide a standardized method to quickly and accurately evaluate an individual's food choices. It was based on a compilation and synthesis of dietary guidelines and goals issued by widely recognized federal government and national health agencies. The DINE includes the following four steps: record present behaviors, analyze dietary intake (DINE Analysis), identify strengths, and plan improvement (Figure 1).

In the United States, there is a high incidence of diet-related disorders. Six of the ten leading causes of death have a nutrition-related component including heart disease, certain cancers, stroke, diabetes, cirrhosis of the liver, and atherosclerosis (U.S. Department of Health and Human Services, 1990). Contributing to the prevalence of diet-related disorders is the lack of a single, standardized process by which individuals can objectively evaluate all aspects of the food choices which affect their eating pattern.The DINE is an understandable and easy-to-use method by which an individual can quantify "how well" or "how poorly" they are eating. It is an objective procedure to improve food choices. Generally, a professional is required to elicit food intake to generate a diet analysis and then interpret the data for the no individual. This involves reviewing the amount of each nutrient obtained in the diet and comparing it with recommendations from one or more sources. The present methodology to provide recommendations to the public consists of the use of any one or a combination of the following dietary guidelines and goals issued by federal government and national health agencies:

The Basic Four Food Guide (U.S. Department of Agriculture, 1956) and The Food Guide Pyramid (U.S. Department of Agriculture, 1992).

The U.S. Recommended Daily Allowances (U.S. RDA) (U.S. Department of Health and Human Services, 1976).

The Dietary Goals for the United States (Select Committee on Nutrition and Human Needs, 1977).

The Exchange Lists (American Diabetes Association and the American Dietetic Association, 1986).

The Recommended Dietary Allowances (RDA) (National Academy of Sciences, National Research Council, Food and Nutrition Board, 1989)

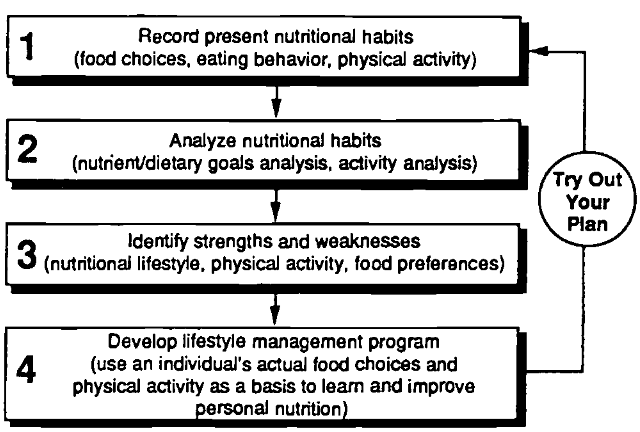
Diet and Health (Committee on Diet and Health, Food and Nutrition Board, National Academy of Sciences, 1989).

Nutrition and Your Health: Dietary Guidelines for Americans (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1995).

The present methodology for analyzing diets and making recommendations for improvement of food choices requires a labor intensive effort by health professionals using complex procedures involving numerous reference publications. Even when these data are computerized, the method by which this task is accomplished is not standardized, and varies from professional to professional. While dietary guidelines are helpful for policy makers and for researchers, they fall short in assisting the public in making food choices. Individuals and professionals trying to evaluate diets with these re-

Figure 1

Four basic steps in the DINE evaluation process



sources find it tedious, complicated, and frustrating.

Each of the above recommendations has inherent limitations so that multiple sources must be used for a comprehensive analysis. For example, The Basic Four Food Guide and the Food Guide Pyramid lack objective criteria to determine if an eating pattern has adequate micro- and macronutrients. The Exchange Lists does not account for micronutrients and is often too cumbersome to accommodate all food choices. The Dietary Goals for the United States and the Dietary Guidelines for Americans focus on the types of foods to eat but do provide an objective method for individuals to know if their food choices provide the amount of nutrients needed. The RDA provide protein and micronutrient allowances to meet the needs of generally healthy people, however allowances for the energy-yielding nutrients of fat and carbohydrate are not given.

For the DINE analysis, predictor nutrients were established and assigned subscores based upon the quantity of food intake meeting selected recommendations. The sum of the subscores yields a score and descriptor which rates the quality of food intake. Formative and process evaluations over a ten-year period were used to develop and to refine the system. The DINE reviews the total intake and identifies the salient aspects so that appropriate changes can be recommended for improved food choices. This paper will present the developmental methodology and formulation of the DINE Score.

Current Problem

Computerized dietary analysis programs are usually based on the RDAs but may be a combination of standards. Of 51 programs identified, 46 profiled the percentage of RDAs (Smith, 1992), 24 used the Dietary Goals. None used a categorical method or scoring system. Most computerized dietary analysis programs analyze more nutrients than the public can comprehend requiring interpretation by a professional. The DINE was developed as a computerized system for professionals who worked with people to improve their food choices. One of the first tasks was to identify which nutrients should be included in the evaluation process. This was determined by reviewing public health issues to identify nutrients which were related to current health problems and which nutrients in foods could predict the presence of other nutrients. The minimum diet for human growth and development must contain about 45 essential nutrients, the essential nature of the remainder is not known (U.S. Department of Health and Human Services, 1988).

Method

To simplify the profile, we reduced the number of nutrients from 45 to 15 by using a predictor nutrient concept conceived in 1983 (Dennison, Frauenheim, Izu, 1983). The rationale is that predictor nutrients are found in foods that are also rich sources of other nutrients or follower nutrients. When predictor nutrients are included in a diet within recommended dietary guidelines, the follower nutrients will generally be present in those foods in adequate amounts. For example, foods which contain sufficient amounts of complex carbohydrates and protein to meet dietary guidelines would most likely fulfill the dietary recommendations for the B-vitamins. The reverse is not true, i.e., B-vitamins are not predictors for macronutrients or other follower nutrients.

To evaluate this concept, an expert panel of Registered Dietitians were each presented with six 24-hour eating plans. These plans had previously been determined as meeting not only the RDAs for protein, vitamin A, vitamin C, iron, calcium and potassium, but also the recommended daily ranges for carbohydrate, added sugar, fat, sodium and cholesterol (Select Committee on Nutrition and Human Needs, 1977). Blinded to the nutrient content of the eating plans, each dietitian assigned one of four categories: poor, fair, good, or excellent, to each plan. A resulting Pearson correlation coefficient of $r=0.85$; $n=18$ indicated agreement between the expert and DINE analyses. This evaluation established confidence in using the DINE Score as a means to correctly evaluate the adequacy of an eating pattern. Figure 2 shows the 15 nutrients that formed the basis of the DINE Score, i.e. the predictor nutrients. They were then organized into 10 categories. The 10 categories are total energy (calories), protein, saturated fat, unsaturated fats, complex carbohydrates and dietary fiber, sugar, cholesterol, electrolytes, vitamins, and minerals. Additional research on the development of the scoring algorithms was previously reported (Dennison D, Dennison K, Pechacek, Frank-Spohrer, 1995).

Scoring. Each category was assigned one point. If a category had two or more nutrients, the points were divided as shown in Table 1. The point system is based upon eating foods which contain nutrients within recommended ranges. If the nutrient intake is within the recommended range, one point per category is awarded for a maximum of ten points across ten categories. Each category is comprised of one, two, or three nutrients. With one nutrient per category, that nutrient is worth one point. With two nutrients per category, each nutrient is worth one-half point. In the category which has three nutrients, one nutrient is worth one-half point and the other two nutrients are worth one-quarter point each. Sixty percent of the DINE score value is attributed to macronutrients and 40 percent to micronutrients. For example, the saturated fat category is assigned one point, whereas vitamin A is part of the vitamins category and is assigned one-half point. The minerals category is comprised of three nutrients. Iron is worth one-half point; calcium, one-quarter point; and phosphorus, one-quarter point.

The DINE scoring process prints pluses, zeros, and minuses for the user. This aids understanding of the nutrient content of the individual's food/meal pattern. Pluses (+) indicate food intake within nutrient guidelines, zeros (0) indicate food intake outside nutrient guidelines, and minuses (-) indi-

11

Table 1

Macro- and Micronutrients/Components, Their Points, and Guidelines Creating the DINE Score System

Macronutrients/Components

Selected Nutrients	Score	Guidelines/Reference
Total Calories	+1.0	Within 10% of Ideal Caloric Level (calculated based on age, sex, height, weight, activity level and desired weight)
Protein	+1.0	10-15% of total Calories (Dietary Goals for the U.S.)
Saturated Fat	+1.0	Less than 10% of total Calories (Dietary Goals for the U.S.) (Dietary Guidelines for Americans)
Monounsaturated Fat	+0.5	Less than 10% of total Calories (Dietary Goals for the U.S.)
Polyunsaturated Fat	+0.5	Less than 10% of total Calories (Dietary Goals for the U.S.)
Complex Carbohydrates	+0.5	45% to 80% of total Calories (Dietary Goals for the U.S. - lower limit)
Dietary Fiber	+0.5	20 gm to 35 gm (National Cancer Institute)
Sugar	+1.0	Less than 10% of total Calories (Dietary Goals for the U.S.)
	Totals 6.0	

Micronutrients/Components

Selected Nutrients	**Score**	**Guidelines*/Reference**
Cholesterol	+1.0	300 mg or less (Dietary Goals for the U.S.)
Sodium	+0.5	500 mg to 2400 mg (RDA - lower limit)
Potassium	+0.5	2000 mg to 3500 mg (RDA - lower limit)
Vitamin A	+0.5	800 RE or more (RDA)
Vitamin C	+0.5	60 mg or more (RDA)
Iron	+0.5	15 mg or more (RDA)
Calcium	+0.25	1200 mg or more (RDA)
Phosphorus	+0.25	1200 mg or more (RDA)
	Totals 4.0	

*guidelines for 19-24 year old women - guidelines may vary based upon age, gender, and condition, i.e. pregnant.

cate a significant departure from guidelines.

The DINE Score descriptors (10 - perfect; 9-8 excellent; 7-6 good; 5-4 fair; 3-2 poor; 1-0 very poor) were developed as a relative index to measure dietary status for eating behavior determined by the number of nutritional guidelines achieved by users. The DINE Score reflects overall quality of dietary intake after a user's actual intake of foods is compared with their recommended intake of nutrients. The objective is for the public to improve food choices until a score of eight or more points is achieved reflecting "Excellent" food consumption.

Evaluation

After the predictor nutrient format was determined, focus group interviews, formative evaluations, and process evaluations were conducted with senior citizens, industrial employees, university students, and elementary students (Cohen, 1984; Dayhoff, 1987; Dennison D and Dennison K, 1989; Dennison D, Dennison K, McCann, 1990; Dennison K, Dennison D, Ward, 1991; Frank, 1985). Instructional modules were presented to the selected populations. Using a deductive process, computerized versions of the modules with different combinations of the recommendations from focus groups were reviewed by the authors for understanding.

Middle School Students. Extensive interviews were conducted with sixth-grade students from Franklin Middle School, Kenmore, New York. The students were shown different recommendation options and scoring procedures. They were then interviewed with a standardized questionnaire to see if they could understand and use a zero to ten rating system. Student suggestions and ideas to improve understandability were obtained.

A second group of sixth-grade children was introduced to the revised recommendations and materials. They were instructed to analyze their diets and were then interviewed regarding intended changes they would make in their diet based upon their understanding of the DINE. The results confirmed that the procedure was understood by the children.

University Students. During a feasibility project, the development of a DINE-based cardiovascular health education unit was used with college and university undergraduate students (Emrich, Dennison D, Dennison K, 1989). The instructional strategy followed the Activated Health Education Model which used the individual's personal food choices as a basis to learn nutrition and to improve their food selections (Dennison, 1984). The unit was evaluated and noted changes were made. The major finding of the process evaluation was that the DINE could be used to evaluate one's personal nutrition and to make food choice decisions.

Reliability was further tested by comparing DINE ranking of university students' 24-hour diet records to DINE rankings of the same 24-hour period using food models within focus group interviews (r=.91). Construct validity was established by correlating DINE scores determined by interview with scores assigned to the same diets by nutritionists (r=.83; n=60)(Dennison D, Dennison K, Pechacek, Frank-Spohrer, 1995).

Senior Citizens. A study was conducted with senior citizens to determine the effect of a nutrition program on the food choices of senior citizens (Dennison D, Dennison K, Ward, 1991). Satisfaction with the DINE was also examined (Dennison D, Dennison K, Ward, Wu, 1992). Thirty-one senior citizens, 61 to 85 years old, were divided into two experimental groups and a control group. The experimental groups included seniors who attended a nutrition program using the DINE (Group 1), and seniors who attended a nutrition program (Group 2) not using the DINE. The control group consisted of seniors who did not attend the program. The seniors in the two experimental groups completed a program satisfaction questionnaire at follow-up. Analysis of variance and t-tests were used to determine differences in satisfaction scores. The findings indicated that Group 1 which was familiar with the DINE was more satisfied with the program than Group 2 which did not use the DINE.

Worksite Wellness. A pilot study at Ford Motor Company, Buffalo Stamping Plant (Dennison, D, Dennison KF, McCann S, 1990) and a weight management program at General Motors, Powertrain Division, Tonawanda, NY (Dennison K, Galante, Dennison D, Golaszewski, 1995;1996), were conducted. Although the major hypotheses in these studies were related to weight-loss, process evaluations further refined the formulation of the DINE and scoring categories. Results after intervention indicate that individuals who were taught and used the DINE had greater weight loss and were food "smarter" than individuals who received nutrition education without the DINE.

Application

To apply DINE, the following four steps must be followed: record present behaviors, analyze dietary intake (DINE Analysis), identify strengths, and plan improvement. In step 1, personal information and food intake are recorded. These data are quantified through databases and analyzed producing a summary of intake in step 2. Step 3: categorical strengths and weaknesses are given as messages to explain why the nutrient is important to health. In step 4, a nutrition improvement plan is generated giving examples of foods to avoid or include.

This format and presentation found to be most effective for consumer's understanding of basic dietary and food choice principles is presented in Table 2. The format organizes the DINE data into a 3 x 3 table. The vertical axis represents Total Calories, Macronutrients and Micronutrients and the horizontal axis represents Your Diet, Ideal Diet, and DINE Score. Our focus group data indicated that presentations had to be very neat, clearly organized and accurately labeled or they were considered too complex or not understandable by the selected subjects. Thereby, a comprehensive, yet simple

Table 2

DINE Analysis and Scoring of a Sample One-Day Diet

			Your Diet	Ideal Diet*	DINE Score
Total Calories			2432	2323 - 2567	+1.00
Macronutrients	Protein	(gm)	83	61 - 92	+1.00
	Saturated Fat	(gm)	30	27 or Less	0.00
	Monounsat Fat	(gm)	39	27 or Less	0.00
	Polyunsat Fat	(gm)	45	27 or Less	0.00
	Complex Carb	(gm)	224	275-489	0.00
	Dietary Fiber	(gm)	10	20 - 35	-0.50
	Sugar	(gm)	38	61 or Less	+1.00
Micronutrients	Cholesterol	(mg)	214	300 or Less	+1.00
	Sodium	(mg)	3667	500 - 2400	0.00
	Potassium	(mg)	2370	2000 - 3500	+0.50
	Vitamin A	(RE)	792	1000 or More	0.00
	Vitamin C	(mg)	99	60 or More	+0.50
	Iron	(mg)	14	10 or More	+0.50
	Calcium	(mg)	610	800 or More	0.00
	Phosphorus	(mg)	1018	800 or More	+0.25
				DINE Score**:	5.25
	**U.S .Patent #5,412,560				Fair

* Recommendations for a 36 year old, 5'10", 170 pound male with an average activity level, a desired weight of 163 pounds, and an ideal caloric level of 2445 calories per day.
(Note: a one-day dietary intake has been analyzed and described for purposes of illustration only and is not intended to accurately reflect an individual's dietary pattern)

schema, was designed for a one-half page to conform to general recommendations (Zimmerman, Newton, Frumin, Wittet, 1989).

The ideal diet provides a positive incentive or goal. Analyzing almost any diet over time will generate some pluses in the categories. These pluses indicate behavioral capability and may serve as contracting or self-management incentives. The bottom half of the printout reviewed food choices and messages. Most people were able to answer questions related to the quality of their diet, and what foods they need to increase or decrease to improve their eating pattern based upon the DINE table and verification. Depending upon the motivational and educational level of the individual, different parts of the information were emphasized.

Summary

Nutrient analysis methodologies which integrate dietary recommendations generally neither use predictor nutrients nor quantify food quality or provide feedback. The underlying premise of DINE was to use an individual's own food choices as a basis to improve their nutrition and health.

The DINE Score helps individuals identify weekly food choice goals, includes successive approximations to achieve these goals, and provides positive reinforcement when the goals have been achieved. The score guides dietary lifestyle modification using predictor nutrients. Pluses (+) are used to demonstrate behavioral capability in meeting dietary goals. Minuses (-) are used to indicate nutritional areas of immediate concern. In addition, DINE can be used by researchers not only as a standardized system to evaluate behaviorally-based dietary interventions, but also as a tool adapted to the daily living and understanding of various groups of individuals.

References

American Diabetes Association and the American Dietetic Association. (1986). *Exchange Lists*. Alexandria VA. and Chicago, IL.

Cohen, G.S. (ed.) Proceedings (1984). The Eighth Annual Symposium on *Computer Applications in Medical Care.* Washington DC. Dennison, D. The DINE System: a microcomputer program for nutritional assessment and diet improvement.

Committee on Diet and Health, National Research Council, National Academy of Sciences. (1989). *Diet and Health: Implications for reducing chronic risk.* Washington, DC: National Academy Press.

Dayhoff, R.(ed.) Proceedings. (1987). The Eleventh Annual Symposium on *Computer Applications in Medical Care* (Abstracts), Dennison, D., Dennison, K.F., Adelman, M., Groeger, L.A. The DINE System: Nutrient Analysis, Diet Improvement Software and Self-Instruction Package for Health Care Settings.

Dennison D, Dennison KF, Pechacek T, Frank-Spohrer GC. (1995). "DINE: A Next Generation Diet Management and Evaluation System." *Journal of Health Education.* 26(2):1-9.

Dennison D., Frauenheim, K., and Izu, L. (1983). The DINE System: An Innovative Curricular Approach, *Health Education* 14(2): 44-47.

Dennison K, Galante D, Dennison D, Golaszewski TJ. (1995). "A Preliminary Analysis of a Comprehensive Computer Assisted Instruction (CAI) Nutrition Program for Overweight Industrial Employees. " *Worksite Health.* Winter 2(1):42-45.

Dennison KF, Galante D, Dennison D, Golaszewski TJ. (1996). "A One Year Assessment of a Comprehensive Computer Assisted Instruction (CAI) Nutrition and Physical Activity Program for Overweight Industrial Employees: Lessons learned." *Journal of Health Education.* 27(1),38-42.

Dennison, D. (1984). Activated Health Education: the development and refinement of an intervention model. *Health Values* 8(2), 18-24.

Dennison, D. and Dennison, K.F. (1989). Nutrient Analysis Methodology: A Review of the DINE Developmental Literature. *Health Education* 20(7), 32-36.

Dennison, D., Dennison, K.F., and McCann, S. (1990). Integration of Nutrient and Activity Analysis Software into a Worksite Weight Management Program. *Health Education* 21 (6), 4-7. 1990.

Dennison, D., Dennison, K.F., Ward, J.Y., and Wu, Y.B. (1992). Satisfaction of Senior Citizens in a Nutrition Education Program With and Without Computer-Assisted Instruction. *Journal of Nutrition for the Elderly* 12 (1).

Dennison, K.F., Dennison, D., and Ward, J.Y. (1991). The Impact of a Computerized Nutrition Program on the Nutrient Intake of Senior Citizens. *Journal of the American Dietetic Association,* 91(11), 1431-1433.

Emrich, L., Dennison D., and Dennison K.F. (1989). Distribution of Nutritional Data. *Journal of the American Dietetic Association* , May, 665-670.

Frank, G.C. (1985). Nutrient profile on personal computers: a comparison of DINE with mainframe computers. *Health Education,* Feb-March, 16-19.

National Academy of Sciences. (1989). National Research Council, Food and Nutrition Board, *Recommended Dietary Allowances.* 10th Edition. Washington, DC.

Select Committee on Nutrition and Human Needs. (1977). United States Senate, *Dietary Goals for the United States,* 2nd Edition. Washington, DC. U. S. Government Printing Office.

Smith, J.L. (ed.) (1992) *Nutrient Databank Directory*, 8th edition, University of Delaware, Newark, DE.

U.S. Department of Agriculture and U.S. Department of Health & Human Services. (1995). *Nutrition and your health: Dietary Guidelines for Americans.* Washington, DC: Government Printing Office.

U.S. Department of Agriculture. (1956). *Basic Four Food Guide.*

U.S. Department of Agriculture. (1992). Human Nutrition Information Service, *Food Guide Pyramid,* Home and Garden Bulletin 252.

U.S. Department of Health and Human Services. (1990). National Health Promotion and Disease Prevention Objectives. *Healthy People 2000*: Public Health Service, Washington, DC., Publication PHS 91-50212.

U.S. Department of Health and Human Services, Public Health Service. (1988). *The Surgeon General's Report on Nutrition and Health.* Publication PHS 88-50210. Washington, DC.

U.S. Department of Health and Human Services. (1989). *U.S. Recommended Daily Allowances.* Public Health Service, Rockville, MD, Publication (FDA) 76-2012.

Zimmerman, M., Newton, N., Frumin, L., and Wittet, S. (1989). *Developing Health and Family Planning Print Materials for Low-Literate Audiences: A Guide.* Program for Appropriate Technology in Health, Washington, DC.

Self-Reported Food Intake Patterns of Older Adults in Australia, China, and the United States[1]

Alyce D. Fly, Ph.D., Nathan W. Shier, Ph.D., Barbara A. Hawkins, Re.D., Susan J. Eklund, Ph.D., Yang Jingyi, Ph.D., & Anne L. Binkley, Re.D.

Abstract

A pilot study was conducted to measure self-reported food intake patterns of a sample of older persons from China, Australia, and the U.S. in order to explore the eating habits of older persons from a cross-cultural perspective. Data reported herein were collected as part of a larger study to determine lifestyle factors and health status of a sample of elderly from each of these countries. Male and female subjects were recruited from Beijing, China, Melbourne, Australia, and Bloomington, Indiana, United States and were approximately evenly distributed among two age bands (60-71, and 72-83 y), sex, and three general lifelong occupational groups (professional/teacher, administrative, worker/laborer). As part of the data collection, subject height, weight and blood pressure were measured, then subjects were interviewed during which they completed a food frequency questionnaire that included portion sizes. The average number of servings that subjects reported consuming each day from dairy, fruit, vegetable, protein and grain products were calculated for each age/sex grouping by country. Means were compared between countries and to the recommended number of servings for older persons according to the U.S.D.A/D.H.H.S. Food Guide Pyramid. The China sample exhibited several deviations from a healthy diet. Both genders were below the Food Guide Pyramid recommended servings for dairy products, vegetables, fruit, and grain products. In addition, Chinese men consumed significantly more protein than recommended. Servings of food groups reported by the Australia sample were closer to the recommended servings. Both genders fell significantly below recommendations for servings of vegetable and grain products, and women in the Australia sample selected less protein servings than recommended. Diets for persons in the sample from the U.S. appeared to be closest to following the Food Guide Pyramid recommendations. Grain product intake for both genders was significantly below guidelines; however, compared to the China sample, the U.S. consumption was higher. Women from the U.S. sample had inadequate protein selection but, in contrast, they selected significantly more fruit servings per day than recommended, a positive food intake pattern. High body mass indices were present only in men from the Australia sample; also, blood pressure was elevated for both men and women in the Australia sample. It appears that in each sample from the three countries, specific dietary changes could be made to potentially improve health.

Introduction

In 1990, the U.S. government published Healthy People 2000: National Health Promotion and Disease Prevention Objectives where health objectives were proposed with a primary directive for prevention, as well as monitoring factors that create a demand for health services (U.S. Department of Health and Human Services, 1990). Maintenance of health and independence of aging adults were identified as important issues, particularly because of the increase in this age group among the U.S. population, and their disproportionately high need for health care services. Other industrialized nations, such as Australia, have developed similar initiatives in their 1990 National Health Strategy (Australian Bureau of Statistics, 1990). Because diet is an important component of health maintenance, there is a need to index specific dietary patterns to assess the health risks of the older population and design effective intervention programs. In both the U.S. and Australia, there are reports of inadequate nutrient intake while a high incidence of chronic diseases has been well documented (Barrocas, White, Gomez & Smithwick, 1996; Dwyer, 1994; Stuckey, Darnton-Hill, Ash, Brand, & Hain, 1984; White, 1994). In rapidly modernizing countries such as China, under nutrition remains a problem while chronic diseases related to dietary excess are leading causes of death much like in the U.S. and Australia (Popkin, Haines, & Patterson, 1992; Popkin, Keyou, Fengying, Guo, Haijiang, & Zohoori, 1993; Popkin, Paeratakul, Ge, & Fengying, 1995). China too has recognized the importance of lifestyle factors in reducing disease risks and has developed a national health promotion program for its citizens ("Principles of the," 1995).

Some of the larger studies of health patterns and food consumption surveys in the U.S. have indicated unhealthy patterns of deficient consumption of certain food groups or nutrients by older persons (Kant, Block, Schatzkin, Ziegler, & Nestle, 1991; Kant, Schatzkin, Block, Ziegler, & Nestle, 1991; Popkin et al., 1992; Ryan, Craig, & Finn, 1992). The finding of a significant decrease in food or energy intake in older persons suggests the need to select more nutrient-rich foods in order to maintain adequate nutrient status (Parker, 1992). Australia studies have shown inadequate dairy consumption (Bell, Dunn, Whitehead, & Xouris, 1993; Magarey, Tiddy, & Wilson, 1993). Little data on food consumption patterns of Chinese elderly exist but with the information available on younger adults it appears that dietary inadequacies may occur for several vitamins and minerals, including retinol, riboflavin, calcium, and zinc (Chen & Gao, 1993). It is difficult to make comparisons across cultures because of the paucity of food intake data on the elderly from the three countries.

The purpose of this study was to characterize the eating patterns among samples of elderly recruited similarly from three different countries and compare their eating patterns to the Food Guide Pyramid recommendations. This information may be used with other data to better define healthy lifestyle patterns among different cultures and in documenting the need for specific nutrition strategies to direct the design of appropriate intervention programs for our older populations.

Methodology

Selection of subjects

Subjects were recruited from the local areas surrounding each research site: Beijing, China; Melbourne, Australia; and Bloomington, Indiana, United States (U.S.). Volunteer subjects were sought using local contacts, retirement rolls, and media recruitment. Non-institutionalized adults who were age 60 or older were recruited and an effort was made to balance the total sample between males and females, occupations (professionals/teachers, administrators/managers, workers), and two age brackets (60-71, 72-83).

Data collection

All procedures were approved by the Indiana University Human Subjects Committee and subjects signed an informed consent statement prior to participation. Total testing time did not exceed 2 hours. Data reported herein was collected as part of a larger study where subjects completed an in depth interview during which time a food frequency questionnaire and a physical health/fitness evaluation was completed (Hawkins et al., 1996). The food frequency questionnaire used in this study was modified from Block et al. (1986) to give a simple indication of the average number of servings from each of the main food groups. The food frequency questionnaire listed common foods from each food group as well as serving sizes (small, medium or large) and frequency of consumption (times per day, week, month, year). Serving sizes were calculated according to procedures by Block et al. (1986), where one medium portion was considered equivalent to one serving; a small portion was equal to one-half a medium portion (or one-half serving), and a large portion was set equal to one and one-half medium portions (or one and one-half servings). Frequency of food selection was then standardized to obtain the total number of servings in the time period. Values were standardized to days; e.g., five times per week was equal to five divided by seven to give a per day equivalent.

Subject height, weight, and blood pressure were recorded and body mass index was calculated from height and weight values.

Analysis of the data

Data were analyzed using Statistical Package for Social Sciences (1990). Subject height, weight, blood pressure and body mass index were compared within sex between countries using Tukey's HSD test (Steele & Torrie, 1980). Mean number of servings for each of the food groups were broken down by age/gender and gender totals, and these groups were compared across country using non-parametric Kruskal-Wallis analysis of variance techniques (Steele & Torrie, 1980). When significant treatment effects were determined, differences between means were identified by Tukey's HSD test. The significance level was set at =0.05. The numbers of servings reportedly consumed from each food group were compared to the lowest value of each range of the Food Guide Pyramid recommendations (Welsh, Davis & Shaw, 1992) by a two-tailed t test (Steele & Torrie, 1980). The low value was chosen for comparison because it has been recommended as providing adequate food energy for older adults (Whitney & Rolfes, 1996).

Results

Subject characteristics

Several characteristics of the subjects are listed in Table 1. Between 34 and 39 subjects were recruited for each gender within each country. Most of the males were married in the China and Australia samples while most males in the U.S. sample were single. Females were more equally distributed in marital status in each of the three countries. Height and weight were used to calculate body mass index, an indicator of body fatness and risk of chronic disease (Bray, 1992). Body mass index for males was lowest for the China sample and highest for the Australia sample. Females from the China sample had a significantly lower mean body mass index than females from the U.S. or Australia sample. Mean systolic and diastolic blood pressures of females and males from the Australia sample were significantly higher than those of their respective gender in the U.S. and China samples.

Intake of food groups

Mean reported servings of foods from each of the food groups is shown for each gender, country and age range (61-70, 71-83 or combined age range) in Table 2. Intake of dairy foods by males in the Chinese sample was significantly lower than that of subjects from the U.S. and Australia among the young/old (61-70 y) males, as well as for all males. There were no significant differences among the old/old (71-80) males comparing across countries. The pattern of differ-

Table 1

Subject Characteristics[1,2]

Characteristic	China Male	China Female	U.S. Male	U.S. Female	Australia Male	Australia Female
Age, number of subjects:						
60-71 y	20	18	16	18	22	18
72-83 y	16	16	20	16	17	17
Marital status[3], %						
Single[4]	14	41	97	60	8	48
Married	86	59	3	38	92	49
No response	0	0	0	3	0	3
Height, cm	169.6±7.5[a]	154.1±4.7[d]	171.7±8.2[a]	159.7±6.3[e]	169.2±9.5[a]	159.7±6.2[e]
Weight, kg	68.0±10.4[a]	55.2±8.9[d]	79.0±9.7[b]	64.4±9.3[e]	83.2±10.7[b]	68.5±11.1[e]
Body Mass Index, kg/m²	23.5±2.8[a]	23.2±3.7[d]	26.3±2.8	25.3±3.6[e]	29.9±7.9[c]	26.5±4.4[e]
Blood pressure, mm Hg:						
Systolic	129±15[a]	138±23[d]	135±20[a]	133±22[d]	152±19[b]	154±13[e]
Diastolic	76±10[a]	74±13[d]	77±10[a]	74±11[d]	87±10[b]	87±11[e]

[1]Variation is expressed as standard deviations.
[2]Means are compared within sex only; means within a row that are not significantly different share a similar superscript letter, [a-c] for comparisons between males in different countries, [d-f] for comparisons between females in different countries.
[3]Denotes percent of the male or female sample within each country.
[4]Single includes: never married, widowed, divorced or separated.

Table 2

Mean Servings of Dairy, Protein, Fruit, Vegetable, and Grain Products Groups by Subjects in Each Country.[1]

Food Group	Age group by sex	China	U.S.	Australia
Dairy	61-70 y females	0.9±0.4[a]	2.7±3.4[b]	1.8±1.1[ab]
	71-83 y females	0.7±0.4[a]	1.9±1.1[b]	1.6±0.9[b]
	All females	0.8±0.4[a]	2.4±2.7[b]	1.7±1.0[ab]
	61-70 y males	0.6±0.5[a]	1.8±0.9[b]	1.6±0.9[b]
	71-83 y males	1.5±1.4[a]	1.9±1.1[a]	1.7±1.3[a]
	All males	1.0±1.0[a]	1.9±1.0[b]	1.6±1.0[b]
Protein	61-70 y females	2.4±1.0[b]	1.6±0.9[a]	1.4±1.1[a]
	71-83 y females	2.6±1.2[b]	1.9±0.6[ab]	1.4±0.4[a]
	All females	2.4±1.1[b]	1.7±0.8[a]	1.4±0.8[a]
	61-70 y males	2.7±1.3[b]	1.8±0.8[a]	1.8±0.9[a]
	71-83 y males	2.6±1.2[a]	2.6±1.7[a]	2.0±1.3[a]
	All males	2.7±1.3[b]	2.2±1.4[ab]	1.9±1.1[a]
Fruit	61-70 y females	1.3±1.0[a]	2.8±1.3[b]	1.7±1.4[a]
	71-83 y females	1.2±0.6[a]	3.4±2.5[b]	1.8±1.1[a]
	All females	1.3±0.8[a]	3.1±1.9[b]	1.7±1.3[a]
	61-70 males	1.0±0.7[a]	2.1±1.4[b]	2.0±1.2[b]
	71-83 males	1.0±0.8[a]	1.9±1.1[ab]	2.3±1.1[b]
	All males	1.0±0.8[a]	2.0±1.2[b]	2.1±1.1[b]
Vegetable	61-70 y females	1.9±0.7[a]	2.9±1.2[b]	2.8±1.1[b]
	71-83 y females	2.0±0.7[a]	4.4±2.0[b]	2.0±0.9[a]
	All females	1.9±0.7[a]	3.5±1.8[b]	2.4±1.1[a]
	61-70 y males	2.0±1.0[a]	2.2±1.2[a]	1.9±0.8[a]
	71-83 y males	1.9±0.8[a]	3.0±2.0[a]	2.1±1.1[a]
	All males	1.9±0.9[a]	2.7±1.7[a]	2.0±0.9[a]
Grain Products	61-70 y females	2.7±0.8[a]	4.2±2.8[a]	3.1±1.6[a]
	71-83 y females	2.9±1.0[a]	4.0±1.9[a]	3.7±2.0[a]
	All females	2.8±0.9[a]	4.1±2.4[a]	3.4±1.8[a]
	61-70 y males	3.3±1.2[a]	3.5±1.2[a]	3.5±2.2[a]
	71-83 y males	2.9±0.9[a]	3.7±2.2[a]	4.1±1.5[a]
	All males	3.0±1.1[a]	3.6±1.8[a]	3.7±2.0[a]

[1]Means within a row, not sharing a common superscript[a-c], are significantly different ($p<0.05$).

ences within both age/gender groups for females and total females showed that the Chinese consumed significantly lower daily amounts of dairy foods compared with female subjects from the U.S. Among the old/old females, the Chinese were also significantly lower than the Australian subjects in daily dairy consumption. There were no significant differences between average intake of dairy products in the U.S. sample compared to the Australia sample among all age/gender groups.

Reported vegetable consumption in the China and Australia samples were significantly lower than that of the old/old females and the female total from the U.S. The U.S. and Australia young/old females had significantly higher vegetable intake compared with the Chinese. There were no differences in the mean number of vegetable servings comparing all age/gender groups, as well as sample totals, among the males.

Reported fruit servings in the U.S. sample were significantly higher than the China sample in all groups except the old/old males. Among all age/gender groups, as well as for the female totals, fruit servings for the U.S. sample were also significantly higher than the Australians. Australian males were higher in fruit consumption than the Chinese males.

The grain products include breads and other cereal products, rice, and pastas. Reported grain products consumption did not significantly differ within all age/gender groups, as well as gender totals, comparing across countries.

The protein group includes meat, poultry, fish, dry beans, eggs, and nut foods. For all age/gender groups except the old/old males, protein consumption among the Chinese subjects was significantly higher than that of the Australians. There were no differences comparing the old/old males across countries. Among the young/old females, as well as total females, the Chinese consumed a significantly greater number of protein servings compared with females from the U.S. Among the young/old males, the China sample consumed more servings from the protein group than the same aged males from the U.S. There were no significant differences between the Australian subjects and U.S. subjects in protein consumption.

Comparison with the Food Guide Pyramid Recommendations

Mean reported food group servings for male and female subjects in each country compared to the Food Guide Pyramid Recommendations are shown in Table 3. Compared to the recommendation of two servings per day, females from the U.S. and Australia samples consumed significantly fewer servings from the protein group, while males from the China sample consumed significantly more servings from the protein group.

Males and females from the China sample both reported consuming significantly fewer servings of dairy products than the recommendations. Reported intake of both genders in the U.S. and Australia sample was similar to the recommended two servings. Both genders of the China and Australia samples reported consuming fewer than the three recommended servings from the vegetable group. Intake from this group by males and females of the U.S. sample met the recommendation. Reported servings from the fruit group were significantly lower than the recommended two servings for both males and females of the China sample. The females in the U.S. sample reported consuming significantly more fruit than the recommendation. Reported consumption of grain products was significantly lower than the recommended six servings for both genders in all countries.

Discussion

Characteristics of subjects recruited in this study were approximately evenly distributed between age, gender, and occupational history for each country. Elevated body mass index (BMI) is used as an indicator of obesity and medical risks in the U.S. (Bray, 1992). Only the males from the Australia sample would be considered to have a BMI above the healthy range by some health organizations (Sichieri, Everhart, & Hubbard, 1992). Different health organizations recommend varying ranges of BMI, some have several age class distinctions, while others set a single range for adults. The World Health Organization recommends that BMI for adults fall within the range of 20-25 kg/m^2. The U.S. National Academy of Sciences recommends BMI fall within 23-28 for persons between 55-64 years of age and 24-29 for persons 65 years or older. A person with a body mass greater than 31.1 for men and greater than 32.3 for women is considered obese.

The body mass indices for Australian males in this study were higher than those reported in other studies which found 24.4-25.6 (Stuckey et al., 1984), 25.1-27.5 (Magarey, Tiddy, Wilson, & McCarthy, 1992) and 25.3 (Magerey et al., 1993). Healthy indices have also been reported for Australian women receiving Meals on Wheels, 23.0, and for women eating at activity centers, 25.3 (Stuckey et al., 1984). Other research reports U.S. BMI of older persons at 24.1 for single males, 25.2 for married males, 25.0 for single females and 25.4 for married females (Mahajan & Schafer, 1993).

Data on older Chinese were not available but the 1991 China Health and Nutrition Survey on younger adults (20-45 y) reported healthy BMI of 21.4 for males and 21.7 for females (Popkin et al., 1995).In comparison to results of the China Nutrition Survey of 1982, the percentage of people with a low BMI has decreased by about 1.4%, but proportion of overweight adults has increased by 4.8 and 2.0% in urban and rural areas, respectively.Body mass index does have limitations, in that it does not distinguish between individuals with large frame and/or muscle mass and those with lower levels. Therefore a high BMI does not necessarily indicate obesity.

Reported intake of the China sample is similar in some respects to what has been reported in young adults in the 1990

Table 3

Mean Servings by Food Group and Gender Compared with Food Guide Pyramid Recommendations[1].

Food Group	Recommendation[2]	Gender	China	U.S.	Australia
Protein	2	male	2.7*	2.2	1.9
		female	2.4	1.7*	1.4*
Dairy	2	male	1.0*	1.9	1.7
		female	0.8*	2.4	1.7
Vegetable	3	male	1.9*	2.7	2.0*
		female	1.9*	3.5	2.4*
Fruit	2	male	1.0*	2.0	2.1
		female	1.3*	3.0*	1.7
Grain products	6	male	3.0*	3.6*	3.7*
		female	2.8*	4.1*	3.4*

[1]Means that are significantly different from the Food Guide Pyramid recommendation are indicated by *.

[2]The Food Guide Pyramid recommends ranges of servings based on a person's activity level and gender, and recommends the lower number of servings to provide the right amount of food energy for older persons. (Whitney and Rolfes, 1996)

Chinese Total Diet Study (Chen & Gao, 1993). Their report of insufficient calcium intake is in agreement with our finding of low dairy product intake. Also, our finding of low vegetable consumption may be indicative of the inadequate retinol (Vitamin A) consumption that was also found in the Total Diet Study. Certain carotenoids found in fruits and vegetables can be converted to retinol. Ascorbic acid (Vitamin C) intake, also a reflection of fruit and vegetable consumption, was not measured in the Total Diet Study, although potassium intake (abundant in plant foods) was insufficient.

In our study, we found adequate reported intake from the protein group in the China sample, which also parallels the finding in the Total Diet Study of 64 g protein/day, exceeding the protein recommended by the World Health Organization (World Health Organization, 1985). Diet selection of Chinese has been reported to be affected by nationality where the Han, the majority nationality group, were found to consume more animal foods and fewer cereal portions of energy and protein intake (Ge, Zhai, & Wang, 1997). Inadequate reported intake from the grain group was found in our China sample.

In contrast to the China sample, the literature contains several reports of dietary studies of older Australians which can be compared to our study. Although reported dairy intake was adequate in our sample, other studies including two with Meals on Wheels recipients (Bell et al., 1993; Pargeter, Briggs, Lo, & Wood-Bradley, 1986), one comparing war veterans to non-veterans (Magery et al., 1993), and one with urban-dwelling noninstitutionalized older persons (Stuckey et al., 1984) document low intake of milk products or calcium.

For protein group intake, females from our sample consumed less than the recommended 2 servings per day, with adequate protein intake by males. Stuckey et al. (1984) found 43-71% of male and female subjects consumed below the Australian Recommended Dietary Intake for protein (58 g females, 70 g males).Magerey et al. (1993) reported older Australian males consumed an average of 1.9 protein servings per day which is consistent with findings in the present study.

The low vegetable consumption reported in this study by the Australia sample is consistent with the report of Magerey et al. (1993) where 3.8 combined servings of fruits and vegetables per day were consumed by older males and with 43% of them consuming less than 25 g of fiber per day. Adequate intake of fruit by the Australia sample of this study parallels other research findings with only 3-6% of older persons having Vitamin C intake below the Australian Recommended Intake of 30 mg (Stuckey et al., 1984).

Data from the U.S. sample can also be compared and contrasted to several reports in the literature. Women in the U.S. sample reported consuming fewer than the two recommended servings from the protein group per day. Houston, Johnson, Poon, and Clayton (1994), and Ryan et al. (1992), reported that U.S. males selected more meat, egg, and beans than females. In both studies, however, protein intake was always at least adequate.

Fruit consumption by older persons in the U.S. was shown to be adequate (Houston et al., 1994; Melnik, Helferd, Firmery, & Wales, 1994; Ryan et al., 1992) similar to findings in this study. Other studies have also noted that older females consume more fruit than older males (Ryan et al.,1992; Houston et al., 1994) as was found in this study. Reported vegetable intake by U.S. subjects in this study was adequate, a finding also shared by Mahajan and Shafer (1993) but in contrast to that found by Melnik et al. (1994) and Ryan et al. (1992). Ryan et al. (1992) found that greater than 40% of males and females consumed less than two-thirds of the RDA for Vitamin E with males also similarly lacking in Vitamin A.

Dairy product intake was adequate for the sample of U.S. males and females in our study in contrast to inadequate intake reported in other studies (Fischer, Johnson, Poon, & Martin, 1995; Melnik et al., 1994; Ryan et al., 1992).

Both males and females from the U.S. sample, as with samples from China and Australia reported consuming significantly less than six servings per day from grain products. This is similar to the report of 3.2 servings per day in a U.S. sample by Melnik et al. (1994). Sixty-four and 80% of males and females, respectively, reported consuming less than 4 servings of from the grain group in the NHANES II, 1976-1980 study (Kant, Block et al., 1991).

There is error in reporting dietary intake from the various food intake assessment methods as documented by others (Horwath, 1993; Sorenson, Calkins, Connolly, & Diamond, 1985). Indeed, some subjects reported difficulty assessing portion size in this study, thus some of the variation between our findings and others could be due to inadequacy of the collection procedures. In addition, subject characteristics, particularly gender, ethnicity, and socioeconomic status certainly influence dietary patterns (Houston et al., 1994) and make comparisons with other studies more difficult.

Summary

Self-reported diet behaviors of the subjects from China, Australia, and the U.S. suggested several deviations from a healthy diet. In the China sample, both genders were below the Food Guide Pyramid recommended servings for dairy products, vegetables, fruit and grain products. In addition, Chinese men consumed significantly more protein than recommended. Servings of food groups reportedly consumed by the Australia sample were closer to the recommended servings. Diets for the U.S. subjects appeared to be closest to following the Food Guide Pyramid recommendations.

While country and gender were major factors in self-reported food group selection, degree of oldness (e.g., young/old vs. old/old) was only a minor factor in reported servings of food groups consumed by the older persons in this study. High body mass indices for men in the Australia sample may be a potential health risk. It appears that in each country studied, specific dietary changes could be made to potentially improve health.

References

Australian Bureau of Statistics. (1990). 1990 Year Book (Publication No. 73). Canberra, Australia.

Barrocas, A., White, J.V., Gomez, C., & Smithwick, L. (1996). Assessing health status in the elderly: the nutrition screening initiative. *Journal of Healthcare for the Poor and Underserved, 7,* 210-218.

Bell, R., Dunn, P., Whitehead, A., & Xouris, S. (1993). The contribution of Meals on Wheels to the nutrient intake of the elderly. *Australian Journal of Nutrition and Dietetics, 50,* 46-50.

Block, G., Hartman, A.M., Dresser, C.M., Carroll, M.D., Gannon, J., & Gardner, L. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124,* p.455.

Bray, G. (1992). Pathophysiology of obesity. *American Journal of Clinical Nutrition, 55,* 488S-502S.

Chen, J., & Gao, J. (1993). The Chinese Total Diet Study in 1990. Part II. Nutrients. *Journal of AOAC International, 76,* 1206-1213.

Dwyer, J. (1994). Nutritional problems of elderly minorities. *Nutrition Reviews, 52,* No.8, S24-S27.

Fischer, J.G., Johnson, M.A., Poon, L.W., & Martin, P. (1995). Dairy product intake of the oldest old. *Journal of the American Dietetic Association, 95,* 918-921.

Ge., K., Zhai, F., & Wang, Q. (1997). Effect of nationality on dietary pattern and meal behavior in China. *American Journal of Clinical Nutrition, 65 Suppl.,* 1290S-1294S.

Hawkins, B.A., Eklund, S.J., Jingyi, Y., Fly, A.D., Shier, N.W., Binkley, A.L., Lawson, D., Weixing, S., Foose, A., Hsieh, C., & Xin, L. (1996). Lifestyle factors and health outcomes of older adults in China, Australia, and the United States. Bloomington, IN: Indiana University School of Health, Physical Education, and Recreation.

Horwath, C.C. (1993). Validity of a short food frequency questionnaire for estimating nutrient intake in elderly people. *British Journal of Nutrition, 70,* 3-14.

Houston, D.K., Johnson, M.A., Poon, L.W., & Clayton, G.M. (1994). *Journal of Nutrition for the Elderly, 13,* 5-23.

Kant, A.K., Block, G., Schatzkin, A., Ziegler, R.G., & Nestle, M. (1991). Dietary diversity in the US population NHANES II, 1976-1980. *Journal of the American Dietetic Association, 91,* 1526-1531.

Kant, A.K., Schatzkin, A., Block, G., Ziegler, R.G., & Nestle, M. (1991). Food group intake patterns and associated nutrient profiles of the US population. *Journal of the American Dietetic Association, 91,* 1532-1537.

Magarey, A.M., Tiddy, J.A., & Wilson, P.C. (1993). The diets of elderly men and the use of dietary supplements: Australian non-veterans compared with war veterans. *Australian Journal of Nutrition and Dietetics, 50,* 25-28.

Magarey, A.M., Tiddy, J.A., Wilson, P.C., & McCarthy, P.J. (1992). Normal anthropometric and biochemical values for two groups of healthy males- war veterans and non-veterans. *Australian Journal of Nutrition and Dietetics, 49,* 90-95.

Mahajan, K.H., & Schafer, E. (1993). Influence of selected psychosocial factors on dietary intake in the elderly. *Journal of Nutrition for the Elderly,12(4),* 21-41.

Melnik, T.A., Helferd, S.J., Firmery, L.A., & Wales, K.R. (1994). Screening elderly in the community: The relationship between dietary adequacy and nutritional risk. *Journal of the American Dietetic Association, 94,* 1425-1427.

Pargeter, K.A., Briggs, D.R., Lo, C.S., & Wood-Bradley, R.L.(1986). Meals on Wheels: A nutritional evaluation. *Occasional Paper in Gerontology, No. 13,* National Research Institute of Gerontology and Geriatric Medicine.

Parker, S.L. (1992). A national survey of nutritional risk among elderly. *Journal of Nutrition Education, suppl. 24,* p. 23S.

Popkin, B.M., Haines, P.S., & Patterson, R.E. (1992). Dietary changes in older Americans, 1977-1987. *American Journal of Clinical Nutrition, 55,* 823-830.

Popkin, B.M., Keyou, G., Fengying, Z., Guo, X., Haijiang, M., & Zohoori, N. (1993). The nutrition transition in China: a cross-sectional analysis. *European Journal of Clinical Nutrition, 47,* 333-346.

Popkin, B.M., Paeratakul, S., Ge, K., & Fengying, Z. (1995). Body weight patterns among the Chinese: Results from the 1989 and 1991 China Health and Nutrition Surveys. *American Journal of Public Health, 85,* 690-694.

Principles of the National Health Promotion Program. (June 29, 1995) *China Youth Daily,* p.4.

Ryan, A.S., Craig, L.D., & Finn, S.C. (1992). Nutrient intakes and dietary patterns of older Americans: a national study. *Journal of Gerontology, 47,* M145-M150.

Sichieri, R., Everhart, J.E., & Hubbard, V.S. (1992). Relative weight classifications in the assessment of underweight and overweight in the United States. *International Journal of Obesity, 16,* 303-312.

Sorenson, A.W., Calkins, B.M., Connolly, M.A., and Diamond, E. (1985). Comparison of nutrient intake determined by four dietary intake instruments. *Journal of Nutrition Education, 17,* 92-99.

Statistical Package for the Social Sciences. (1990). *SPSS Reference Guide.* Chicago: SPSS, Inc.

Steele, R.G.D. & Torrie, J.H. (1980). *Principles and Procedures of Statistics: A biometrical approach.* 2nd ed. New York: McGraw-Hill.

Stuckey, S.J., Darnton-Hill, I., Ash, S., Brand, J.C., & Hain, D.L. (1984). Dietary patterns of elderly people living in inner Sydney. *Human Nutrition:Applied Nutrition, 38A,* 255-264.

U.S. Department of Health and Human Services. (1990). *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* (D.H.H.S. Publication No. PHS 91-50212). Washington, D.C: U.S. Government Printing Office.

Welsh, S., Davis, C., & Shaw, A. (1992). Development of the Food Guide Pyramid. *Nutrition Today, 27,* 12.

White, J.V. (1994). Risk factors for poor nutritional status. *Primary Care, Mar 21,* 19-31.

Whitney, E.N., & Rolfes, S.R. (1996). *Understanding nutrition.* New York: WestPublishing Co.

World Health Organization. (1985). *Energy and Protein Requirements, Report of a Joint FAO/WHO/UNU Expert Consultation,* Technical Report Series No. 724, Geneva, Switzerland, p. 206.

Enhancing Effectiveness and Assessing Cost-Effectiveness of Nutrition Education Interventions

Janet K. Grommet, PhD, RD

Nutrition education has been defined as any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and well-being (Olson, 1995). Thus, nutrition education interventions can be found in treatment as well as prevention and wellness programs; can be implemented via one-on-one, small group, or community-wide modalities; can be targeted to pre-school children through older adults; and can be supported by private as well as public funds.

Although nutrition education may be diverse in terms of setting, intervention modality, target audience, and funding, certain design components are common to all nutrition education interventions. This paper will elucidate these common components and examine factors that enhance the effectiveness and subsequently the cost-effectiveness of nutrition education interventions. Society tends to be favorably predisposed towards nutrition education since it presumably enhances health and well-being. In fact, arguing against nutrition education is akin to arguing against "apple pie and motherhood." Yet all "apple pies" are not the same, and nutrition education too can vary particularly in terms of effectiveness. Perhaps because of the favorable predisposition toward nutrition education, a guiding tenet historically has been that doing something (in nutrition education) is better than doing nothing at all.

Yet an era of cost-containment, an era of continuous quality improvement and an era of "right-sizing" is upon us. The public sector ushered in this era regardless of the federal government's attempt to legislate health care reform, and nutrition education is no exception in this environment. The "pie" is no longer apple pie but the budget pie chart. Although resources have always been finite, they are now acknowledged to be so; and the reality is that services now compete for the available resources. Those services that give evidence of cost-effectiveness are most likely to remain in the service mix.

Nutrition education, including clinical dietary services that were once regarded as fundamental to hospital service that they were part of the "bed" cost, is now being re-examined in the crucible of cost-effectiveness. This environment is potentially stressful particularly when the budget is on your desk, when you are asked to counsel more clients per day lead more patient education groups per week, when you are completing more audit reports, or worse when your job has been dissolved due to "right sizing." On the whole, however, this era of redefining the delivery of services as well as the quality of services is an exciting, challenging era as it calls upon programs to ascertain what constitutes an effective intervention. This era offers an opportunity to be a part of the solution, a part of the growth and development of a fundamentally "good" program area.

Common Components for Effective Intervention

Needs Assessment

Conducting a needs assessment precedes the planning and implementing of a nutrition education intervention and is intended to identify the problems and issues of the target audience. This initial step in program design, however, is frequently side-stepped as the practitioner may not feel equipped to conduct an assessment, may presume to know the needs of the target audience, or may dismiss this step in an effort to save time.

Several resources are available to assist in conceptualizing a needs assessment (Falvo, 1994; Rankin & Stallings, 1990; Contento & Morin, 1988) so the inability to conduct an assessment can be remediated. But in spite of ability, even seasoned practitioners sometimes presume to know the needs of the target audience perhaps because of familiarity with the group. Yet the perception of problems and issues frequently depends on the vantage point; furthermore, needs of a target audience change with time. Thus, defining the needs based on input from the target audience rather than exclusively from the practitioner's perspective is critical to sound program planning. Nevertheless, dismissing a needs assessment in an effort to save time is often tempting. The savings, however, is only short-term for the lack of assessment data may result in misusing time in the long-term. A needs assessment is valuable not only in identifying the needs but also in ranking the needs so the program time can be devoted to the most critical needs.

Ideally, a needs assessment is not limited to assessing the target audience's knowledge but also assesses attitudes, e.g., values and beliefs regarding health or health care; skill levels; and social and environmental factors. Although needs assessment data are typically solicited using questionnaires, focus groups, or interviews, generating new data is not mandatory. Practitioners may already have access to relevant data; and by understanding the purpose of a needs assessment, they may be able to synthesize these data. Although not ideal, rather than summarily dismiss conducting a needs assessment, the briefest of assessments is to assess "in-the-moment" by fielding inquiries such as, "What brought you here today?" or "What would you like to accomplish in the next few minutes?" or "What are some of your concerns about . . .?" Alternatively, Kraak, Stricker, & Utermohlen's (1994) needs assessment of a population of individuals living with HIV/AIDS provides a model of a comprehensive assessment that served as the basis for the planning and implementation of nutrition services including nutrition education interventions.

Program Objectives

When a needs assessment systematically delineates the problems and issues of the target audience, objectives can then be formulated to address these needs. Formulating program objectives clarifies the purpose of the nutrition education intervention which is valuable for both the practitioner and the target audience. Furthermore, when the objectives originate from a needs assessment, program objectives can be better substantiated to administrators and funding sources.

Sound program design encompasses objectives across a number of domains, namely cognitive, affective, and psychomotor, in an attempt to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and well-being (Olson, 1995). In addition to formulating objectives across these domains, objectives may be formulated within a given domain at various levels of sophistication. With cognitive objectives, for example, the practitioner may consider focusing the target audience on lower-level cognitions such as knowledge and comprehension of knowledge versus higher-level cognitions such as application, analysis, synthesis, or evaluation of material (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Similarly, affective objectives may vary from lower levels whereby the practitioner facilitates the target audience's awareness of certain affects or feelings and valuing of these feelings to higher levels of ultimately internalizing these values and beliefs such that they influence behavior (Krathwohl, Bloom, & Masia, 1964). Likewise, objectives in the psychomotor (skills) domain may vary from lower levels of simply observing a skill through higher levels of practicing the skill and becoming proficient at that skill (Simpson, 1966).

Practitioners are frequently less familiar with formulating objectives in the affective domain. For example, the following affective objective might be appropriate in a nutrition education program designed to reduce cancer risk: *upon completion of the group sessions, participants will be able to acknowledge a personal need for improving dietary habits to decrease cancer risk.* This affective objective might be relevant to a nutrition education program for individuals with hypercholesterolemia: *upon completion of the group sessions, participants will be able to recognize personally acceptable low fat food items.* Both of these objectives intend for the participant to become aware of certain affects related to food intake.

As previously noted, nutrition education encompasses the "adoption of eating and other nutrition-related behaviors" (Olson, 1995, p. 58). Thus, delineating cognitive, affective, and/or psychomotor objectives assists the practitioner in designing a program that facilitates behavioral change. These domains assist the practitioner in focusing on the prerequisites or determinants of behavioral change. When the goal of the program is to change specific nutrition-related behaviors, objectives across the domains can then be thought of as steps toward meeting the behavioral goals. In spite of the diversity in program settings, intervention modalities, target audiences, or funding sources, all nutrition education interventions are strengthened with the articulation of objectives. Furthermore, objectives serve not only as a road map for program delivery but a bench mark for program evaluation.

Intervention Strategies

The strategies or methods invoked to deliver a nutrition education program facilitate the participants meeting the objectives of the intervention program. Thus, strategies are not randomly selected, but they are *designed* to address specific objectives. Strategies can be grouped into categories including lectures, the most passive of the classic intervention strategies; discussions; simulations; and projects or activities, the most active of the strategies.

Holli and Calabrese (1991) note that all strategies are not equally effective in achieving various objectives. Lecturing, for instance, is not only the most passive of strategies but its effectiveness is primarily limited to the single domain of cognitive objectives. Thus, lecturing about affective objectives such as participants' fears concerning a recent diagnosis has little utility, and lecturing about a psychomotor objective such as using a blood glucose meter is limited as well. Alternatively, strategies such as discussions may effectively address cognitive as well as affective objectives. And strategies such as simulations, e.g., reactions to proposed scenarios, and projects or activities are effective strategies for addressing cognitive as well as affective and psychomotor objectives. Intervention strategies are summarized in Table 1 noting those strategies that are particularly effective in meeting objectives in either the cognitive, affective, or psychomotor domains.

In addition to selecting the more effective strategies to meet specified objectives, sequencing a combination of strategies may engage program participants in the process more than relaying on a single strategy. Thus, two separate patient education sessions designed to meet the same objectives may be strikingly different depending on the strategies. One group might consist of a 90 minute lecture; and with accurate content and supportive print material this strategy may theoretically meet the stated objectives. Another group session, however, might consist of an opening "mini' lecture (10-15 min

Table 1 **Summary of Intervention Strategies Noting Those Strategies Particularly Effective in Meeting Cognitive, Affective, or Psychomotor Objectives**

Objectives	Intervention Strategies			
	Lecture	Discussion	Simulation	Project/Activity
Cognitive Objectives	X	X	X	X
Affective Objectives		X	X	X
Psychomotor Objectives			X	X

utes) to provide a common basis for all participants. This might be followed by an in-group activity (20-30 minutes) whereby group members actively use the content, followed by a discussion (20-30 minutes) whereby members reflect on the activity and plan to implement the activity outside the group. Then, there might be a closing "mini" lecture (10-15 minutes) whereby the group session is recapped. Although both sessions are directed toward the same objectives, the second example is indicative of active learning since strategies are invoked that actively involve the participants in the process.

Evaluation

Although commonly positioned as the last step in nutrition education interventions, evaluation in reality needs to be planned before a program is implemented. That is, if no thought is given to evaluating a six-session patient education series until the final session, evaluation will be compromised since simply assessing attendance may be difficult to accurately reconstruct by the sixth session. Although evaluation is perceived as the final step in nutrition education in tervention, effective evaluation is actually conceived after formulating the objectives and is tied to the objectives.

Evaluation is akin to needs assessment, however, in that it is often side-stepped. Again evaluation may be minimal because the practitioner may not be equipped to conduct an evaluation, or may presume to know the results (e.g., "I was there for all six sessions; I should know what went on"), or may dismiss evaluation in an effort to save resources (e.g., "I'm onto the next project; no time to evaluate that last one"). As with needs assessment, comprehensive resources are available to assist practitioners in upgrading program evaluation skills (Fawcett et al., 1995; IOX Assessment Associates, 1988; Green & Lewis, 1986).

Evaluation literature, however, is wrought with terminology. In sum, evaluation is categorized as either formative or summative. Practitioners conduct formative evaluation during the implementation of a program to assess the quality of program delivery whereas summative evaluation is conducted at the conclusion of a program to assess the impact or outcome of the intervention (Green & Lewis, 1986, p. 362, p. 366). Thus, the term formative evaluation is synonymous with process evaluation; and impact or outcome evaluation relates to summative evaluation.

Recent efforts in the field of nutrition to institute critical pathways or practice guidelines, particularly in clinical settings, as well as quality assurance programs aim to improve the process of program delivery (Cameron, 1994). Then in formative, i.e., process, evaluation the practitioner solicits participants' feedback during the course of the program delivery; formative evaluation is "short-loop" evaluation and may have immediate influence on the intervention program. Summative, i.e., impact and outcome, evaluation documents the changes that presumably result from the program intervention and thus assesses the effectiveness of a program.

Impact and outcome evaluation are differentiated by the variables assessed. Impact evaluation, for instance, focuses on intermediate effects of a program, e.g., changes in eating and nutrition-related behaviors. Outcome evaluation focuses on health status, the ultimate program outcome, and is determined by physiological changes, e.g. changes in laboratory values such as serum glucose or lipids, blood pressure, or body weight/body composition. Whereas process evaluation assesses short-term effects, impact and outcome evaluations assess intermediate and long-term effects, respectively (Fawcett et al., 1995). These three forms of evaluation are related in that program processes are thought to influence program impact and subsequently program outcomes: processes impact outcomes.

By definition, nutrition education is intended to facilitate behavioral change, specifically changes in eating and other nutrition-related behaviors. Ideally, program objectives are formulated across the domains of cognitive, affective, and psychomotor objectives in an effort to elicit the desired behavioral change. Summative evaluation then assesses the impact of the nutrition education interventions with well-designed summative evaluation clearly including an assessment of changes in behavior. Practitioners, however, frequently limit summative evaluation to an assessment of changes in knowledge, the lowest level of cognitive objectives, thus revealing little about the behavioral effect of the intervention. Practitioners inadvertently focus exclusively on evaluating physiological changes which are more readily quantifiable but are "distal" to the behavioral changes. Physiological changes are, of course, desirable outcomes; but the lack of physiological changes might be interpreted as an ineffective nutrition education intervention whereas the intervention may, in fact, have significantly changed behavior but has not as yet impacted clinical parameters. Program participants, for instance, might have significantly reduced saturated fat intake, but this dietary change would not be immediately evidenced in significantly reduced serum cholesterol. Thus, summative evaluation encompassing an assessment of behavioral change is critical to ascertaining the effectiveness of nutrition education interventions.

The common elements of nutrition education have been delineated: needs assessment, program objectives, intervention strategies, and evaluation. These elements are not only common to all nutrition education interventions, but they are requisite to effective programs. Effectiveness, however, is more complex than including these components.

Enhancing the Effectiveness of Nutrition Education

Effectiveness in nutrition education is now equated with behavioral change (Contento et al., 1995, p. 279). In recent years, however, a major thrust in the professional nutrition community has been directed toward enhancing the effectiveness of nutrition education interventions. The historic tenet that doing something in nutrition education is better than doing nothing is a weak premise unless the "doing something" results in changed behavior. After all, "doing something" requires resources, however marginal; and unless the inputs of time, money, and personnel result in change, these expenditures would be difficult to justify even for altruistic reasons.

In the past few years, two major works have been published delineating the effectiveness of nutrition services. Both works have been sponsored by the federal government, i.e., U.S. Department of Agriculture (USDA) and U.S. Department of Health and Human Services (DHHS). The findings provide guidance beyond the classic components of needs assessment, program objectives, intervention strategies, and evaluation that are invoked to design strong programs.

The review of the effectiveness of nutrition education initiated by the USDA was published as a monograph by the Society for Nutrition Education, a professional nutrition organization (Contento et al., 1995). Only work that incorporated an evaluation component was considered for the review which underscores that careful program design is requisite to program effectiveness. The review had defined search strategies to identify relevant published literature, but understandably the subsequent monograph refers to the review as "comprehensive but not exhaustive." The review focused on the field of nutrition *education* and was predominantly organized by life cycle stage, e.g., effectiveness of nutrition education for school-aged children.

In general, effective nutrition education interventions were those that were behaviorally focused and based on theoretical frameworks of behavioral change. This conclusion from the USDA-sponsored review of program effectiveness confirmed an earlier review by Smith and Lopez (1991) who reported that "... theory-based [nutrition education] research has the potential to greatly improve our effectiveness in nutrition education." Undoubtedly, human behavior is much too complex to be entirely captured in a theory or model; but the prevailing models, nevertheless, attempt to distill salient aspects of behavioral change, particularly determinants of change. These models of behavioral change further inform the program components and thus enhance the effectiveness of nutrition education interventions. Logically, nutrition education guided by an understanding of behavioral change is better able "to facilitate the voluntary adoption of eating and other nutrition-related behaviors" (Olson, 1995, p.58).

Theories addressing behavioral change derive from the psycho-social literature. Glanz, Lewis, & Rimer (1990) address a number of promising theoretical models in one comprehensive treatise which serves as a resource for a number of disciplines. Additionally, the Health Communications Resources web site developed by Emerson College in collaboration with Tufts University School of Medicine (*www.emerson.edu/accidents/cs/health.com/home/html*) has a link that addresses "communication models, theories, and practices." Increasingly, undergraduate and graduate nutrition students are exploring the rudiments of theory- driven nutrition education interventions as part of their academic preparation; so with each passing year, the professional nutrition community is better equipped to design and implement theory-driven programs.

Theories can be classified as to those that propose the process of behavioral change in individuals, interpersonal, and community settings. Those that address the process whereby an individual voluntarily adopts new behaviors include, for example, the health belief model, the theory of reasoned action, and the transtheoretical (or stages of change) model. The interpersonal model noting that individuals change their environment as well as recognizing that they are changed by their environment is the social learning theory. And lastly, notable models of community change include the community organization model, diffusion of innovations theory, and social marketing.

Invoking the current theories (models) makes the concept of behavioral change explicit to the program design and delivery. Alternatively, planning nutrition education interventions without attention to theoretical constructs does not mean that the intervention is "null and void" of theoretical underpinnings; but rather programs that lack explicit theoretical underpinnings are often vulnerable to practitioners' *assumptions* of how participants make behavioral changes. In the USDA-sponsored review of nutrition education interventions, those programs that did not define the theoretical framework of the nutrition education intervention were frequently based on the implicit assumption that participants in the nutrition program would change as a result of receiving more information which is inconsistent with the prevailing models of behavioral change. In reviewing the U.S. Department of Agriculture-sponsored work, Contento et al. (1995, p.281) wrote, "In many programs, there is a mismatch between the stated goals related to dietary change and a didactic, information-based educational methodology."

Notably, the critique of effectiveness of nutrition education sponsored by the USDA focused predominantly on community-based programs presumably since this federal agency frequently supports nutrition education interventions imbedded in community-based government programs such as school food service. In these programs the target audiences are primarily well populations. On the other hand, the review sponsored by the DHHS (Barr, 1993) focused on clinical effectiveness in dietetics/nutrition, namely clinical effectiveness of nutrition intervention related to cholesterol and fat reduction; diabetes mellitus; hypertension; and weight loss as well as health services research related to dietetics.

In addition to differences in settings and target audiences, the essence of the term "effectiveness" was different in the two critiques. Whereas the USDA-sponsored critique defined effectiveness as behavioral change, the DHHS-sponsored critique, presumably because of the interest in clinical effectiveness, regarded effectiveness as physiological change. Thus, in the USDA-sponsored work, nutrition intervention would be regarded as effective if the intervention resulted in participants selecting lower fat foods; whereas in the DHHS-sponsored work, the intervention would be regarded as effective if the clients' serum lipids decreased.

The issue is not one of "rightness" or "wrongness" in these two reviews, but rather an issue of definition and ultimately the relationship of these two forms of effectiveness. Whereas effective nutrition education interventions result in behavioral changes (and subsequently physiological changes), clinical effectiveness may be defined exclusively in terms of physiological change since the clinical nutrition intervention may not necessitate any change in behavior. The clinical procedure of administering an enteral tube feeding in the management of Crohn's disease, for instance, might indeed use physiological change, e.g., body weight gain, as a measure of effectiveness. Clinical interventions, however, are not always limited to technical procedures such as enteral tube feedings or total parenteral nutrition that are "done for" the client. In many situations even clinical interventions necessitate behavioral changes such as increasing fiber intake or consuming small frequent meals. In these situations the client would benefit from the inclusion of a behaviorally-focused nutrition education. Thus, the issue is not simply to determine if effectiveness is defined in terms of behavioral or physiological change but to appreciate the relationship of these changes/outcomes and to recognize that educational interventions are most effective when directed towards behavioral changes as a means to impacting physiological changes that are indicative of improved health status.

As depicted in Figure 1, behavioral changes precede physiological changes. Behaviors, however, are not randomly targeted for change but are frequently identified in the needs assessment and legitimized by the nutritional science underpinnings. In a cholesterol reduction program, for instance, an appropriate target behavior might be to substitute low-fat for full-fat dairy products since a body of literature supports the relationship between saturated fat intake and serum lipid levels.

Figure 1

Relationship of Variables to Behavioral Change, the Criterion for Effectiveness in Nutrition Education Interventions

Determinants of behavioral change	Behavioral change	Physiological change

In reality, however, participants of health and presumably nutrition education programs frequently are not ready to implement behavioral changes (Prochaska et al., 1994). Thus, to enhance the effectiveness of nutrition education, the program may need to focus on factors that facilitate behavioral change. As depicted in Figure 1, these factors or determinants of behavioral change obviously precede the targeted behavior. This is where the models of behavioral change are particularly valuable as they attempt to distill the predisposing factors (e.g., participants' knowledge and attitudes), enabling factors (e.g., participants' skills), and reinforcing factors (e.g., practitioners' attitudes and behavior toward participants) that facilitate change.

In sum, theory-driven nutrition education interventions assist practitioners in designing programs directed toward behavioral change by more clearly identifying the processes of change. As noted in the review of effectiveness sponsored by the USDA, effectiveness is equivalent to changes in behavior. The assessment of changes in behavior and mediating factors is thus most appropriate in assessing the effectiveness of educational interventions whereas clinical nutrition procedures that are "done to" a client may be evaluated against different criterion of effectiveness, namely physiological changes.

Cost-effectiveness of Nutrition Education

The vangard today in nutrition education as well as other health service areas is outcomes research including cost-effectiveness work. This work builds on the issue of effective program intervention by adding a financial criteria. This emphasis is due to economic forces at play in "recasting" the delivery and quality of health care and relatedly to forces within the field of nutrition such as concerted efforts to explore third-party reimbursement (American Dietetics Association, 1995).

Cost-effectiveness analysis needs to be distinguished from cost-benefit analysis (Eisenberg, 1989). Cost-benefit analysis relates the financial costs (numerator) to the financial benefits (denominator). Desirable programs, of course, are those in which benefits are equal or greater than costs. This approach may be financially enlightening, but the monetary value of benefits may be impossible to determine and thus, in the practice arena, determining cost-effectiveness may be more realistic than cost-benefit analysis.

Cost-effectiveness analysis compares two or more interventions that are intended to achieve the same outcome. This approach has intuitive appeal to practitioners. Program costs may, in fact, generate savings so the cost is frequently reported as net costs (numerator) and the effect is reported in terms of the program outcome (denominator). Outcomes are reported in a single unit of measurement or as a measure that combines several outcomes on a common scale. Thus, in comparing two programs that result in the same outcome, the program that necessitates fewer inputs is the more cost-effective program. Or in comparing two programs that have the same inputs, the program that results in the greater change is the more cost-effective program. Details for conducting these analyses are provided by Disbrow and Dowling (1992) including examples of case studies.

Although a body of literature exists regarding the cost-effectiveness of nutrition services (Splett, 1991), evidence regarding the cost-effectiveness of nutrition education interventions is just beginning to accumulate. Of note is Schectman, Wolff, Byrd, Hiatt, & Hartz's (1996) comparison of the cost-effectiveness of managing hypercholesterolemia with intensive dietary intervention using individual and group counseling compared to the "usual health care" provided by general internists. Total program costs were higher for the "nutrition education" intervention than the "usual health care" intervention: $659 versus $477 per patient, p 0.001. At the end of the 24 month study period, however, patients involved in the "nutrition education" intervention were more likely to have reached low density lipoprotein cholesterol (LDL-C) goal levels and also to have achieved greater reductions in LDL-C. Thus, although the program costs for the "nutrition education" intervention were greater, the impact of the intervention was also greater. Cost-effectiveness, defined as the cost per unit reduction of LDL-C was $758 for the "nutrition education" intervention and $1,058 for the "usual health care" intervention, $p \leq 0.002$. Thus, in this study, the "nutrition education" intervention was the more cost-effective of the two interventions.

Cost-effectiveness data are also emerging in the field of diabetes education. In a randomized clinical trial, Franz et al. (1995) compared the cost-effectiveness of two forms of nutrition education: basic nutrition care and practice-guidelines nutrition care. Basic care consisted of a single nutrition visit whereas the practice-guidelines care consisted of a minimum of three visits and included educational interventions. Patients in the basic care group experienced a mean decrease of 0.4 mmol/L (7 mg/dl) in fasting glucose levels at the end of the six month study period and a total per patient cost of $42. Individuals in the practice-guidelines nutrition care group experienced a mean decrease of 1.1 mmol/L (20 mg/dl), a larger decrease compared to the basic care group, and a total per patient cost of $112, a greater expense compared to the basic care group. Since the expenditures also generated certain savings, the cost-effectiveness was appropriately analyzed in terms of net costs revealing that the cost-effectiveness ratio for basic care was $5.32 per unit change in fasting plasma glucose compared to only $4.20 per unit change in the practice-guidelines care group. As in the work by Schectman et al. (1996) in hypercholesterolemia, the initially greater program costs of the educational intervention bore a greater return and thus was the more cost-effective program.

These studies represent the nucleus of specific work in cost-effectiveness, work devoted toward assessing the cost-effectiveness of nutrition education interventions. As data begin to accumulate in this area of study, practitioners will be better able to determine the strengths of selected program interventions.

Conclusions

This paper has examined the utility of each of the components of nutrition education interventions, i.e., needs assessment, program objectives, intervention strategies, and evaluation, to improve the effectiveness of nutrition education. Furthermore, work from a review of nutrition education programs underscores the value of using theoretical models of behavioral change to "tease out" the relationship of the determinants of behavioral change and thus further enhance program effectiveness. A newly emerging body of literature is assessing the cost-effectiveness of nutrition education.

To improve cost-effectiveness, however, program costs need to be decreased and/or program effect or outcomes need to be increased. Thus, enhancing the effectiveness of a program is a viable strategy for improving cost-effectiveness. Nutrition education interventions that astutely address the components of needs assessment through evaluation, and that build the intervention on a theoretical model that clarifies the determinants of change have an improved prognosis for facilitating behavioral change in participants. In turn, these behavioral changes influence physiological outcomes, a major factor in cost-effectiveness analysis.

Evidence of cost-effectiveness positions nutrition education for competitive service delivery which is an asset to both practitioners and program participants.

References

American Dietetic Association. (1995). Position of The American Dietetic Association: Cost-effectiveness of medical nutrition therapy. *Journal of the American Dietetic Association, 95*(1), 88-91.

Barr, J. T. (1993). *Critical Literature Review: Clinical effectiveness in allied health practices* (AHCPR Pub. No. 94-0029). Rockville, MD: U.S. Department of Health and Human Services/Public Health Service/Agency for Health Care Policy and Research.

Bloom, B.S., Engelhart, M., Furst, E., Hill, W., & Krathwohl D. (1956). *Taxonomy of Educational Objectives Hand book I: Cognitive Domain*.New York, NY:David McKay.

Cameron, A.M., (Ed.). (1994). *Incorporating nutrition care into critical pathways for improved outcomes*.Columbus, OH: Ross Products Division/Abbott Laboratories.

Contento, I., Balch, G.I., Bronner, Y.L., Lytle, L.A., Maloney, S.K., Olson, C.M., & Swadener, S.S. (1995). The effectiveness of nutrition education and implications for nutrition education policy, programs, and research: A review of research. *Journal of Nutrition Education, 27*(6), 277-418.

Contento, I. R. & Morin, K. (1988). *Manual for Developing a Nutrition Education Curriculum, Nutrition Education Series, Issue 16* (pp. 9-31). Paris, France: UNESCO /Division of Science, Technical, and Environmental Education.

Disbrow, D.D., Monsen, E.R., & Dowling, R.A. (1992). Cost-effectiveness and cost-benefit analyses: research to support practice. In Monsen, E.R. (Ed.), *Research: Successful approaches* (pp. 272-294). Chicago, IL: American Dietetic Association.

Falvo, D.R. (1994). *Effective Patient Education: A guide to increased compliance*, 2nd ed. (pp. 45-57).Gaithersburg, MD: Aspen Publishers, Inc.

Fawcett, S.B., Sterling, T.D., Paine-Andrews, A., Harris, K.J., Francisco, V.T., Richter, K.P., Lewis, R.K., & Schmid, T.L. (1995). *Evaluating Community Efforts to Prevent Cardiovascular Disease*. Atlanta, GA: U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Center for Chronic Disease Prevention and Health Promotion.

Eisenberg, J.M. (1989). Clinical economics: A guide to economic analysis of clinical practices. *Journal of the American Medical Association, 262*(20), 2879-2886.

Franz, M.J., Splett, P.L., Monk, A., Barry, B., McClain, K., Weaver, T., Upham, P., Bergenstal, R., & Mazze, R.S. (1995). Cost-effectiveness of medical nutrition therapy provided by dietitians for persons with non-insulin-dependent diabetes mellitus. *Journal of the American Dietetic Association, 95*(9), 1018-1024.

Glanz, K., Lewis, F.M., & Rimer, B.K., (Ed.). (1990). *Health Behavior and Health Education: Theory, research, and practice.* San Francisco, CA: Jossey-Bass Publishers.

Green, L.W. & Lewis, F.M. (1986). *Measurement and Evaluation in Health Education and Health Promotion.* Palo Alto, CA; Mayfield Publishing Company.

Holli, B.B. & Calabrese,R.J. (1988). *Communication and Education Skills for Dietetics Professionals, 3rd ed.* (p.163). Baltimore, MD: Williams & Wilkins.

IOX Assessment Associates. (1988). *Program Evaluation Handbook: Nutrition Education*. Los Angeles, CA: IOX Assessment Associates.

Kraak, V.I., Stricker, J.D., & Utermohlen, V. (1994).Determining the nutrition needs of an ethnically diverse urban population with HIV/AIDS. *Journal of the American Dietetic Association, 94*(9 suppl), A-60.

Krathwohl, D., Bloom, B.S., & Masia, B. (1964). *Taxonomy of Educational Objectives, Handbook II: Affective domain*. New York, NY: David McKay.

Olson, C.M. (1995). Joint position of Society for Nutrition Education (SNE), The American Dietetic Association (ADA), and American School Food Service Association (ASFSA): School-based nutrition programs and services. *Journal of Nutrition Education, 27*(2), 58-61.

Prochaska, J.O., Velicer, W.F., Rossi, J.S., Goldstein,M.G., Marcus, B.H., Rakowski, W., Fiore, C., Harlow, L.L., Redding, C.A., Rosenbloom, D., & Rossi, S.R.(1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychology, 13*(1), 39-46.

Rankin, S.H. & Stallings, K.D. (1990).*Patient Education: Issues, principles, practices*, 2nd ed. (pp. 127-164). Philadelphia, PA: J.B. Lippincott Company.

Schectman, G., Wolff, N., Byrd, J.C., Hiatt, J.G., & Hartz, A. (1996). Physician extenders for cost-effective management of hypercholesterolemia. *Journal of General Internal Medicine, 11*(5), 277-286.

Simpson, E. (1966). The classification of educational objectives in the psychomotor domain. *Illinois Teacher of Home Economics, 10*, 110.

Smith, J.L. & Lopez, L.M. (1991). The application of theory and its relationship to program effectiveness in nutrition education research. *Journal of Nutrition Education, 23*(2), 59-64.

Splett P.L. (Ed.). (1991). Effectiveness and cost effective nessof nutrition care: a critical analysis with recom mendations. *Journal of the American Dietetic Association, 91*(11S), S1-S53.

Nutrition Education for African-Americans: Challenges and Opportunities

Delores C. S. James

Abstract

African-Americans face a variety of social and economic problems that present formidable challenges to daily existence. This population usually feels no sense of urgency about preventing diseases and little concern for the long term consequences of eating habits. Barriers to healthful eating in this population include the social and cultural symbolism of traditional foods, busy lifestyles, lack of information to consistently make healthful food choices, and lack of innovative, and culturally specific nutrition education tools and programs. For significant dietary change to occur, recommended foods must be available and acceptable, according to cultural customs and attitudes. Furthermore, the desired behavior changes must be realistic, sensible, practical, and satisfying. This article identifies barriers and opportunities for providing effective nutrition education for African-Americans, including ethical considerations and the need for cultural relevance. Ten specific recommendations for program development are offered.

Compared to the general population, African-Americans suffer disproportionately from coronary heart disease, hypertension, obesity, some cancers, and other chronic diseases (U.S. Department of Health and Human Services, 1990). African-Americans tend to have diets high in fat, calories, sodium, salt-cured, smoked and nitre-cured foods, but, low in fruits, vegetables, whole grains, and fiber. These eating patterns contribute to the incidence of diet-related disorders (Bal and Foerester, 1993; Hargreaves, Baquet, and Gamshadzahi, 1989; Kumanyika, 1990; U.S. Department of Health and Human Services, 1990).

African-Americans face a variety of social and economic problems that present formidable challenges to daily existence. They usually are not motivated to change their eating or health habits unless they or a family member are diagnosed with a serious illness. Thus, prevention of chronic diseases usually is not perceived as a priority or as important as the more immediate issues of daily living (Hankin, 1993). Only a small percentage of Americans adopt health-promoting behaviors to reduce their risks for chronic diseases (Heimendinger, 1993; Hochbaum, 1981). However, the opportunities to prevent diseases through dietary modifications among African-Americans are great, and the national dietary recommendations have sound public health implications for prevention of diet-related diseases.

Barriers to Dietary Change

Food purchasing, preparation, and nutrition-related attitudes and behaviors—whether positive or negative— usually are established early in life and are primarily determined by cultural, psychosocial, and socioeconomic factors (Crockett and Sims, 1995 ; Hochbaum, 1981). Habits established in childhood may require greater effort to change than those established in adulthood (Hochbaum, 1981). Demographic and sociocultural factors such as more female-headed households, both spouses in the labor force, food advertisements, and the media have contributed to buying more convenience foods, increased consumption of fast foods, and the marginal nutritional status of many Americans (Crockett and Sims, 1995; Hochbaum, 1981).

Like other members of the general population, African-Americans often have little concern about long term consequences of poor eating habits. They are more concerned with establishing a career, trying to make ends meet, taking care of families, and coping with other stressors in society (Heimendinger, 1993). Valuing health and purchasing foods because of their health benefits is a verbal rather than a behavioral norm in our society (Hochbaum, 1981). Thus, achieving "optimal" health and preventing diseases are not strong enough motivators to change the eating patterns of most African-Americans.

African-Americans often maintain traditional diets to remain connected to tradition and culture. People do not tire easily of traditional and staple foods. Therefore, it is useful to know the extent to which traditional foods are consumed, for these foods will offer the biggest emotional resistance (Sanjur, 1995). Certain foods also have symbolic, emotional, and cultural meaning. For example, the absence of meat on the table may symbolize the family's financial hardship and the man's inability to provide for his family. The woman's cooking ability also is a great source of pride for African-American men and constitutes "bragging rights" (James, 1997).

Many African-Americans lack the information to consistently make healthful food choices. The cost of food also prevents many African-Americans from eating healthy. Low-fat, low-sugar items usually cost more at restaurants and supermarkets than the regular items. Perceptions also exist that nutritious foods are expensive (James, Rienzo, and Frazee, 1996). Taste also is a large factor in food choice (Gleason, 1995). Many believe "healthy foods" do not taste good. If people do not like the taste of the food, they will not eat it or eat it for very long, regardless of their health condition or what the doctor or nutritionist says (James, 1997; Sanjur, 1995).

Assumptions of Nutrition Education

The American Dietetic Association (1973) defines nutrition education as "the process by which beliefs, attitudes, environmental influences, and understandings about food lead to practices that are scientifically sound, practical, and consistent with individual needs and available resources" (p. 520). Nutrition education should mean more than providing information and developing skills. It should involve individuals, within the context of their family and community, so proposed solutions become personally and culturally relevant and valid (Sanjur, 1995).

While the eating habits of many African-Americans may be viewed negatively by nutritionists, many African-Americans resent criticisms of their diets. Some African-Americans may even perceive "eating healthy" as giving up part of their cultural heritage and trying to conform to the dominant culture (James, 1997). For compliance to occur, recommended foods must be available and acceptable, according to cultural customs and attitudes. Furthermore, the desired behavioral change must be realistic, sensible, and practical for the client, and the learning experience should give the learner immediate or long-term satisfaction (Sanjur, 1995). Hochbaum believes three erroneous assumptions shape nutrition education. The first assumption holds that knowledge of the health consequences should be a sufficient motivator to change one's unhealthy diet. Like other Americans, African-Americans are likely to engage in particular behaviors if they see a value to those behaviors, regardless of whether the behaviors are labeled by health professionals as detrimental to health. Most Americans know some of the health consequences of their diets and can identify aspects of their diet that need improvement. However, only a small percentage adopt health-promoting behaviors to reduce their risks for chronic diseases (Heimendinger, 1993; Hochbaum, 1981). Individuals also have to be "emotionally ready" before long-term change occurs (Hochbaum, 1981). In the absence of such readiness, facts and recommendations are either disregarded or altered to rationalize the present behavior. People interpret data and recommendations to support what they wish them to mean (Hochbaum, 1981). Dietary compliance often requires individuals to make profound personal changes. The more rigid the recommendations for change in lifestyle and the longer the duration required, the less likely is compliance (Sanjur, 1995). The second assumption holds that people do not eat healthy because they lack information. However, information alone has limited, if any, effect on nutrition-related practices (Hochbaum, 1981). While some African-Americans may lack the information to consistently make healthy food choices, many eat the way they do because of taste, tradition, lifestyle, cost, and other related factors (James, 1997). Nutrition education goals should be set by and agreed upon by both client and counselor, and these goals must be specific, reasonable, measurable, and attainable. Dietary change must be approached with flexibility and anticipation of lapses. Therefore, corrective action must be discussed and planned as integral parts of goal-setting and nutrition education. It is not only important to consider the information the client needs to know, use, and understand, but how the information will be received and how they want to receive it (Sanjur, 1995). Few guidelines help nutrition educators match an optimally effective combination of type and quantity of factual information with delivery methods and specific target populations. Most educators rely on their experience, skills, and instincts (Hochbaum, 1981). The third assumption holds that informed people will eat healthy if they can afford and have access to the proper foods (Hochbaum, 1981). Food purchasing habits of many African-Americans are determined largely by income. Low income individuals typically buy foods that will "fill them up." While the cost of food may prevent many African-Americans from eating healthy, nutritionists need to emphasize and give practical examples of how to eat nutritious foods on a limited budget. But again, most individuals are guided by taste, preferences, costs, convenience, advertisements, and so forth (Gleason, 1995; Hochbaum, 1981; James et al., 1986).

Nutritionists still have difficulty identifying and understanding the complex and challenging factors that affect and predict health-and food-related behaviors. Instead of asking how to change food habits, they may find it more productive to ask how food habits are formed (Sanjur, 1995). Other questions to consider are: Which groups of African-Americans should change or are more likely to change food habits? What meanings do African-Americans place on certain foods? How often are traditional foods consumed? Which foods are more difficult to eliminate or add to the diet? How strong is the habit being considered for change? What significant life events would cause an improvement in the current diet? What are the economical, nutritional, and ethical implications of particular diet modifications? What personal skills need learning or relearning to implement change? What situational factors are involved? What types of nutrition education programs would work best in a specific African-American community? Any search for these answers must be systematic and holistic.

Marketing and Promoting Dietary Change

Modifying the food purchasing, preparation, and nutrition-related attitudes and behaviors of African-Americans may need a marketing approach. Social marketing provides a framework for developing and disseminating ideas, issues, programs, and strategies. Social marketing goes beyond mere advertising and promotion. It offers a set of principles and techniques that together provide a framework and a tool from which nutrition educators can systematically affect, promote, and solve problems related to drug use, sexual behavior, food purchasing, and nutrition-related attitudes and behaviors (Andreasen, 1995; Lefebvre, 1992).

Marketing Approaches

When targeting African-Americans, it is typically better to conduct segmented marketing or concentrated marketing. In segmented marketing, different programs, materials, and strategies are developed for different target groups or segments of the population (Andreasen, 1985; Rossman, 1994; Weinstein, 1994). Members of the African-American middle class often are highly educated and privileged, and they live worlds apart from the poor, inner-city underclass. Yet, a pervasive myth holds that African-Americans are all the same, and so no need exists to develop different programs or materials. A variation on this theme suggests that all African-Americans are either rich celebrities or welfare recipients, with no middle class (Rossman, 1994). Objective, general measures such as age, gender, socioeconomic status, and place of residence usually are used because they are available in census data and other secondary sources. However, these data indicate little about the groups' needs, wants, and perceptions, and how they might respond to specific strategies. Inferred, specific measures such as attitude, lifestyle, risk factors, and media usage may be more helpful (Andreasen, 1985). One of the most valuable inferred measures may be emotional readiness to change (Hochbaum, 1981).

In concentrated marketing, programs, materials, and strategies are concentrated on one or a few segments of African-Americans, such as women, high risk groups, and low socioeconomic levels, because of limited resources or because a major effect is desired. For example, a nutrition education program primarily may target women because they usually are gatekeepers to the home and they influence the food intake of their husbands and children (James et al, 1996; Kristal, White, Shattuck, Curry, Anderson, Fowler & Urban, 1992; Shattuck, White, & Kristal, 1992).

Relevance

Educators often disregard cultural- and value-based messages so critical for reaching African-Americans. The programs, materials, and media mix must be culturally relevant and sensitive to their lifestyles and must reflect a positive image of them as clients and consumers. Food provides one way for ethnic groups to identify themselves and distinguish themselves from other groups, and it is important for the foods and experiences of these groups to be validated (Sanjur, 1995; Rossman, 1994).

Respect, Not Tolerance

Dietitians and nutritionists often work with people who are culturally and ethnically different from themselves. Health professionals like to consider "their" medicine and foods as better than "their client's" (Sanjur, 1995). What is presented as "good tasting foods" or "healthy foods" may not be acceptable to an African-American. Effective diet counseling and nutrition education begin when the provider develops respect and cultural empathy for the values, beliefs, and feelings of the client. Simple tolerance is not enough. A perceived threat or lack of respect often causes people to cling more tenaciously to their traditional dietary values and practices (Sanjur, 1995). Positive aspects of traditional African and African-American diets should be stressed, while stressing the need for modifying or reducing certain elements of the diet. Nutrition educators also need to be knowledgeable about traditional African diets before slavery as well as what aspects of the diets were retained and modified by those who were enslaved. They also need to be familiar with the traditional foods that are currently eaten by African Americans, with emphasis on regional differences.

Program Recommendations

Challenges facing public health nutritionists include the need to serve a culturally diverse population and the need to reach large geographical areas with limited resources (Romero-Gwynn & Marshall, 1990). Working effectively with African-Americans requires one to recognize not only the different approaches to nutrition education, but that the goals, objectives, and messages should be planned with a clear understanding of the population's health and nutrition needs. Most educators practice by trial and error until they find approaches that work with specific individuals, groups, and communities. The following recommendations relate specifically to programs for African-Americans.

1. <u>Use a multilevel approach</u>. Making a program more culturally appropriate often means choosing multiple strategies to address different levels of a problem. For example, a heart-healthy education program might include teaching individuals how to make changes in their diet, working with family members to provide support, encouraging local "soul" food restaurants to offer healthier versions of traditional oods, and using supermarkets for label-reading tours. Likewise, cooperative learning has been shown effective in promoting learning among African-Americans (Slavin, 1987). Cooperative learning facilitates development of conceptual frameworks and incorporates factors that affect knowledge acquisition, attitude development, and behavior change. Cooperative learning is generally more effective than individual instruction in promoting learning among all age groups and subject matter (Johnson & Johnson, 1985).

2. <u>Choose the media mix carefully</u>. Most African-Americans can be reached through the general market media. How

ever, the multiplier effect increases when African-American consumers see a T.V. or print message targeted to them at the same time they see the product in a store. Use of radio offers an inexpensive and effective tool for reaching African-Americans, due to the large number of African-American radio stations in urban cities, widespread use of radio among this population, and because the listening audience is less segmented than the Caucasian audience. (Rossman, 1994). Print media also are effective since more than 70% of African-Americans read community-based news publications (Rossman, 1994). The church bulletin also provides another effective educational and marketing tool.

3. Do more than change the color of the people in the brochure. African-Americans often are treated as an undifferentiated mass. Program planners and educators mistakenly believe because African-Americans speak English, they can be reached through general publications (Rossman, 1994; Weinstein, 1994). The "one-size-fits-all" approach to educating African-Americans just does not work. Sometimes the health message may be universal or global—"no more than 30% of calories should come from fat"—but the promotional and media mix must be specific to the target group. African-Americans may attend the same classes, read the same message, and see the same ads and promotions as everyone, but they do not always interpret messages in the same way. Sometimes it may be better to create new materials based on needs assessments, and research data, which then can be refined after pilot testing with focus groups (Lorig, 1996).

4. Involve the target group at all levels. Program goals and objectives should be set by and agreed upon by the clients and program planners. Community members can participate by serving on the board of directors, chairing or participating on ad-hoc committees, organizing health fairs, choosing a name for the program, and developing the program logo.

5. Incorporate different types of music, art, drama, and dance into your education activities. The Alachua County, Florida chapter of the American Cancer Society (ACS) formed a committee, Brothers and Sisters Against Cancer (BASAC) that organizes the annual "Gospel Gathering for Good Health." This event, held at a local school or church, combines a gospel concert, drama, testimonials from cancer survivors, breast and prostrate screening and education, nutrition education , and related activities. Other ACS chapters in Florida are using the BASAC model to develop similar events.

6. Personalize the delivery of the program. Education should be provided in a warm, nurturing environment. Changes to existing programs can be as simple as encouraging staff and volunteers to be warm and friendly, offering programs in a church or community center rather than at a hospital or clinic, and providing transportation and child care. It also might include providing flexibility with appointments, and sending invitations to the people you want to attend, followed with phone calls or postcards as reminders (Lorig, 1996).

7. Include family members. Family confers a sense of identity and self-worth, provides social support, and helps with adherence to a particular dietary treatment (Sanjur, 1995). Programs targeted at children should have parental support. Parents should model appropriate health habits and lifestyle choices. Sound nutrition information may be provided to children but some children lack the family structure and resources to put healthful eating into practice.

8. Choose role models carefully. Identify positive role models from the community and train them to deliver your message and/or teach your programs. African-American restaurants can be contacted to cater healthful "soul food" meals at community events or African-American cooks and chefs can teach clients how to modify favorite recipes that are still tasteful. Reaction to the use of celebrities may be mixed. Some people cannot identify with celebrities because the celebrities are not "real people," have different lifestyles, and are paid to do endorsements; but some people may listen more to celebrities than to the average person (James et al., 1996). The "add-on-a-African-American-celebrity" approach to a mainstream health campaign rarely succeeds unless it considers the broader set of variables involved when educating and marketing to African-Americans (Rossman, 1994).

9. Train program staff and educators to be culturally competent and sensitive. If educators lack awareness, training, and information to deal with multicultural groups, they may mistakenly rely on stereotypical misinformation and distortion. Nutrition educators also need to develop personal and professional relationships with African-Americans in the community, which may help them counteract ethnic biases and distinguish between stereotypes and reality (Sanjur, 1995).

10. Emphasize empowerment. Eating healthy requires a conscious effort, and dietary modification requires a change in human behavior. Programs often emphasize how individuals should change, but the environment in which they live may contribute to the problem. To encourage empowerment, nutrition educators could focus on developing assertiveness skills with health care providers, taking responsibility for personal growth, encouraging participation in clinical trials, recruiting volunteers, and supporting clients' efforts to make their own decisions.

Ethical Considerations

Health professionals generally agree that clients must be informed, persuaded, and motivated to adopt healthy patterns for their personal benefit and the benefit to society. The ethics of helping individuals change begins with an understand ing of their culture, recognizing the good in it and the assumptions that underlie it. To be an instrument of change, nutrition educators must recognize the moral burden inherent in attempting to change people's diets. The nutritionist's job is not to tell people what food choices to make but to emphasize the interrelationship among good health, nutrient function, and the quality of human life, so people can make their own decisions based on the best information available.

However, if food practices are truly harmful, the nutritionist is justified in guiding efforts to improve those habits. Change should be introduced in a way least disruptive to traditional values and practices (Sanjur, 1995). Questions to consider include: What right do we have to change an individual's or group's health attitudes and behavior? Is it ethical to alter traditional ways or beliefs? What are the trade-offs in any proposed diet change? What is the best way to communicate change so that the benefits are greater than the detriments? (Hill, 1993; Sanjur, 1995).

Conclusion

Nutrition education would be simple if people would do what was "good" for them. African-Americans often are aware of sound nutritional information, but many lack the family structure, motivation, social support, and resources to put healthful eating into action (Heimendinger, 1993). Individuals may have more difficulty unlearning old food habits than accepting the validity of new ones. Consequently, changing eating patterns and designing effective, innovative nutrition education programs still pose challenges for nutrition educators.

Nutrition education should be available to everyone throughout the life cycle regardless of income, culture, and economic levels (American Dietetic Association, 1973; Sanjur, 1995). African-Americans must be reached wherever they are and within the context of their daily lives. Programs and materials must be culturally relevant and sensitive to their lifestyles and should reflect a positive image of them as consumers (Rossman, 1994). African-Americans need to learn how to differentiate between reliable and unreliable nutrition information, products, and services. They also need to understand how culture, media, and advertising influence their food choices, decision making, and overall health.

Major gaps still remain in our knowledge of public health education techniques and much work remains to be done in developing and validating methods for motivating and educating culturally diverse groups (Hill, 1993). Significant changes in food purchasing and food-related attitudes and behaviors of African-Americans will more likely succeed if nutrition education programs, messages, and strategies are placed within the context of individual and community empowerment.

References

American Dietetic Association (1973). Position paper on nutrition education for the public. *Journal of the American Dietetic Association, 62*, 520.

Andreasen, A.R. (1995). *Marketing social change.* San Francisco: Jossey-Bass Publishers.

Bal, D.G., & Foerester, S.B. (1993). Dietary strategies for cancer prevention. *Cancer, 72* (3), (suppl), 1005-1010.

Crockett S.J., & Sims, L.S. (1995). Environmental influences of children's eating. *Journal of Nutrition Education, 27(5),* 235-249.

Gleason, P.M. (1995). Participation in the national school lunch program and the school breakfast program. *American Journal of Clinical Nutrition 61(suppl)*, 213S-220S.

Hankin, J.H. (1993). Role of nutrition in women's health: Diet and breast cancer. *Journal of the American Dietetic Association, 93* (8), 994-999.

Hargreaves, M, Baquet, C, & Gamshadzahi, A. (1989).Diet, nutritional status and cancer risk for minority populations. *Nutrition and Cancer, 12*, 1-28.

Heimendinger, J. (1993). Community nutrition intervention strategies for cancer risk reduction. *Cancer (suppl), 72(3),* 1019-1023.

Hill, M. (1993). Some ethical considerations and the status of dietary advice. *Pharmacology and Toxicology, 72 (suppl),* S148-S153.

Hochbaum, G.M. (1981). Strategies and their rationale for changing people's eating habits. *Journal of Nutrition Education, 13*(1) supplement, S59-S65.

James D.C.S. (1997). *Using focus groups to understand the barriers and motivators to healthful eating among African-Americans.* Manuscript submitted for publication.

James, D.C.S., Rienzo, B.A., & Frazee, C. (1996). Using focus groups to assess barriers and motivators to healthy eating among adolescents. *The Health Educator, Fall*, 39-44.

Johnson, D.W, & Johnson, R.T. (1985). The process of nutrition education: A model for effectiveness.*Journal of Nutrition Education, 17*, S1-S7.

Kristal, A.R., White, E., Shattuck, A.L., Curry, S., Ander son, F.L., Fowler, A., & Urban, N. (1992). Long-term maintenance of a low-fat diet: Durability of fat-related habits in the women's health trial. *Journal of the American Dietetic Association, 92*(5), 533-559.

Kumanyika S. (1990). Diet and chronic disease issues for minority populations. *Journal of Nutrition Education, 22*, 89-96.

Lefebvre, R.C. (1992). Social marketing and health promotion. In: R. Bunton, & G. Macdonald (Eds.), *Health promotion: Disciplines and diversity* (pp. 153-181). London: Routledge.

Lorig, K. (1996). *Patient education: A practical approach.* Thousand Oaks, CA: Sage Publications, Inc.

Romero-Gwynn, E., & Marshall, M.K. (1990). Radio: Untapped teaching tool—Effective nutrition education for Hispanics. *Journal of Extension, Spring*, 9-11.

Rossman, M.L. (1994). *Multicultural marketing.* New York, NY: AMACOM.

Sanjur, D. (1995). *Hispanic foodways, nutrition, and*

35

health. Boston, MA: Allyn and Bacon.
Shattuck, A.L., White, E., & Kristal, J. (1992). How women's adopted low-fat diets affect their husbands. *American Journal of Public Health, 82*, 1244-1250.
Slavin, R. (1987). *Cooperative learning: Student teams.* National Education Association of the United States.
U.S. Department of Health and Human Services. (1990). *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.* Washington, DC: US Public Health Service.
Weinstein, A. (1994). *Market segmentation.* Chicago, IL: Probus Publishing Company.

Do Women Athletes Need to Eat Differently from Men Athletes?

Alice K. Lindeman, Ph.D., R.D.

Introduction

Women in general have a few nutrient needs different from those of men. But do these needs change when women become quite active? Does athletics diminish or exemplify these differences? The following discussion reviews how exercise may become the great equalizer between the sexes. A case study summarizes the recommendations.

Do men need more calories than women? Dietary intake surveys of men and women athletes indicate that men generally consume higher energy levels than women (Deakin & Inge, 1994). Although a problem with such research is inadequate reporting, these surveys indicate that some women athletes, especially those in which a lean body is crucial (ballet, running, gymnastics), have marginal energy intake. A new trend being observed is caloric restriction in men athletes who also need to have a lean body, such as endurance runners. (Deakin & Inge, 1994; Ruud, 1996)

Energy intake for anyone depends upon one's sex, age, weight, and physical activity. Up to 60% of energy intake may be derived from physical activity. (Danforth, 1985; Deakin, 1994). To calculate how many calories are required, the Resting Energy Expenditure (REE - see Table 1) and Physical Activity Factor (PAF - see Table 2) need to be determined. REE measures the energy required at rest to maintain vital body functions, e.g., respiration, temperature maintenance, nerve conduction, and muscle tone. The greater the weight for any given age, the greater the REE. To attain a range of need, add or subtract 10% of the REE. The REE tends to increase with increasing height and body mass and correlates closely with lean body mass (muscle mass.) Thus, an athlete who is taller and leaner than his sedentary counterpart would have a higher REE. Unless lean body mass assessment or a clinical evaluation to accurately determine REE is conducted, Table 1 provides a good guide to measuring baseline energy needs.

The normal range of REE for adult men is 1575 - 1925 and for women, 1174 - 1454 calories. Due to their higher lean body mass, at all ages men need more calories than women in order to maintain body weight, even without considering physical activity. A 20 year-old woman weighing 60 kg would have an REE of 1378; a man's REE at the same age and weight would be 1597 calories, a 16% difference.

Physical activity level determines how much additional energy is required over the REE.Table 2 shows how REE is affected by physical activity.The more time spent in activties and/or the greater the intensity, the greater the energy need.

Table 1

Estimation of Daily Resting Energy Expenditure (REE)[a]

Men: Age (yr)	Equation	Women: Age (yr)	Equation)
3 - 9	$(22.7 \times kg)^b + 495$	3 - 9	$(22.5 \times kg)^b + 499$
10 - 17	(17.7 x kg) + 651	10 - 17	(12.2 x kg) + 746
18 - 29	(15.3 x kg) + 679	18 - 29	(14.7 x kg) + 496
30 - 60	(11.6 x kg) + 879	30 - 60	(8.7 x kg) + 829
> 60	(13.5 x kg) + 487	> 60	(10.5 x kg) + 596

[a] Schoefield, Schoefield & James, 1985; Warwick 1989.
[b] Weight in kilograms (pounds ÷ 2.2) Example: 121# woman age 20: 121#/2.2 = 55 kg
(14.7 x 55) + 496 = 1305 (REE)

37

Table 2

Physical Activity Factor Classification System[a]

Activity	Multiple of REE
Resting: Sleeping, reclining while watching TV.	1.0
Very light: sitting and standing activities such as driving, playing cards, typing. Sports such as pool.	1.5
Light: Activities comparable to walking at a leisurely pace, light housework. Sports such as ping-pong, golf, tennis (leisurely), bowling.	2.5
Moderate: Walking at a pace of 3.5-4.0 mph, active gardening. Sports such as cycling (slowly), horse-riding, sailing, swimming (slowly) aerobics (stretching), tennis (moderate pace).	5.0
Heavy: Faster walking, stair and hill climbing. Sports such as tennis (fast pace), ice/roller skating, swimming (moderate pace), gymnastics, aerobics, basketball, football jogging/running (6-10 min mile), squash, weight lifting.	7.0
Very strenuous: Competition (race pace) for swimming, rowing, cycling, running.	10.0

[a] *Schoefield, Schoefield & James, 1985; Warwick 1989.*

To use Table 2, decide how much time is spent on each type of activity, and then determine the average PAF for the day. Example: A 20 year old woman spends 8 hr/day sleeping; 10 hr/day commuting and sitting at work; 3 hr/day showering, dressing, walking, doing household chores, fixing meals, etc.; 3 hr/day pleasure reading and watching television. To determine her PAF, the hours per activity are multiplied by the multiple of REE, as follows:

Activity	Hours x Multiple of REE	Total PAF
Resting	8 Hr x 1.0 =	8
Very light	13 Hr x 1.5 =	19.5
Light	3 Hr x 2.5 =	7.5
Total	***24 Hr***	***35.0***

To determine her average daily PAF, the total PAF is divided by the total hours, i.e., 35/24 =1.46 To determine her total daily energy expenditure, multiply the REE (1378 - for the 20 year old, 132 lb. woman) x PAF (1.46), resulting in a daily requirement of 2012 calories.

If this woman were an athlete in training, 2 of her 3 hours spent reading and television viewing would be replaced with 30 minutes stretching (moderate) 1 hr running (heavy) and 30 minutes weight training (heavy). This athlete's average PAF is 1.88, with a daily energy need of 2591, a difference of almost 600 calories! If our example were a man (at the same weight and age), the sedentary man would need 2332 calories (1597 x 1.46), where the male athlete would need 3002 calories. So, a woman athlete age 20 years, weighing 132 pounds, would need 2591 calories, where her male counterpart would need 3002 calories, a 16% difference. This difference is entirely due to gender, not activity.

Everyone says carbohydrate is the key fuel for athletes, whether they're involved in endurance or sprint/strength sports. Do men need more carbohydrate than women? Actually, based on the number of calories allowed, women need proportionately more carbohydrate than men. Routinely athletes are told to eat 60 to 70% of calories from carbohydrate. These numbers often mean nothing to the athlete, as he/she doesn't know how many calories are consumed. If an athlete consumes only 1500 calories per day, then 60 - 70% is 900 to 1050 calories, or 225 to 262 grams of carbohydrate per day (there are 4 calories/gm carbohydrate.) This amount of carbohydrate can be found in 10 slices of bread plus 4 cups of juice. If this athlete focused on carbohydrate with such a low caloric intake, there would be risk for inadequate protein intake. If, on the other hand, the athlete ate 2500 calories per day, 60-70% calories from carbohydrate would come to 1500-2750 calories, or 375 to 438 grams of carbohydrate. This is the amount of carbohydrate in 15 slices of bread plus 7 cups of juice. It's obviously inaccurate to tell all athletes that carbohydrate should comprise 60 - 70% of calories consumed.

Recommended carbohydrate intake for athletes is based on body weight and type of training, but not gender. Endurance athletes (participating in events lasting > 1 hour, such as marathon running, long-distance swimming, cross-country skiing, soccer, triathlons, tennis) should eat 7 to 10 grams carbohydrate/kg body weight during training and competition. Training for ultraendurance events (events which last more than 6 hours) may require a carbohydrate intake of 10 to 12 grams/kg body weight. In ultraendurance athletes, the level of muscle glycogen (carbohydrate stored in the muscles) significantly affects performance. Athletes training for shorter duration or strength events, such as middle-distance running, weight lifting, throwing events, football, and basketball, need

5-8 grams carbohydrate/kg body weight. In these sports, muscle glycogen is not as depleted as in longer events. Such activities rely more on liver glycogen stores and adequate blood glucose for energy than they do on muscle glycogen stores (Sherman, & Wimer, 1991).

So, women and men do not differ in the amount of carbohydrate needed. The difference is based on weight, not gender. Fiber and sugar, two important carbohydrates, also are the same for both sexes. Athletes don't need any more sugar, in terms of percentage of calories, than their sedentary counterparts. Ten to fifteen percent of total calories can come from sugar in a healthy diet. Athletes need more calories and can eat more total sugar than nonathletes, but they do need to be aware that most of the carbohydrate in supplements and sport drinks is sugar. If an athlete routinely drinks sport drinks, eats sport bars and/or consumes liquid meal replacements or supplements, she needs to count most of the carbohydrate in these products as sugar (Sherman & Wimer, 1991).

A healthy diet should have 20 to 35 grams of fiber per day. If a high calorie diet is consumed, e.g., >4000 calories, fiber content may significantly exceed this recommended range. Because a level 60 grams fiber per day may interfere with essential nutrient absorption, athletes eating high calorie diets should follow the recommendation of 10 grams fiber per 1000 calories consumed (Bennet & Cerda, 1996).

Men need more protein than women because men have more muscle mass, right? The amount of protein needed by sedentary men and women is 0.8 grams/kg body weight. Athletes need more protein than nonathletes, but the amount recommended is still somewhat controversial. Many strength athletes falsely believe that they require more protein than endurance athletes because they (strength athletes) are building more muscle tissue. In truth, during early conditioning, whether for endurance or strength, there is an increased demand for protein. Weight lifters and other athletes training to increase muscle mass and strength in the early stages of training, should consume more protein. Lemon (1995), a leading exercise physiologist in the area of protein for athletes, recommends 1.5-1.7 gm/kg body weight (Gatorade Sports Science [GSSI] Exchange, 1992). Endurance athletes in early conditioning (which includes strength training) have the same increased need for protein. In this group accretion of muscle occurs, though not to the same degree as in strength athletes. In addition, there is an increased synthesis of enzymes needed for glucose and fat utilization associated with endurance activities, and a loss of amino acids during exercise due to exercise-induced muscle damage (Lemon, 1995). Once at the "trained" or "conditioned" state, strength gains and muscle accretion, enzyme synthesis, and exercise-induced muscle damage all slow resulting in an abatement in protein requirement. At the trained state, a protein intake of 1.2-1.4 gm/kg body weight is recommended (GSSI Exchange, 1992; Lemon, 1995).

Although there is no difference in protein requirement between men and women athletes, there is the important issue of women athletes consuming enough protein. Protein requirements increase when caloric intake is low. If energy intake is less than expenditure, then the protein consumed will be used for energy instead of its preferred function of building and repairing body tissues. If both energy and protein intake are inadequate then the body will be in negative nitrogen balance and the body will draw on its protein stores for energy. The athlete can then lose muscle and strength. Inadequate caloric and protein intake is a concern for the women athletes who tend to exclude foods rather than substituting for them. For example, they remove animal products diets without substituting high-quality plant proteins in the diet. Athletes who try to lose weight or feel compelled to consume a very low calorie diet in order to maintain a very low body weight for their sport (e.g., ballet, ice skating, gymnastics, and distance running) are at greatest risk for inadequate protein intake (Ruud, 1996).

Since women need to focus on adequate carbohydrate and protein in the diet, they should restrict fat as much as possible. Many people today have become overly concerned with dietary fat. Some falsely believe that fat intake correlates with body fat. The American public is advised to limit fat to 25-30% of the diet (US Department of Agriculture & US Department of Health and Human Services, 1995). Athletes, because of their increased need for carbohydrate, find they may need to restrict their dietary fat intake more than the general public. This fat restriction, however, should not be taken to the extreme of 10% or less from fat. In addition to providing essential fatty acids and serving as a medium for the absorption of antioxidants (beta carotene and vitamin E), fat adds satiety to the diet. Severely limiting fat can increase hunger and thus cause one to either eat or search for food more frequently. To assure adequate satiation, nutrient absorption, and variety in food selection, athletes are advised to consume a 15-25% fat diet.

Women athletes should probably eat less fat then their male counterparts. Because women athletes have to eat the same amount of carbohydrate and protein as men, i.e., based on body weight, this leaves proportionately less fat allowed in the diet. If women athletes restrict their caloric intake, they must still include enough carbohydrate and protein to assure optimal training and performance. These women may need to restrict their fat intake even more than those women athletes who can eat ad libitum, i.e., not trying to control energy intake. In any case, diets should be 15-25 % fat. If they are lower than this recommendation, athletes should confer with a dietitian to assure that variety and balance are maintained in the diet.

Is it more important for women athletes to take vitamin/mineral supplements than it is for men? Standard reference for vitamin and mineral requirements is the Recommended Dietary Allowance (RDA). These values represent the amount recommended to avoid the risk of deficiency in 97.5% of a healthy population (National Research Council, 1989). This amount is not indicated as an optimal amount to consume to enhance health. A common misconception is that the RDA will promote health. This is not the case and should be considered when applying the RDA to athletes. Vitamins are organic compounds that are found naturally in small amounts in a variety of foods. For most physiological processes to occur, vitamins must be consumed in adequate quantities. Enzyme, hormone, and antioxidant functioning rely in part on adequate vitamin intake and stores. Deficiencies in any vitamin could affect physical performance. In a healthy population, vitamin deficiencies are rarely seen in the absence of an underlying disease or long-standing aberrant eating. The questions are, "If vitamin needs are increased with performance? Can performance can be enhanced by additional vitamin intake?"

In general, men with their larger mass require more vitamins than women. The only exception is folic acid (also called folacin and folate.) This vitamin is essential for normal neural tube development in the human fetus. Although the RDA for women is only 180 g per day, it is recommended for all women of childbearing age to consume at lest 400 g per day. Fortunately folic acid is widely distributed in foods - meat, orange juice, and green leafy vegetables. As of January 1998 all fortified grain foods (cereals, breads, pasta, flour, rice) that are labeled "enriched" are to be fortified with folic acid (Williams, 1994). The requirement for many B-vitamins is dependent upon energy or nutrient intake. A woman athlete who meets her added energy needs by eating a variety of unrefined, or whole foods, maximizes her B-vitamin intake (Ruud, 1996). Again, variety, balance and moderation are key. Vitamin C, like vitamin E and beta-carotene, is a powerful antioxidant. It is also essential for collagen formation and wound healing. Constant tissue damage and excessive generation of free radicals are associated with the intense training by athletes. Because of the critical role of vitamin C in repairing and controlling these processes, it is essential that athletes consume at least the RDA (60 mg) of vitamin C. Optimal intake can be assured by daily including brightly colored fruits and vegetables and their juices.

Based on athletics, men and women athletes do not differ in their vitamin requirements. Yet, studies of athletes indicate that some women undereat and/or selectively eliminate whole food categories (Deakin & Inge, 1994; Ruud, 1996). If women athletes choose to restrict energy intake to lose body weight, they must be especially careful to consume a variety of foods packed with vitamins. Under such conditions, optimal intake of vitamin E and folate may be impractical. Supplements, under the guidance of a dietitian, may be warranted.

Unlike vitamins, where generally men require more than women, women often need the same amount or more of minerals than do men. Calcium needs for women are the same as for men but yet women must eat fewer calories to maintain weight. Adequate iron intake can be even more difficult, as women require more iron than men, but with fewer calories allowed. In both cases, selecting a nutrient-dense diet is crucial for women. Studies of women athletes' diets have found low dietary intake of calcium, iron and zinc (Deakin & Inge, 1994; Ruud, 1996). Equally important to the amount of mineral consumed, is how well it is absorbed by the body, i.e., its bioavailability. Certain drugs and eating habits may inhibit or enhance mineral absorption. Calcium, iron, and zinc are significantly affected by one's eating habits.

Calcium, essential for bone development and maintenance, is also responsible for maintaining normal heartbeat, muscle contractions, enzyme activity, and blood clotting. Women gymnasts, runners, cyclists, swimmers, field athletes, dancers and bodybuilders have all been reported to have suboptimal intakes of calcium (Ruud, 1996). Dietary oxalate (as found in tea and spinach), high fiber intake and inadequate vitamin D intake, can decrease the absorption, of calcium (Arnaud & Sanchez, 1996). Very high caffeine or protein intake can also increase the excretion of calcium.

Iron is essential for transporting oxygen in the body. When blood levels are low, anemia results, yielding fatigue, weakness, shortness of breath, decreased ability to train, and poor performance. Like calcium, eating habits affect iron absorption. Meat, fish, poultry, and vitamin C enhance iron absorption. On the other hand, tea (tannins), high fiber, and oxalate (spinach) can inhibit iron absorption. Iron deficiency anemia is not only prevalent among women athletes, but also is one of the most common nutritional deficiencies in the U.S. and the world (Yip & Dallman, 1996). Women athletes who eliminate animal flesh from their diets should meet with a dietitian to assure both adequate intake and healthy eating habits to enhance iron absorption.

Zinc, like iron, is commonly found in animal products. It is an essential component of many enzymes involved in the metabolism of protein, carbohydrate, and fat. Zinc affects the activity of growth, thyroid and sex hormones. It is also crucial for proper immune function and helping the body fight off infections. The dietary zinc of bioavailability is enhanced by consuming meat and seafood, but is limited by excessive fiber intake (Cousins, 1996).

Will supplements improve performance of women athletes? Studies have shown that supplements result in improved performance only when an underlying deficiency of that vitamin is present. If no deficiency is noted, supplementation does not enhance performance (Williams, 1995).

Because women don't sweat as much as men, dehydration is not a problem for them. Adequate fluid ingestion during exercise enhances athletic performance, prevents a fall in plasma volume, stroke volume, cardiac output and skin blood flow, maintains serum sodium concentrations. Given the same level of fitness, men do dissipate heat faster and sooner than women. Men sweat at a lower body temperature than women, i.e., they have a lower thermo-regulatory set point, and because men have a greater muscle mass and a higher metabolic rate, sweat more than women (Noakes, 1993.) Unlike men, women's thermo-regulatory set-point varies with the menstrual cycle. In the luteal phase (ovulation to menses) there is an increase in the set point, producing greater heat retention and suppressed heat dissipation. So, women athletes may not sweat as much, thus not needing as much fluid, but they also, especially at the leuteal phase, find it more difficult to dissipate heat (Stephenson & Kolka, 1993). Fluid replacement is critical to both men and women athletes for optimal performance. Even following the recommended fluid regimen of 6 to 8 oz (180-240 ml) at 10 to 15 minute intervals. Only 60-70% of the amount consumed can be absorbed. If one does not rehydrate post workout, a dehydration cycle begins and training/performance can be compromised. Consuming sport drinks during workouts is recommended if the exercise bout is longer than 1 to 1° hours. The carbohydrate and salt in these solutions may enhance fluid absorptions. For workouts 1 hour or less, only water is necessary in most cases. (Gisolfi & Duchman, 1992; Williams, 1995)

Application of information

To most effectively apply these recommendations, it's best to provide real-life comparisons. Table 3 provides dietary recommendations for two athletes: same age, weight, sport, and level of fitness, different sex.

Table 3

Dietary Recommendations for a Man and a Woman Athlete

Name	Sport	Age	Ht.	Wt.	REE[a]	PAF[b]	TDE[c]	Carb[d]	Pro[e]
Henry	Swimming	20	5' 9"	130#	1583	2.1	3324	472g	95g
Lois	Swimming	20	5' 6"	130#	1356	2.1	2848	472g	95g

[a] Resting energy expenditure in calories, see Table 1 (weight of 130# is 59.1 kg)
[b] Physical activity factor, see Table 2
[c] Total daily expenditure in calories, see page 3
[d] At 8 gm/kg/day, midway between 7-10 gm/kg/day recommendation
[e] At 1.6 gm/kg/day, midway between recommend 1.5-1.7 gm/kg/day during conditioning

By these recommendations, Henry's diet will be 57% carbohydrate, 11% protein and 32% fat. The fat intake exceeds the recommended 25-30% for all Americans and the 15-25% for athletes. To lower his fat intake, Henry should eat more carbohydrate than 8 gm/kg/day. But he must to be careful to include low-to-moderate fat protein foods so that he will meet his protein need. Lois's diet will be 66% carbohydrate and 13% protein. This will leave 21% calories from fat, right where it should be. Once conditioning season is over the recommended protein intake for Henry and Lois will drop from 95 to 77 gm/day - omitting the equivalent of 2 ounces of meat plus one slice of bread. However, their energy need will also drop, as they are not training as long or as intensely. Essentially, they can maintain the same eating habits as at conditioning, only consume smaller portions.

Below is a day's intake to meet the needs of Henry and Lois. Difference in foods selected or portion sizes are noted in *italics*. Of note, these foods represent those typical for this age group, not necessarily the best choices.

Except for a few items, Lois could eat most of the same foods as Henry. She needs more nutrient dense (more nutrients for the calories) food selections for calcium and carbohydrate than Henry. He, on the other hand can eat more calories. Lois easily met her increased iron and folic acid re-

Daily Intake to Meet Nutritional Recommendations

HENRY

Breakfast

- *2 c* orange juice
- *1° c* raisin bran cereal
- *2 c* 1% milk

Lunch

- 6" sub- club sandwich
- 12 oz. cola
- 1 banana

LOIS

Breakfast

- *1 c* orange juice
- *1 c* raisin bran cereal
- *1 c* 1% milk

Lunch

- 6" sub- club sandwich
- 12 oz. cola
- 1 banana

41

Dietary Intake to Meet Nutritional Recommendations

Dinner

2 c cooked spaghetti
∫ c (6 oz) spaghetti sauce
3 oz ground turkey
1 oz (2 TB) Parmesan cheese
Tossed salad w/ ranch dressing (1 TB)
2 c 1% milk
1 large apple

Snack

1 small microwave cheese pizza
12 oz orange soda
2 oz (4 small) chocolate chip cookies

Dinner

2 c cooked spaghetti
∫ c (6 oz) spaghetti sauce
1° oz ground turkey
1 oz (2 TB) Parmesan cheese
Tossed salad w/ ranch dressing (1 TB)
1° c 1% milk
1 large apple

Snack

1 bagel with 1 oz. low-fat cheese
12 oz orange soda
1 oz (2 small) chocolate chip cookies

Table 4

Nutrient Analyses for a Man and a Woman Athlete's Diet[a]

	Henry's Intake			Lois's Intake		
Nutrient	*Consumed*	*Goal*	*% goal*	*Consumed*	*Goal*	*% goal*
Calories	3317	3324	100%	2894	2848	102%
Carbohydrate (gm)	523	472	111	464	472	98
Protein (gm)	148	95	156	129	95	136
Fat (gm)[b]	81	<92	88	66	<79	84
Fiber (gm)	28	25-35	100	23	25-35	*92*
Cholesterol (mg)	225	<300	75	187	<300	62
vitamin C (mg)	300	60	500	198	60	330
Calcium (mg)[c]	1680	1500	112	1486	1500	99
Iron (mg)	25	10	250	22	15	220
Zinc (mg)	19	15	127	13	12	108
Folic acid (g)	670	200	335	459	400	115
Sodium (mg)	5916	2400	247	5698	2400	237
Potassium (mg)	5231	3500	150	4263	3500	122

[a] Nutritionist IV, 1994

[b] Goal is represented by < 25% total calories from fat. The % goal attained is for *actual* intake compared to 25% of the calories consumed being from fat, not 25% of the *ideal* intake.

[c] NIH, 1994

42

quirements without having to rely on supplements. Table 4 presents how Henry and Lois fared in their intake of nutrients discussed in this paper.

The reported foods may not be the healthiest, but they do represent those selected by this age group, i.e., easy to pick up or easy to make. Lois and Henry were successful in controlling fat, but like many who do not prepare most of their meals, their intake was high in sodium and low in fiber. One food significantly contributed to these results - the sub! This sandwich was the largest contributor of calories (693 - a lot for Lois!), fat (22 gm), protein (46 gm), and sodium (2717 mg.), yet it contained only 5 grams fiber! Something as simple as fixing a turkey (2 oz) and cheese (1 oz -low fat) sandwich on whole wheat bread (2 large slices) with low-fat mayonnaise (1 tsp) would not only save 325 calories, 11 gm fat, 20 gm protein and 1157 mg sodium, but also add 3 gm fiber. In addition, it would not add much time to a busy schedule. Lois especially would find making a sandwich to her advantage, since she must be very careful to include enough carbohydrate in her diet.

Conclusions

Athletics adds to the importance for women to eat an adequate diet. All athletes must consume enough calories, carbohydrate, and protein for optimum conditioning and performance, and the avoidance of injury. Women athletes need fewer calories but, based on body weight, need the same amount of carbohydrate as men athletes. Thus, it can be a struggle for these women to eat a carbohydrate-rich diet, all the while meeting every woman's increased need for calcium, iron, zinc, and folate. Athletes can have hectic schedules and frequently make food choices based on convenience. Women athletes must carefully evaluate their food selections for not only fat content, but also for carbohydrate, calcium, folate and sodium. Preparing their meals rather than relying on carry-out, fast foods, and home delivery, needs to be more of a priority for women than for men athletes.

References

Arnaud, C. D. & Sanchez, S.D. (1996). Calcium and phosphorous. In Ziegler E.E. & Filer L.J. (Eds.) *Present Knowledge in Nutrition, 7th edition,* 245-255. Washington, D.C.: International Life Sciences Institute.

Bennet, W.G, & Cerda. J.J. (1996). Benefits of dietary fiber. *Postgraduate Medicine, 99(2)*, 153-159.

Cousins, R.J. (1996). Zinc. In Ziegler E.E. & Filer L.J. (Eds.) *Present Knowledge in Nutrition, 7th edition,* 293-306. Washington, D.C.: International Life Sciences Institute

Danforth E. (1985). Diet and obesity. *American Journal of Clinical Nutrition, 41*, 1132-45.

Deakin V. (1994). Assessment of nutritional status of athletes. In Burke L. & Deakin V. (Eds.) *Clinical Sports Nutrition*, 38-73. Sydney, Australia: McGraw-Hill Book Company.

Deakin V. & Inge, K. (1994). Training nutrition. In Burke L. & Deakin V. (Eds.) *Clinical Sports Nutrition*, 16-37. Sydney, Australia: McGraw-Hill Book Company.

Gatorade Sports Science (GSSI) Exchange.(1992). Roundtable: Protein needs of the active person. *Gatorade Sports Science Institute, Chicago, IL. 8(2 Summer).*

Gisolfi, C. & Duchman, S. (1992). Guidelines for optimal replacement beverages for different athletic events. *Medicine and Science in Sports and Exercise,* 24, 679-687.

Lemon, P.W.R. (1995). Do athletes need more dietary protein and amino acids? *International Journal of Sport Nutrition, 5, S39*-61.

National Research Council. (1989). *Recommended Dietary Allowances.* Washington, DC: National Academy Press.

NIH Consensus Development Panel on Optimal Calcium Intake (1994). Optimum calcium intake. *Journal of the American College of Nutrition, 15*, 21.

Noakes, T.D. (1993). Fluid replacement during exercise. In Holloszy, J.O. (Ed). *Exercise and Sport Sciences Reviews, vol 23*, 297-330. Baltimore, MD: Williams & Wilkins.

Nutritionist IV Diet Analysis (1994). San Bruno, CA:First DataBank Division, The Hearst Corporation.

Ruud, J.S. (1996) *Nutrition and the Female Athlete.* Boca Raton, FL: CRC Press.

Schofield, W.N., Schofield C. & James W.P.T. (1985). Basal metabolic rate - review and prediction, together with an annotated bibliography of source material. *Human Nutrition Applied Nutrition , 39(C) Supp,*1-96.

Sherman W.M. & Wimer G. (1991). Insufficient dietary carbohydrate during exercise: Does it impair athletic performance? *International Journal of Sports Nutrition, 1*, 29-44.

Stephenson, L.A. & Kolka, M.A. T.D. (1993). Thermoregulation in women. In Holloszy, J.O. (Ed). *Exercise and Sport Sciences Reviews, vol 23*, 231-262. Baltimore, MD: Williams & Wilkins.

U.S. Department of Agriculture & U.S. Department of Health and Human Services. (1995). *The Dietary Guidelines for Americans.* Washington D.C.

Warwick, P.M. (1989). Predicting food energy requirements from estimates of energy expenditure. *Australian Journal of Nutrition and Dietetics, 46 (S),* 3-29.

Williams, M.H. (1995). *Nutrition for Fitness and Sport.* Dubuque, IA: Brown & Benchmark.

Williams, R.D. (1994). FDA proposes folic acid fortification. *FDA Consumer, May,* 11-14.

Yip, R. & Dallman, P.R. (1996). Iron. In Ziegler E.E. & Filer L.J. (Eds.) *Present Knowledge in Nutrition, 7th edition,* 277-292. Washington, D.C.: International Life Sciences Institute.

Do Athletes Need Antioxidant Supplements?

Susan Massad, H.S.D., R.D.

Abstract

Recent discussion in the sports medicine profession has focused on increased antioxidant needs of physically active individuals to offset exercise-induced lipid peroxidation. Though nutritional antioxidants may detoxify potentially damaging free radicals generated during and after exercise, findings regarding increased requirements are equivocal. This study was undertaken to determine if significant differences in beta carotene, vitamin C, and vitamin E existed between active and non-active college students (n=290; mean age = 22.1 +/- 4.0). All subjects kept a detailed 3 day food record which was analyzed using Diet Analysis Plus, version 2 (ESHA Research, 1995). The mean percent RDA (M) for beta carotene for the active group was 190.09 +/- 139.37. For the inactive group, M for beta carotene was 116.60 +/- 92.03. For vitamin C, M for the active group was 311.76 +/- 234.58. For the inactive group, M for vitamin C was 249.97 +/- 150.58. The M for vitamin E for the active group was 120.69 +/- 98.01. For the inactive group, M for vitamin E was 66.57 +/- 48.86. Levene's test for unequal variances revealed significant differences in beta carotene and vitamin E intakes ($p < 0.01$), and in vitamin C intake ($p < 0.05$). Dietary analyses of the subjects in this study show no compelling reason to recommend supplements. Risks associated with megadosing of these nutrients need to be stressed. More research needs to be conducted in this area to determine if athletes do need antioxidant nutrients in amounts which exceed the current RDA. Subsequent investigations may aim at examining the extent to which athletes and non-athletes rely on supplements to meet their nutritional needs.

Do Athletes Need Antioxidant Supplements?

Much discussion has been generated within the sports medicine profession recently, regarding the increased use of antioxidant nutrients amongst physically active individuals. The most well researched antioxidants are ascorbic acid (vitamin C), alpha tocopherol (vitamin E), and beta carotene (the precursor to vitamin A). Ascorbic acid is found mainly in citrus fruits and citrus juices, strawberries, red and green peppers, potatoes, tomatoes, and broccoli. Alpha tocopherol is found in vegetable oils, nuts, wheat germ, and leafy green vegetables. Beta carotene is found in deep-yellow vegetables (sweet potatoes, yams, butternut squash, carrots), dark-green leafy vegetables, peaches and cantaloupe. Investigators often examine whether or not the Recommended Dietary Allowances (RDAs) for various nutrients, such as the antioxidants, are sufficient for certain groups. Set by the National Academy of Sciences-National Research Council, the RDAs are designated to meet the needs of 97.5 percent of healthy Americans. They are statistical constructs set at two standard deviations above the mean requirements. They were not intended to assess nutrient needs for conditions such as major illness, recovery, or excessive exercise.

Primary interest in antioxidant nutrients stems from their role in neutralizing the damaging effects of highly reactive molecules known as *free radicals,* which combine with fat molecules in the cell membranes, causing cell wall damage. Free radicals are chemicals with an unpaired electron. Oxidative and free radical damage to cells are associated with initiating cancer, heart disease, compromised immunity, and premature aging.

The antioxidant components in human plasma include enzymes known as superoxide dismutase and glutathione peroxidase (Hunt & Groff, 1995). Oxidants which occur in the environment, such as air pollution and cigarette smoke, attack the cell membrane lipids (fats), causing oxidation. One of the first compounds to become oxidized is vitamin C. When vitamin C is depleted, other plasma components become depleted. Oxidative stress affects certain plasma lipid particles such as the low density lipoproteins (LDL). The proteins and lipids in these compounds are good targets for oxidation. Oxidized forms of LDL are implicated in the formation of fatty lesions which lead to atherosclerosis or hardening of the arteries. Nutritional antioxidants may detoxify potentially damaging free radicals generated during and after physical exercise.

Use of nutrients as ergogenic aids for athletes remains controversial. Recommendations of most scientific authorities sharply contrast with the habits of most athletes and coaches who experiment with supplements to enhance performance (Shils, Olson, & Shike, 1994). Though exercise may increase the need for some nutrients, findings of most scientific studies show that increased needs can be met through a balanced diet. Even certain deficiencies which are more common in specific groups of athletes (e.g., iron deficiency anemia in long-distance runners), can be corrected by proper diet.

Experimental data suggesting that antioxidant supplements can provide protective effects for active people are slightly contradictory. A key question is whether or not active people would benefit from taking antioxidant supplements in amounts greater than RDA. Nutrient deficiencies in humans consuming sufficient energy to support daily activities are uncommon. Data regarding effects of supplementation in well-nourished people are equivocal (Kanter, 1994). Some studies indicate antioxidant nutrient supplementation can decrease blood & tissue markers, indicative of oxidative stress and skeletal muscle damage. Other studies fail to show any effect of supplementation.

Since a primary concern is lipid peroxidation, which has been used as a marker of oxidative stress, lipid breakdown products, such as serum or urinary *molondialdehyde* (MDA), and *expired pentane* have been used as estimates of peroxidative damage in clinical studies (Helgheim, Hetland, & Nilsson, 1979; Maxwell, Jakeman, & Thamason, 1993). Kanter, Nolte, and Holloszy (1993) studied the effects of a multiple antioxidant supplement on exercise-induced lipid peroxidation in 20 young males over a six week period. The antioxidant supplementation did not prevent the exercise-induced increase in lipid peroxidation, reflected by the rate of pentane production or increased serum MDA production. However, antioxidant supplementation did result in significantly lower resting post-exercise levels of expired pentane and serum. The researchers concluded that the amounts of antioxidants taken by the subjects did lower markers of lipid peroxidation, but did not lessen exercise-induced oxidative stress.

Witt, Reznick, Viguie, Stark-Reed, and Packer (1993) studied the effects of multiple antioxidant supplements on moderately trained cyclists and found no difference in oxidative stress-induced muscle damage between the supplement takers and the control group. Earlier research (Gey, Cooper, & Bottenberg, 1970) on the influence of 1000 mg day of vitamin C during military training found no difference in either endurance or rate in severity of injury, between experimental and control groups.

Other studies have focused on solely vitamin E. One group found no effect of a 6 week vitamin E supplement following exercise in both trained and untrained subjects (Helgheim et al. 1979). Vitamin E supplementation (270-400 tocopherol equivalents/day) on pre and post exercise serum indices of lipid peroxidation and expired pentane showed minimal or no effect in subsequent studies (Maxwell et al. 1993; Tidus & Houston, 1995).

Mode of exercise often differs from study to study. It may be that antioxidants may benefit a certain type of activity, such as longer-duration, moderate intensity. Also, there is a lack of uniformity in the types and doses of supplements given. Most literature regarding supplementation indicates that prudent dosing is relatively harmless. It is important to note that mega-dosing, or taking supplements in excess of 5 times the RDA, can be hazardous, particularly if the nutrients are fat soluble, such as vitamins A, D, E, and K (Hunt & Groff, 1995; Shils et al., 1994). Vitamin E toxicity is relatively uncommon, but high doses may augment the effects of anticlotting medications and increase vitamin K requirements, since vitamin K is involved in clotting. Beta carotene is not toxic, but its precursor, vitamin A is toxic in high doses. Symptoms include red blood cell breakage, growth retardation, abdominal cramps, blurred vision, skin rashes, hair loss, and liver and spleen enlargement (Hunt & Groff, 1995). Vitamin C, a water soluble vitamin, is generally less toxic since it is not stored in the body for long periods. However, supplemental doses which exceed 1000 milligrams a day (15 times the RDA) can cause abdominal cramps, diarrhea, and kidney stones. If the vitamin C is not buffered, large doses can damage the tooth enamel, due to the high acidity of this vitamin.

Another important consideration is dietary intake of antioxidants. Few studies assess the existing nutritional intakes of subjects; instead they focus on effects of supplementation. Different methods can be used in collecting dietary intake data. A common method of assessing nutrient adequacy is through dietary recall. This method relies on accurate recollection of subjects, and usually only includes a few days, which may not be truly representative of typical intake. The dietary recall method involves the interviewer asking the subject to record all foods and beverages, and their amounts, consumed over a certain time period, usually ranging from 1 to 7 days. Since memories of intake may fade beyond the most recent day or two (Lee & Neiman, 1993), loss in accuracy may occur. In population studies, 24 hour recalls and diet records will accurately assess mean intakes but they are less useful when the purpose of the assessment is to evaluate individual disease risks. (Feskanich & Willett, 1993).

Methods

This study was undertaken to determine if significant differences in selected antioxidant nutrients existed between active and non-active individuals. The study sample included 290 college students between the ages of 18 and 35 (mean age = 22.1 +/- 4.0). Subjects were divided into 2 categories: active and non-active. Individuals who reported regular aerobic-type exercise for a minimum of 30 minutes duration 3 times per week were classified as active. Those who reported exercising twice per week or less were classified as non-active.

All subjects were asked to keep a 3 day food record on 2 weekdays and one weekend day, during a time period in which they felt they consumed their most typical diet. Subjects were given instructions on food-record keeping, and were shown how to estimate portion sizes by examining food models. All diets were analyzed by computer using *Diet Analysis Plus, Version 2* (ESHA Research, 1995). A three day period, as opposed to a longer period was chosen because memories of food intakes tend to fade beyond the most recent few days, and loss in accuracy may exceed gain in representatives. Also, the act of recording food intake after several days may cause the respondent to change his or her usual diet; after recording intakes beyond a few days, participants tend to simplify their intakes to streamline the recording process (Lee & Neimen, 1993).

The antioxidant nutrients which were available for analysis using the selected software included beta carotene, vitamin E, and vitamin C. Independent samples T-tests were computed to compare differences in calories and intakes of the antioxidant vitamins between active and non-active individuals. A Levene's test for equality of variances was computed with each T-test. All statistics were computed using the Statistical Package for the Social Sciences (SPSS Inc., 1995).

Results

The mean daily caloric intake in the active group (n=220) was 2420; for the inactive group (n=70), mean caloric intake was 2321. The difference was not statistically significant. The mean percent RDA (M) for beta carotene for the active group was 190.09, with a standard deviation (s.d.) of 139.37. For the inactive group, M for beta carotene was 116.60; s.d. was 92.03. Levene's test for unequal variances revealed a significant difference in beta carotene intakes ($p < 0.01$). The M for vitamin E for the active group was 120.69; s.d. was 98.01. For the inactive group, M for vitamin E was 66.57; s.d. was 48.86. Levene's test for unequal variances revealed a significant difference in vitamin E intakes ($p < 0.01$). For vitamin C, M for the active group was 311.76; s.d. was 234.58. For the inactive group, M for vitamin C was 249.97; s.d. was 150.58. Levene's test for unequal variances revealed a significant difference ($p < 0.05$). A summary of results is presented in Table 1.

Discussion

For the active subjects, the mean percent RDA for beta carotene, vitamin C, and vitamin E exceeded 100. The mean percent RDA for beta carotene and vitamin C for the inactive group exceeded 100. The inactive group's mean vitamin E intake was approximately 67%, which still meets the "margin of safety" since the RDAs are set at two standard deviations above the mean requirements. Based on this sample, this group of individuals is meeting and exceeding their RDAs for most antioxidant nutrients, hence, supplementation would not be recommended.

Health risks associated with over-consumption of fat soluble nutrients need to be stressed. As a rule of thumb, it is inadvisable to take fat-soluble vitamins in excess of 5 to 10 times the RDA. Many athletes who use supplements are unaware of the side effects associated with their use. A study of high school athletes (n=509) found that the most common reasons for using vitamins A and E were for improvement of the health of the skin, while many reported using vitamin C for "energy" and to boost the immune system. Greater knowledge about supplements, however, was associated with less use (Massad, Shier, Koceja, & Ellis, 1995).

The RDA for vitamin A in retinol equivalents (RE) is 1000 for adult males and 800 for adult females. Acute hypervitaminosis A can be induced by single doses of retinol in excess of 66,000 RE in adults. Symptoms include nausea, vomiting, fatigue, weakness, headache, and anorexia. Chronic hypervitaminosis A usually reflected in misuse of supplements can follow the repeated intake of vitamin A in amounts

Table 1

Antioxidant Nutrient Intakes Comparing Active and Inactive Subjects

Variable	Number of cases	Mean	SD	Standard Error of mean	P
Vitamin A					
Active	220	190.09	139.37	9.39	
Inactive	70	116.60	92.03	11.00	<0.01*
Vitamin E					
Active	220	120.69	98.01	6.60	
Inactive	70	66.57	48.86	5.84	<0.01*
Vitamin C					
Active	220	311.76	234.58	15.81	
Inactive	70	249.97	150.85	17.98	<0.05*

* Statistically significant

greater than or equal to 10 times the RDA. If serum vitamin A is 25 to 660 RE per 100 milliters of serum, symptoms include hair loss, hepatomegaly, bone pain & fragility, dry fissured skin, cheilosis, ascites and portal hypertension, and brittle nails (Shils et al. 1994).

The RDA for vitamin E in alpha-tocopherol equivalents (TE) for adult males is 10; for adult females it is 8. Unlike other fat-soluble vitamins, the risk of toxicity from vitamin E is relatively low, even at high doses. However, some caution is still in order. Some patients on coumadin (anticoagulant) therapy and 1200 IU (805 TE) of vitamin E per day had bleeding until vitamin E supplementation stopped. (Olesen, 1994).

Supplemental vitamin C is associated with fewer side effects. The RDA for vitamin C is 60 milligrams a day for both adult males and females. It is the most commonly used supplement in the U.S.A. It is taken by 8% of young people & 44% of elderly people (Johnson & Luo, 1994). A survey of 509 high school students (Massad et al. 1995) found that close to 30% reported weekly to daily use of supplemental vitamin C. The usual symptom of excessive doses is diarrhea from the osmotic effect of unabsorbed vitamin C passing through the gastrointestinal tract. Excess vitamin C excreted in the urine can give a false positive test for blood sugar elevation, since the chemical structure of ascorbic acid is similar to that of glucose. "Rebound scurvy" is another risk associated with excessive doses of vitamin C, since the high circulating levels cause excess excretion of it in the urine. When abruptly stopped, the vitamin C output remains constant for a period, which may result in symptoms of scurvy. Also, excess can cause retention of iron stores especially in African Americans who are sensitive to iron (Mahan & Escott-Stump, 1996).

One revelation of the November 1993 Food and Drug Administration (FDA)-sponsored conference on antioxidants and vitamins was that antioxidants combat free radicals in physiological amounts in food, but may even act as pro-oxidants in some cases (FDA, 1994). It is clear that more research needs to be done in this area to determine if antioxidant supplements really are needed by very active individuals. It seems prudent to recommend a one-a-day type multiple antioxidant supplement, which provides RDA doses of these nutrients, especially since the 1990s lifestyle seems to preclude taking time to ensure a variety of vegetables, fruits, seeds, and grains which provide significant amounts of antioxidants.

Conclusion

Within the limitations of this study, the conclusion that athletes do not need to take supplemental doses of antioxidants is warranted, since intakes are already well over the RDA. Financial constraints precluded recruiting a larger sample size, hence, findings are generalizable only to this group. It appears that a well-balanced, varied diet with adequate amounts of nutrients, in conjunction with the higher calorie intakes of most athletes, should suffice. Coaches and nutritionists should emphasize ways to incorporate food sources of the antioxidants into an active lifestyle. Individuals who are on-the-run a lot and take little time to prepare meals can still meet their vitamin C needs from citrus fruits and citrus juices. Convenient sources of vitamin E are vegetable oils often used in salad dressings, nuts, and seeds. Beta carotene is easily obtained from deep yellow and dark green leafy vegetables, dried apricots, peaches, and cantaloupe.

More research needs to be conducted in this area to determine if athletes do need antioxidant nutrients in amo unts which exceed the current RDA. These findings may prompt other investigators to conduct subsequent studies looking at a broader sample of individuals from a greater age range. Researchers may also want to look at the use of supplements, and to what extent athletes and non-athletes rely on them to meet their nutritional needs. Dietary analyses of the subjects included in this study show no compelling reason to recommend supplements.

Special thanks to Eta Sigma Gamman Ailis Brosnan, M.S. for her assistance with data collection for this project.

References

ESHA Research. (1995). Diet Analysis Plus, Version 2: Salem, Oregon.

Feskanich, W.C. & Willett, W.C. (1993). The use and validity of food frequency questionnaires in epidemiological research and clinical practice. *Medicine, Exercise, Nutrition, and Health, 2*, 143- 154.

Food and Drug Administration. (1994). Caution on the use of antioxidants. *Nutrition Today, 29*(2), 4.

Gey, G.O., Cooper, K.H., & Bottenberg, R.A. (1970). Effect of ascorbic acid on endurance performance and athletic injury. *Journal of the American Medical As sociation, 211*, 155.

Helgheim, I., Hetland, O., & Nilsson, S. (1979). The effects of vitamin E on serum enzymes levels following exercise. *Applied Physiology, 40*, 283-289.

Hunt, S.M., & Groff, J.L. (1995). *Advanced nutrition and human metabolism*, St. Paul: West Publishing Company.

Johnson, C. & Luo B, (1994). Comparison of the absorp tion and excretion of three commercially available sources of vitamin C. *Journal of the American Dietetic Association, 94*, 779.

Kanter, M.M. (1994). Free radicals, exercise, and antioxi dant supplementation. *International Journal of Sport Nutrition, 4*, 205-220.

Kanter, M.M., Nolte, L.A., & Holloszy (1993). Effects of an antioxidant vitamin mixture on lipid peroxidation at rest and postexercise. *Journal of Applied Physiol-*

ogy, 74, 965-969.

Lee, R.D. & Neiman D.C. (1993). *Nutrition Assessment*, St. Louis, Mosby.

Mahan, L.K. & Escott-Stump, S. (1996). *Food, Nutrition, and Diet Therapy*, 9th edition. Philadelphia: W.B. Saunders.

Massad, S.J., Shier, N., Koceja, D.M, & Ellis, N.T. (1995). High school athletes and nutritional supplements: A study of knowledge and use. *International Journal of Sport Nutrition, 5*(3), 232-245.

Maxwell, S.R.J., Jakeman, P., & Thamason, H. (1993). Changes in plasma antioxidant status during eccentric exercise and the effect of vitamin supplementation. *Free Radical Research, 19*, 191-201.

Olesen, P. (1994). Oral vitamin E for refractory hand dermatitis. *Lancet, 343*, 672.

Shils, M.E., Olson, J.A., & Shike, M. (1994). *Modern nutrition in health and disease*, 8th edition. Philadelphia: Leas and Febiger.

Statistical Package for the Social Sciences (SPSS), version 10. (1995), SPSS, Inc., Chicago Illinois.

Tidus, P.M. & Houston, M.E. (1995), Vitamin E status in response to exercise training. *Sports Medicine, 20*(1), 12-23.

Witt, E.H., Reznick, C.A., Viguie, P., Stark-Reed & Packer, L. (1993). Exercise, oxidative damage and effects of antioxidant manipulation. *Journal of Nutrition, 122*, 766-773.

School Cafeteria: A Culture for Promoting Child Nutrition Education

Kweethai Chin Neill, Ph.D., CHES,
Thomas E. Dinero, Ph.D., Diane Demuth Allensworth, Ph.D., RN, CHES

Abstract

Children's eating behavior is influenced by personal characteristics and environmental factors in the home, school, and the community (Bandura, 1965; Gillespie, 1981, Wolford & Allensworth , 1988). Children are subject to formal nutrition instruction in the classroom as well as by the culture in the school cafeteria. Culture is made up of subjective and objective components (Triandis, 1972). The purpose of this study was to propose an empirical description of objective school cafeteria culture. Data from the Ohio School Food Service Study (Neill & Olds, 1994) were analyzed to compile a statistical profile of cafeteria culture. The survey consisted of 61 items on school food service characteristics. The survey was sent to a proportionate random sample of school food service managers in Ohio. A response rate of 58.2 % resulted (N=177). Fourteen dependent variables of cafeteria culture were identified and tested against delivery systems and age-level. Six MANOVA's and post hoc analyses were employed to generate the profiles. Statistical differences were found on specific variables indicating unique profiles of cafeteria cultures by system and age. This study provides a "springboard" for program planning and further research in support of the environmental and contextual factors that promote child nutrition behavior.

The positive relationship between good nutrition, health, and learning has been well established, (US Deparmtent of Health and Human Services [USDHHS], 1990) Since children spend a third of their day in school, it is important to pay attention to what eating habits they learn that influence their present and future health. Since The National School Lunch Act (1946) and the Nutrition Education and Training (NET) Program (School Nutrition Act, 1977), school lunch programs have been considered an integral part of nutrition education. The cafeteria is viewed as a laboratory for learning and practicing good eating habits. Currently only about half the nation's 48 million public school children participate in the National School Lunch Program (NSLP) (Burghart & Devaney, 1993). Since school lunches delivered 38% or more of total calories from fat (Burghart & Devaney, 1993; Neill & Olds, 1994), in 1996 all NSLPs were mandated to offer meals to children that met Dietary Guidelines (specifically 30% or less of total fat calories). The American School Food Service Association (ASFSA) and the National School Food Management Institute (NSFMI) issued the Nutrition Integrity Standard (NIS) to assure that meals adhered to the Dietary Guidelines (White, Sneed & Martin, 1992).

Children's eating behavior is influenced by personal characteristics and environmental factors in the home, school, and the community (Bandura, 1965; Gillespie, 1981). Children's food habits are influenced by the objective and the subjective culture of their behavior settings (Klepp, Wilhemsen, & Andrews, 1991). School food service is one of the eight key components of the Comprehensive Health Education Program (Allensworth & Kolbe, 1987), therefore an understanding of the behavior setting (cafeteria culture) may help one learn and practice good eating habits.

Triandis (1972) defined culture as subjective (norms, attitudes, values learned from family and peers) and objective (people's artifacts and other tangible effects). Cushner and Trifonovitch (1989) emphasized that the understanding of culture helps one learn. The idea of governance (Acterberg and Clark (1992) encompassed all of the environmental and social issues that influence nutrition learning and dietary behavior. They included food accessibility, food availability, and changes in physical, social, emotional, socioeconomic, political, and historical characteristics. Governance parallels Triandis' (1972) idea of objective culture.

Neill & Olds proposed the following model using ideas listed above. The model identifies 14 variables in an intiative to decribe school cafeteria culture. While not exhaustive, these variables are identified to "springboard" an empirical profile.

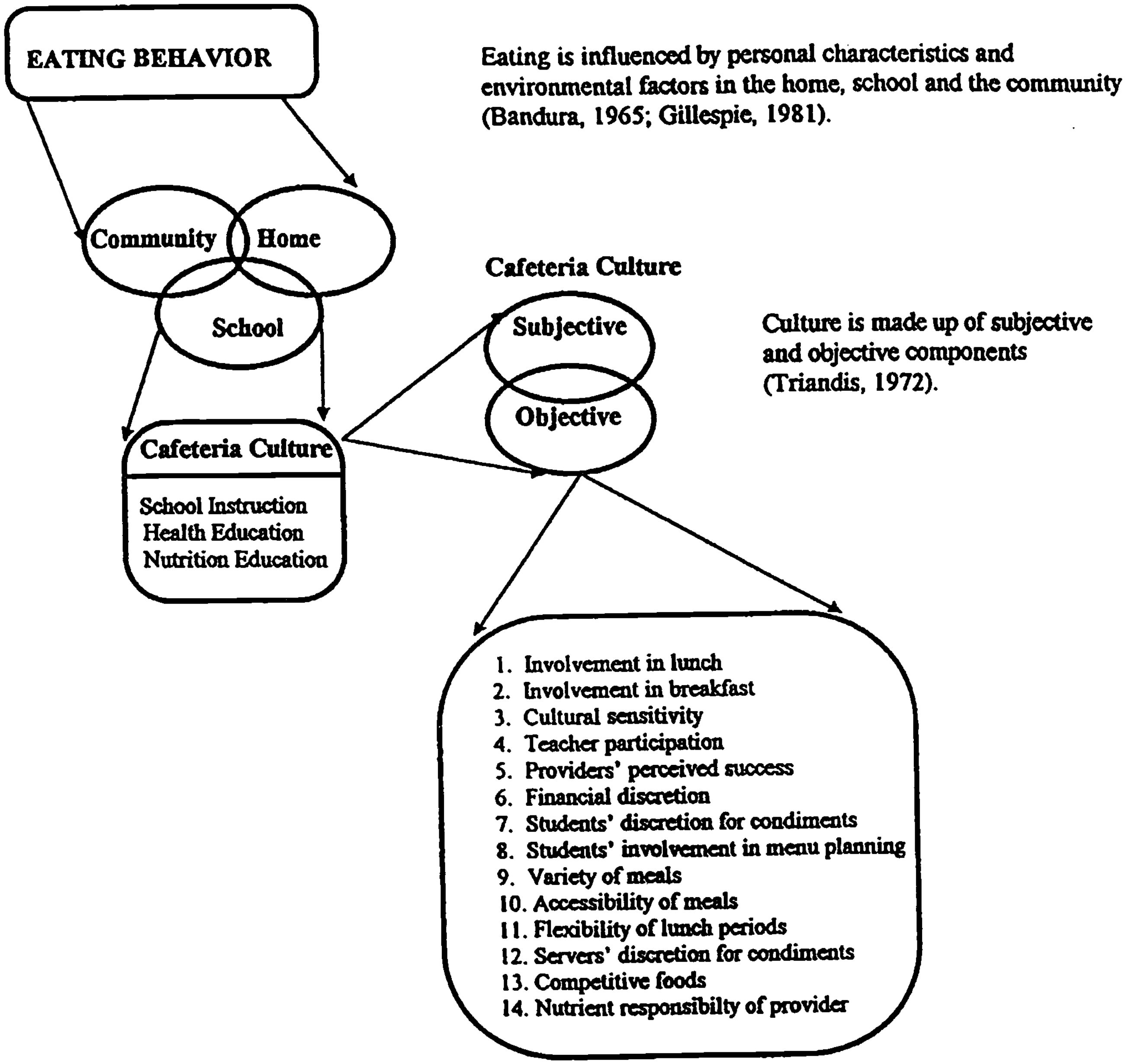
Method

Sampling

A proportionate stratified random sample was drawn from Ohio public schools stratified by food service delivery systems. The inventory of schools by delivery systems was devised in the Ohio School Food Service Study (OSFSS) (Neill & Olds, 1994). Stratifying schools by delivery systems was based on Neill's and Old's notion that if one were to change cafeteria environment it would make sense to change the delivery system. Ohio public schools were stratified by the type of school food service delivery systems: onsite, prepak satellite, and bulk satellite. Onsite schools were cafeterias where meals were prepared in the kitchen and served in the same building. Prepak satellite schools were cafeterias which received meals that were prepared, individually packed, sealed, refrigerated and or frozen in a

Figure 1

Model for School Cafeteria Culture



central kitchen that may or may not be in the same building. These prepacked meals were then reheated and served at the cafeterias. Bulk satellite schools received ready to serve meals that were pre- pared in a remote central kitchen. A proportionate random sample of 275 was computed to produce a statistical power of 0.6.

Survey Instruments

In the OSFSS, two instruments, SURVEY I and SURVEY II, were adapted from the School Nutrition and Dietary Assessment Study (SNDA) (Burghart &Devaney, 1993). SURVEY II contained 61 items (Section A : 31 items on characteristics of school food service; Section B: 10 items on meal quality self-assessment; Section C: 20 items on factors that promote or hinder successful food service operation). Items in SURVEY II were selected to operationalize the Objective Cafeteria Culture Components. Specifically cafeteria culture was identified as : I) Non Food Characteristics II) Student Characteristics and III) Food Characteristics (See Table 1). Content validity was established by a methodologist, a nutritionist, and a school food service professional. Arbitrary maximum values were assigned to the variables and scores were established as a percentage of maximum attainable to compute the profile.

Procedure

An initial mailing for permission to participate was sent to superintendents of 450 proportionate randomly selected schools. Two hundred ninety nine schools consented to participate. The surveys were mailed to 299 school food service managers/directors. Participants were promised a Food Guide Pyramid-apron if complete data were returned by the deadline. One hundred and seventy seven completed surveys were returned yielding a response rate of 58.2 percent.

Research Questions and Variables

Since food preparation and service depend on delivery systems (the first dependent variable), the question was asked, "Were there any differences among the three types of food service delivery systems on school cafeteria culture as defined by the 14 dependent variables?" It is important that school cafeterias be structured so that they are age-sensitive. For example it would not be feasible to put kindergarten and first grade students through a salad bar line where they would not be able to make so many decisions in a short time, nor would one expect elementary students to have open lunch sessions if they had to go distances away from school unsu-

Table 1

Dependent Variables: Objective Components of School Cafeteria Culture

NON-FOOD
1) Involvement in lunch program[1]
2) Involvement in breakfast program[2]
3) Cultural sensitivity of menus[3]
4) Teacher participation[4]
5) Perceived Success by provider[5]

STUDENT
6) Financial discretion of students[6]
7) Students' discretion for condiments[7]
8) Students' involvement in menu planning[8]

FOOD
9) Variety of meals[9]
10) Accessibility of lunches[10]
11) Flexibility of lunches[11]
12) Servers' discretion for condiments[12]
13) Competitive foods[13]
14) Nutrient responsibility of provider[14]

[1]*Do cafeterias participate in the NSLP?*
[2]*Do cafeterias participate in the SBP?*
[3]*Do providers serve ethnically specific meals on special holidays?*
[4]*Do teachers buy lunches from the cafeterias?*
[5]*How do providers perceive success in making profits, providing appropriate nutrition and involving student participation?*
[6]*How much more money beyond the price of lunch will students spend at the cafeteria?*
[7]*Can students add condiments to their food before they eat?*
[8]*Are students par t of the menu planning process?*
[9]*What proportion of luch sales are from the a la carte sales?*
[10]*How many serving lines are available at the cafeteria?*
[11]*Are lunch periods open or closed?*
[12]*Do servers add condiments to meals before serving?*
[13]*Open vending before or during lunch?*
[14]*Do providers engage in food preparation procedures to ensure healthy meals?*

51

pervised. The second independent variable was age-level. Ponce (1993) reported that more schools were turning over the management of cafeterias to commercial food contractors athough it had not been established whether there was any difference in quality between contract-managed or in house-managed systems. Unfortunately due to lack of variance (97 percent compared in house) in the sample, management-type was abandoned as the third independent variable.

Analyses

Six hypotheses were tested to answer the two research questions. Descriptive statistics were used to generate a 14-variable profile of objective school cafeteria culture across the two independent variables. Six one-way multivariate analyses (MANOVA) were performed. Three MANOVAs were performed using the non-food characteristics (variables 1-5); student characteristics (variables 6,7,8); and food characteristics (variables 9-14) as dependent variables respectively against school food service delivery as the independent variable (see Table 1). The next three MANOVAs were performed using the three sets of dependent variables respectively against age-level. Pillai's statistic was chosen to determine if differences existed among the groups within the independent variables. When significant differences were found among dependent variables in each of the MANOVAs, post hoc univariate F-tests were performed to determine which of the individual dependent variables contributed to the significant differences. Post hoc Newman-Keuls procedure was performed to determine which groups in the independent variables contributed significantly to the multivariate differences. The critical value for each MANOVA was 0.05.

Results

Statistical profiles of objective culture of school cafeterias were compiled using descriptive statistics derived from responses. Profiles across the 14 dependent variables were compiled for onsite, prepak satellite, bulk satellite schools and also for elementary, middle, and high schools. Results from testing the first three hypotheses indicated that cafeteria cultures in onsite, prepak satellite, and bulk satellite schools were unique. Significant differences were found among onsite, prepak satellite, and bulk satellite schools on the non-food variables (variables 1-5; approximate F =3.126, p<0.001). Follow-up univariate F-tests showed that involvement in breakfast program (F=5.595; p<0.01); cultural sensitivity (F=4.10; p<0.05); and teacher participation (F=6.998; p<0.01) contributed significantly to the differences. Post hoc Newman-Keuls procedure indicated that onsite schools differed significantly (p<0.05) from prepak satellite schools on the involvement in breakfast programs, cultural sensitivity and teacher participation. Bulk satellite schools differed significantly (p<0.05) from prepak satellite schools on teacher participation.

No significant differences (p>0.05) were found among the delivery systems on the financial discretion of students, students' discretion for condiments, and students' involvement in menu planning.

Significant differences were found among onsite prepak satellite and bulk satellite (F=3.612, df=12/302; p<0.05) schools on the food variables. Follow-up univariate F-tests showed that the differences involved the variety of meals (F= 12.596, p<0.05), servers' discretion for condiments (F= 3.90, p < 0.05), and competitive foods (F= 7.15, p<0.05). Post-hoc Newman-Keuls procedure showed that onsite schools differed significantly (p<0.05) from prepak satellite schools on the variety of meals and on competitive foods while onsite schools differed significantly(p<0.05) from bulk satellite schools on servers' discretion for condiments. Prepak satellite schools differed significantly from bulk satellite schools on servers' discretion for condiments. Cafeteria culture between onsite and prepak satellite schools is depicted in Figure 2 (School Cafeteria Culture Profile by Delivery).

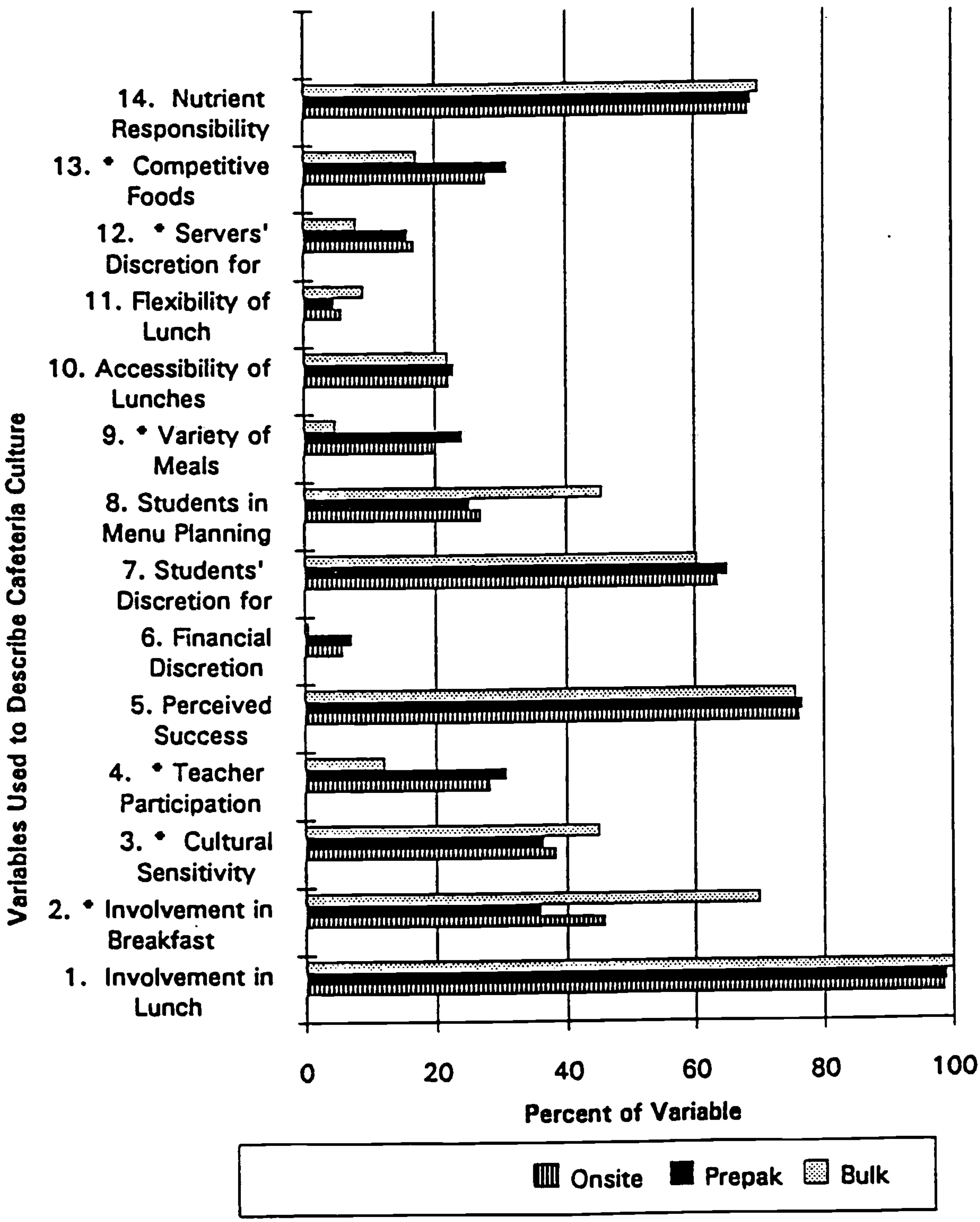
Descriptive statistics were used to compile the objective culture profile for schools by age-level (Figure 3).

Results of the fourth MANOVA showed no significant differences (F=1.586, df= 10/250, p>0.05) among elementary, middle, and high schools with respect to the non-food group. The fifth MANOVA indicated significant differences (F=9.744, df = 6/282, p<0.05) among elementary, middle, and high schools on the student dependent variables . Follow up univariate F-tests showed that both the dependent variables financial discretion of students (F = 14.163, p <0.05), and students' discretion for condiments (F= 13.828, p<0.05) contributed significantly to the differences. A post hoc Newman-Keuls procedure revealed that elementary schools differed significantly (p<0.05) from high schools on financial discretion of students. With respect to students' discretion for condiments, both middle schools and high schools differed significantly (p<0.05) from elementary schools. The sixth MANOVA indicated significant differences (F = 7.267, df= 12/302, p<0.05) among elementary, middle, and high schools on variety of meals, accessibility of lunches, flexibility of lunch periods, servers' discretion for condiments, competitive foods, and nutrient responsibility of provider. Follow-up univariate F-tests showed that variety of meals (F=46.107, p<0.05), and competitive foods (F=17.814, p< 0.05) contributed significantly to the differences. Post hoc Newman-Keuls procedure revealed that on the variety of meals, elementary schools differed significantly (p<0.05) from high schools and middle schools. On competitive foods, elementary schools differed significantly from high schools and from middle schools (p<0.05).

While no significant differences were found among elementary, middle, and high schools on the non-food group of dependent variables, significant differences were found among elementary, middle, and high schools on the variables financial discretion of students, students' discretion for condiments, variety of meals, and competitive foods. Differences

Figure 2

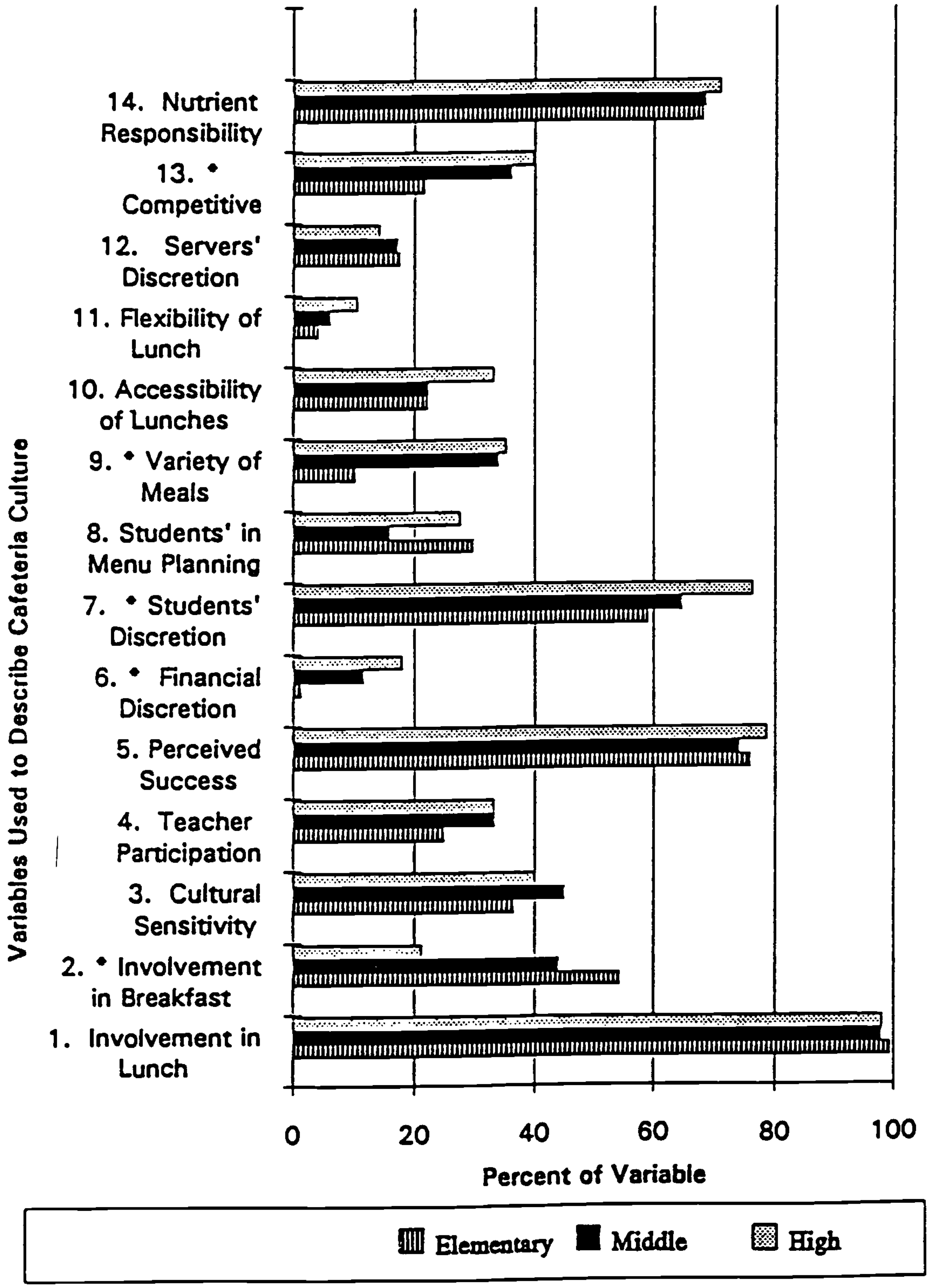
School Cafeteria Profile by Delivery System



* Significant Difference ($p<0.05$) 53

Figure 3

School Cafeteria Profile by Age-Level



* Significant Difference (p<0.05)

were found between elementary and middle schools on the variety of meals and competitive foods variables (Newman-Keuls $p<0.05$). Elementary schools differed significantly from high schools on the financial discretion of students, students' discretion for condiments, variety of meals, and competitive foods variables (Newman-Keuls $p<0.05$). Middle school cafeteria culture differed from high school cafeteria culture on students' discretion for condiments (Newman-Keuls $p<0.05$).

Onsite school cafeteria culture differed significantly from prepak satellite cafeteria cultures on involvement in breakfast programs, cultural sensitivity, teacher participation, variety of meals, and competitive foods. Onsite school cafeteria culture differed significantly from the bulk satellite school cafeteria culture on the variety of meals served. Prepak satellite school cafeteria culture differed significantly from the bulk satellite cafeteria culture on teacher participation and servers' discretion for condiments (Figure 2).

Elementary school cafeteria culture differed from middle school cafeteria culture on variety of meals and competitive food. Elementary school cafeteria culture differed significantly from high school on the financial discretion of students, students' discretion for condiments, the variety of meals, and on competitive foods. Middle school cafeteria culture differed significantly from high school on students' discretion for condiments (Figure 3).

Implications of the Profile of School Cafeteria Culture

The cafeteria culture plays an important role in education of the child. Cafeteria culture enables a student to apply the knowledge of good nutrition. Schuler (1982) showed that cafeterias could be effective in teaching students good nutrition behavior by providing a more eating-conducive environment. Cafeterias play a major role in promoting students' lifelong health habits by serving nutritionally adequate meals and by offering environments for students to practice the healthy eating patterns learned in the classroom (Wolford & Allensworth, 1988). This study suggests that cafeteria culture could serve as a positive behavior setting if it: 1) was highly involved in the lunch program, 2) was highly involved in the breakfast program, and if it had: 3) a high level of culturally sensitivity, 4) a high level of teacher participation serving as positive role models, 5) food service providers who have a high level of perceived success, 6) students whose financial discretion was matched with nutrient appropriate items to purchase, 7) a level of students' discretion for condiments that was matched with increased number of healthy choices for condiments, 8) more student involvement in menu planning, 9) a high level of variety of meals, 10) greater accessibility of lunches, 11) little flexibility for lunches (few schools engaged in open lunch periods), 12) a level of server's discretion for condiments that is matched with the appropriate choices for condiments, 13) a low level of competitive foods, and 14) a high level of nutrient responsibility(providers are conscientious in providing nutritious meals). This profile offers policy makers and food service directors insight in specific needs to create a cafeteria culture in Ohio public schools that will support good eating habits.

Success for improvement is dependent upon the support that is available from school administration, staff, parents, and the community. It has not been established if one delivery system was more desirable than the other. While similarities exist, differences identified in these profiles offer a more precise framework for efforts to create a positive school cafeteria culture. Efforts to improve cafeteria culture could focus on specific characteristics by age- levels and by delivery systems. These specific changes may be addressed individually or collectively but it is prudent to take steps gradually.

Limitations

The objective components of cafeteria culture identified are not exhaustive. Future studies should consider parent participation, role-modeling from teachers, parents, food service personnel, and older peers participating in the lunch programs at lower grade levels. Wolford & Allensworth (1988) proposed that school food service personnel are important advocates for nutrition education for students. This study did not address the extent to which school food service personnel influence the nutrition behavior of children. While the subjective culture of the cafeteria is largely beyond the control of school policy, the objective culture is within control. Therefore, the social and structural organization of the cafeteria should also be considered. Other considerations are: educational props, promotional and marketing props and activities posters, table tents, labels of food, table arrangements, light intensity, food temperature, temperature and noise in the cafeteria, age of the building; appearance of the food; and the general appearance of the cafeteria. Socio-economic status (SES) of the student population, length of time students have to eat, and the level of training of cafeteria staff may also impact cafeteria culture.

The survey instrument was validated but not piloted for content validity or test-retest reliability. Whether the cafeteria culture affects children's nutrition behavior independently or whether interactive there were effects of the variables which could not be addressed in this study.

Recommendations for Further Study

To fully understand children's dietary behavior, one should examine the variety of factors. Studies are needed to examine how the cafeteria culture can facilitate students' practice of nutrition knowledge gained in the classroom. Future studies could include: 1) intervention studies using the cafeteria culture profiles to determine how each variable affects nutrition behavior; 2) experimental studies to determine if all or some of these components are necessary for cultivating positive nutrition behavior; 3) intervention studies to determine if some of the variables used to define cafeteria culture are more effective in levels of schools, or in different delivery systems; 4) studies to determine if nutrition instruction in the classroom could be enhanced by positive cafeteria culture; 5) studies to explore the subjective components of cafeteria culture such as the students' attitudes, norms, peer values, and beliefs that cafeteria that can impact dietary behavior and how these interact with other culture variables; 6) studies to investigate students' perceptions of cafeteria culture and how those perceptions correlate with their dietary choices in the cafeteria; 7) studies to investigate the relationship between cafeteria workers' dietary behavior and students' dietary behavior in the cafeteria; 8) studies to investigate the impact of teachers' and parents' attitude toward cafeteria culture and the dietary behavior of the students in the school cafeteria; and 9) in a setting where there is large variation in schools served by in-house and those served by contract management, the present study could be repeated using management type as an independent variable.

Conclusions

The importance of the school cafeteria as a learning laboratory is clear (The National School Lunch Act, 1946, School Nutrition Act, 1977, White, Sneed & Martin, 1992). The American Cancer Society (1993) and nutrition educators (Zifferblatt, Wilbur, &Pinsky, 1980; Acterberg & Clarke, 1992) maintained that effective nutrition education should be conducted in the setting where the behavior is most likely to occur. The important role of the school cafeteria to feed students and provide a setting for nutrition behavior should be a priority of education policy.

This empirical description of the culture within the school cafeteria identifies the factors that may influence students' dietary behavior while they are in school. Cafeteria culture offers a "governance" for learning nutrition behaviors (Acterberg &Clark, 1992). Profiles of cafeteria culture could be used as frameworks for future studies on the contextual influences on children's nutrition behavior. Since cafeteria culture profiles are unique in schools by levels and by delivery systems, school administrators and policy makers should note that resources can be more specifically targeted for improving school nutrition programs. The profiles of school cafeteria culture resulting from this study offer a framework for future research on nutrition education and children's dietary behavior. Although it is established (Flanagan, 1971, Allensworth & Kolbe, 1987; and Ellison, Capper, Goldberg, Witchi & Stare, 1989) that school cafeterias play an important role in children's nutrition education , a paucity of research exist. Nicklaus, Baroni, & Berenson (1991) proposed that institutional models that involved school lunch management and curriculum components within the school environment are necessary to affect health promotion and school based programs. Acterberg and Clarke (1992) found that most of the theories and models used were drawn from psychology and were primarily related to learning. They suggested that future efforts in nutrition education research and programming should address the context for the students to learn as well as the setting for them to apply the knowledge of good nutrition. Therefore the profiles of school cafeteria culture would be useful for future school nutrition research and program planning.

Educators need to take heed (American Cancer Society, 1993),

Children are constantly developing attitudes about food and nutrition through what they see and what they experience. To avoid sending mixed messages about nutrition, schools must reinforce nutrition education programs with a school atmosphere that is conducive to eating healthfully..............................this means that nutrition education in the classroom should be coupled with a school cafeteria that serves as a laboratory where children can experiment with their newly acquired nutrition information. (Page 32).

Understanding the culture of the school cafeteria will help in creating that environment that will enable students to practice good nutrition.

References

Acterberg, C., & Clark, K. L. (1992). A retrospective examination of theory use in nutrition education. *Journal of Nutrition Education, 24* (5), 227-233.

Allensworth, D. D., Kolbe, L. J. (1987). The comprehensive school health program: Exploring and expanded concept. *Journal of School Health, 57* (10), 409-412.

American Cancer Society (1993). *Eat to learn, learn to eat-the link between nutrition and learning in children*. National Health/Education Consortium.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentiss Hall.

Burghart, J., & Devaney, B. (1993). The School Nutrition and Dietary Assessment Study. Summary of Findings. U. S. Dept. Of Agriculture.

Cushner, K., & Trifonovitch, G., (1989). Understanding mis understanding: Barriers to dealing with diversity. *Social Education.* September, 318-322.

Ellison, R. C., Capper, A. I., Goldberg, R. J., Witchi, J. C., Stare, F. J. (1989). The environment component: Changing school food service to promote cardiovascular health. *Health Education Quarterly 16*(2), 285-297.

Flanagan, T. G. (1971). School food service, in education in the States nationwide development since 1900. Washington, DC, *National Education Assoc.* P. 556.

Food Research Action Center, Community Childhood Hunger Identification Project: *A survey of childhood hunger in the United States*. Washington, DC, March 1991, p. 11.

Gillespie, A. (1981). A theoretical framework for studying school nutrition education programs. *Journal of Nutrition Education 13* (4), 150-152.

Klepp, K., Wilhelmsen, B. U., Andrews, T. (1991). Promoting healthy eating patterns among Norwegian school children in *Youth Health Promotion From Theory to Practice in School and Community*. (Eds.: Nutbeam, D., Haglund, B., Farley, P., Tillgren, P.) London Forbes Publishers, pp. 137-156.

The National School Lunch Act *PL 79-396* ch 281, 60 Stat 230 (Title 42 SS 1751-1760), (1946).

Neill, K. C., & Olds, R. S. (1994). The Ohio School Food Service Study, Summary of Findings. Available from the Ohio Dept. Of Education, Nutrition Education and Training Program.

Nicklaus, T. A., Maroni, A., Berenson, G. S. (1991). *Heart smart school lunch nutrition manual.* New Orleans, LA: National Center for Cardiovascular Health, Louisiana State University Medical Center.

Ponce, H. (1993). To contract or not to contract? *School Food Service Journal,47*(4), 50-52.

School Nutrition Act. P. L. 95-166 (1977).

Schuler, B. (1982). Ticketto discovery. *School Food Service Journal, 36*(10), 92-94.

Triandis, H. (1972). *The analysis of subjective culture.* New York: Wiley-interscience.

U. S. Dept. of Agriculture and U. S. Dept. Of Health and Human Services (1985). *Dietary guidelines for Americans home and garden*. Bulletin No. 232. Washington, DC: U. S. Govt. Printing Office.

U. S. Dept. Of Health and Human Services (1990). Public Health Service *Healthy People 2000:National health promotion and disease prevention objectives*. Publication No. (PHS) 91-50212.

White, G., Sneed, J., & Martin, J. (1992). *School Food Service Journal, 6*, 68-70.

Wolford, C. A., & Allensworth, D. D. (1988) Learn how to promote nutrition. *School Food Service Journal, 42* (10), 38-39.

Zifferblatt, S. M., Wilbur, C. S., Pinsky, J. L. (1980). Changing cafeteria eating habits. *Journal of American Dietetic Association,* 76, 15-20.

American Cancer Society's Guidelines on Diet and Cancer Risk Reduction

John R. Seffrin, Ph.D.

Cancer researchers have long known good nutrition can reduce the risk of many types of cancer. Indeed, about one-third of the 500,000 cancer deaths that occur in the United States each year are due to dietary factors (McGinnis & Foege, 1993). Therefore, good eating habits are a powerful weapon in an individual's fight against cancer.

The American Cancer Society, as the nation's largest private nonprofit health organization dedicated to eliminating cancer as a major health problem, has long been interested in the role good nutrition plays in maintaining health and reducing the risk of disease. To this end, the Society is active in a number of nutrition-related areas, including sponsoring research related to nutrition, advocating for strong governmental programs encouraging good nutrition, and developing guidelines intended to help Americans reduce their risks of cancer. This article gives some background on how the Society develops its nutrition guidelines, and highlights, in an abbreviated manner, its most recent version of these guidelines.[1]

Background on the Society's Nutrition Guidelines

The American Cancer Society first issued nutrition guidelines in 1984. These guidelines were revised in 1991 by the Society's Work Study Group on Diet, Nutrition, and Cancer. Also in 1991, the Society endorsed the 1990 Federal Dietary Guidelines for Americans and designated nutrition as a high priority for the Society. In 1996, the Society's guidelines were revised again. The purpose of periodically updating the guidelines is to give Americans timely information to assist them in making informed decisions for a healthy lifestyle and to reduce their risk of cancer. The guidelines reflect the most current research and scientific understanding available; however, as with all fields of scientific inquiry, new evidence may warrant further changes.

The process used to develop these guidelines combines scientific analysis with attention to the practical issues of how these recommendations can be used in the real world. To update the 1991 guidelines, the Society commissioned a national panel of experts in cancer research, prevention, epidemiology, public health, and policy to provide advice about dietary guidelines for cancer prevention. This expert panel convened for two days and considered all relevant worldwide epidemiologic and laboratory research studies as well as the recently revised US Dietary Guidelines. Ultimately, after examining the merits and weaknesses of these data and discussing how pertinent they were to real life situations, the panel reached consensus on four broad guidelines. These new guidelines take a strong stand on the benefits of a plant-based diet, physical activity and a reduction in the consumption of meats, other fats, and alcohol.

Importantly, the Society's revised nutrition guidelines are intended for people age two years and over and do not apply to those undergoing cancer treatment or those seeking to reduce the risk of cancer recurrence.

The Society's New Nutrition Guidelines

The Society's revised nutrition guidelines follow:

1. Choose most of the foods you eat from plant sources.

Eat five or more servings of fruits and vegetables each day.

*Include fruits or vegetables in every meal.
*Choose fruits and vegetables for snacks.

Eat other foods from plant sources, such as breads, cereals, grain products, rice, pasta, and beans several times each day.

*Include grain products in every meal.
*Choose whole grains in preference to processed (refined) grains.
*Choose beans as an alternative to meat.

The scientific basis for these recommendations is very strong. A number of studies suggest that a diet based on plant sources can reduce the risk of many forms of cancer, especially those of the gastrointestinal and respiratory tracts (Ames, Gold & Willett, 1995; Steinmetz & Potter, 1991; Willett, 1994). In addition, there is strong evidence that increased consumption of fruits and vegetables reduces the risk of colon cancer (Potter, 1996). The evidence is not as strong for those cancers considered hormonal, such as breast and prostate cancer.

Increased consumption of fruits and vegetables has also been associated with a lower risk of lung cancer (Zeigler, Mayne & Swanson, 1996). Since many studies have indicated that foods high in beta carotene protect against lung cancer, it has been suggested that beta carotene itself might reduce lung cancer risk. However, recent clinical trials conducted by The Alpha-Tocopherol, Beta Carotene Cancer Pre-

[1]This artcile is adapted from Guidelines on Diet, Nutrition, and Cancer Prevention: Reducing the Risk of Cancer with Health Food Choices and Physical Activity. (1996). CA: *A Cancer Journal for Clinicians, 46(6), 325-339.*

vention Study Group (1994) and others have shown that smokers taking beta carotene supplements actually developed lung cancer at higher rates than those taking placebos (see also Omen, Goodman, Thornquist, Balmes, Cullen, et al., 1996). These findings suggest that taking a single nutrient in large amounts may produce adverse effects.

Vegetables and fruits are complex foods, containing more than 100 beneficial vitamins, minerals, fiber, and other substances. Since it is not clear which of these substances may protect against cancer, the best advice is to eat five or more servings of fruits and vegetables each day.

Grains, such as wheat, rice, oats, barley, and the foods made from them constitute the base of healthful diets, as illustrated in the US Department of Agriculture's Food Guide Pyramid (1995). Healthful diets include 6 to 11 standard servings of food from this group daily. Whole grains are an important source of many vitamins and minerals, such as folate and selenium, all of which have been associated with a lower risk of colon cancer. However, because the benefits of grain foods may derive from other nutrients as well as from fiber, it is best to consume fruits, vegetables, and whole grains rather than supplements.

Beans are an excellent source of many vitamins and minerals, protein, and fiber. Beans are especially rich in nutrients that may protect against cancer (Messina & Erdman, 1995) and can be a useful low-fat, high-protein alternative to meat.

2. Limit your intake of high-fat foods, particularly those from animal sources.

Choose foods low in fat.

*Replace fat-rich foods with fruits, vegetables, grains, and beans.

*Eat smaller portions of high-fat foods.

*Choose baked and broiled foods instead of fried foods.

*Select non-fat and low-fat milk and dairy products.

*When you eat packaged, snack, convenience, and restaurant foods, choose those low in fat.

Limit consumption of meats, especially high-fat meats.

When you eat meat, select lean cuts.

*Eat smaller portions of meat.

*Choose beans, seafood, and poultry as an alternative to beef, pork, and lamb.

*Select baked and broiled meats, seafood, and poultry, rather than fried.

Diets high in fat, especially fat from animal sources, have been linked to a number of health risks, including cardiovascular disease and certain types of cancer. High-fat foods have been associated with an increase in the risk of cancers of the colon and rectum (Potter, 1996), prostate (Kolonel, 1996) and endometrium (Hill & Austin, 1996). The association between high-fat diets and breast cancer is much weaker (Hunter & Willett, 1996). Whether these associations are due to the total amount of fat, the particular type of fat (saturated, monounsaturated, or polyunsaturated), the calories contributed by fat, or some other factor has not yet been determined. Because a gram of fat contains more than twice the calories of a gram of protein or carbohydrate (9 versus 4 kcal/gram), studies cannot easily distinguish the effects of fat itself from the effects of the calories it contains. Additionally, people who eat high-fat diets tend to be heavier and eat more meat and fewer fruits and vegetables, so their risk of cancer also is increased for other reasons.

Although meats are good sources of high-quality protein and supply many important vitamins and minerals, consumption of meat — especially red meats such as beef, pork, and lamb — has been linked to cancers at several sites, most notably the colon and prostate (Kushi, Lenart & Willett, 1995). How much of the association between red meats and cancer is due to total fat or saturated fat and how much is due to other constituents of meat is uncertain at present (Hill & Austin, 1996; Kolonel, 1996; Potter, 1996). For example, in addition to fat, mutagenic compounds such as heterocyclicamines, which are produced when protein is cooked, may be a contributing factor in colon cancer.

Saturated fat may be particularly important in increasing the risk for cancer as well as heart disease. The best way to reduce saturated fat intake is to make wise choices in the selection and preparation of animal foods. Choose lean meats and lower-fat dairy products, and substitute vegetable oils for butter or lard. Choose smaller portions of meat or use it as a side dish rather than as the focus of a meal. Emphasize beans, grains, and vegetables in meals to include more foods from plant rather than animal sources. Preparation methods are also important. Baking and broiling foods, rather than frying them, reduces the overall amount of fat.

3. Be physically active: achieve and maintain a healthy weight.

Be at least moderately active for 30 minutes or more on most days of the week. Stay within your healthy weight range.

Moderate physical activity provides a number of health benefits and can help protect against some cancers, either by balancing caloric intake with energy expenditure or by other mechanisms. Being overweight or obese can increase the risk of colon and rectum (Potter, 1996), prostate (Kolonel, 1996), endometrium (Hill & Austin, 1996), breast (among postmenopausal women) (Hunter & Willett, 1996) and kidney (Wolk, Lindblad & Adami, 1996) cancers.

It is not known whether physical activity may simply prevent obesity or may act in other ways to reduce cancer risk. For breast and prostate cancer, physical activity may have a beneficial effect on hormone levels (Friedenreich & Rohan, 1995; Shephard, 1993). For colon cancer, physical activity stimulates movement through the bowel, thereby reducing the length of time that the bowel lining is exposed to mutagens.

Many organizations besides the American Cancer Society, including the NIH Consensus Development Panel on Physical Activity and Cardiovascular Health (1996) and the US Department of Health and Human Services (1996), recommend 30 minutes of moderate physical activity each day as a means to promote health (see also Pate, Pratt & Blair, Haskell, W.L., Macera, C.A., Bouchard, C., Buchner, D. 1995). The 30 minutes does not need to be continuous to be beneficial. To lose weight, caloric restriction should be done in conjunction with physical activity.

4. Limit consumption of alcoholic beverages, if you drink at all.

Alcoholic beverages, along with cigarette smoking and the use of snuff and chewing tobacco, cause cancers of the oral cavity, esophagus, and larynx. Cancer risk increases with the amount of alcohol consumed and may start to rise with an intake of more than two drinks per day (Cheng & Day, 1996; Marshall & Boyle, 1996; Ribolo, Kaaks & Esteve, 1996). A drink is defined as 12 ounces of regular beer, 4-5 ounces of wine, or 1 ounce of hard liquor.

It is important to note that the combined use of tobacco and alcohol significantly increase the risk of oral and esophageal cancers. The effect of tobacco and alcohol combined is greater than the sum of their individual effects (Cheng & Day, 1996; Marshall & Boyle, 1996).

Studies have also shown an association between alcohol consumption and an increased risk of breast cancer. The mechanism for this effect is unknown, but the association may be due to carcinogenic actions of alcohol or its metabolites, to alcohol-induced changes in levels of hormones such as estrogens, or to some other process. Regardless of the mechanism, studies suggest that the risk of breast cancer may increase with an intake of just a few drinks per week (Ribolo, Kaaks & Esteve, 1996).

However, the overall effect of alcohol on health is still being debated. Moderate intake of alcoholic beverages has been shown to decrease the risk of coronary heart disease. Indeed, the cardiovascular benefits may actually outweigh the risk of cancer in men and women over 30 (Thun et. al., 1997). Public health officials at the US Department of Agriculture and US Department of Health and Human Services advise people who already drink alcoholic beverages to limit their intake to two drinks a day for men and one drink per day for women (1995). Women with an unusually high risk of breast cancer might reasonably consider abstaining from alcohol. Children and adolescents, pregnant women, and people taking certain medications should also abstain from alcohol consumption.

Additional Items

In addition to food recommendations, the Society's new guidelines recognize that other dietary factors can affect cancer risk, including food preparation and selection, food variety, portion size, and overall caloric balance. For example, vegetables are not a smart dietary choice if they are fried, and meats that are fried or charbroiled may be less healthful than those that are broiled or baked. Since no one is sure what specific components of foods may fight cancer, eating a wide variety of foods enhances one's chances of ingesting such beneficial items. The concept of portion size is also important: one serving of meat is two to three ounces — roughly the size of the palm of a hand and far less than the typical restaurant serving.

Conclusion

Unfortunately, many Americans do not follow healthful eating practices. Studies indicate an increase in caloric intake, greater use of high-fat convenience foods, and a decline in physical activity among Americans (Frazao, 1995). The causes of these trends have not been established, but some evidence suggests that more food is being eaten outside of the home, lifestyles are becoming more sedentary, and high-calorie foods are being heavily advertised and promoted, especially to children and adolescents. Therefore, the Society not only issues guidelines but also provides information and guidance, as well as education programs and interventions, to help people incorporate these potentially life-saving recommendations into their lifestyles.

The Society also recognizes that many important questions about diet, nutrition, and cancer risk remain unanswered and supports nutrition research by conducting its own research and by funding outstanding research projects throughout the country. Studies supported by the Society on the effects of diet, nutrition, and exercise on cancer risk have been made possible by the efforts of nearly 100,000 volunteers and the financial contributions of millions of Americans.

References

The Alpha-Tocopherol, Beta Carotene Cancer Prevention Study Group. (1994). The effect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. *New England Journal of Medicine, 330*, 1029-1035.

American Cancer Society. (1984). Nutrition and cancer: Cause and prevention: An American Cancer Society special report. *Cancer Journal for Clinicians, 34*, 121-126.

Ames, B. N., Gold, L. S., & Willett, W. C. (1995). The causes and prevention of cancer. *Proceedings of the National Academy of Sciences USA, 92*, 5258-5265.

Cheng, K. K., & Day, N. E. (1996). Nutrition and esophageal cancer. *Cancer Causes and Control, 7*, 33-40.

Frazao, E. (1995). The American Diet: Health and Economic Consequences *(Agriculture Information Bulletin* 711). Washington DC, US Department of Agriculture.

Friedenreich, C. M., & Rohan, T. E. 1995. A review of physical activity and breast cancer. *Epidemiology, 6*, 311-317.

Hill H. A., & Austin, H. (1996). Nutrition and endometrial cancer. *Cancer Causes and Control, 7*, 19-32.

Hunter, D. J., & Willett, W. C. (1996). Nutrition and breast cancer. *Cancer Causes and Control, 7*, 56-68.

Kolonel, L. N. (1996). Nutrition and prostate cancer. *Cancer Causes and Control, 7*, 83-94.

Kushi, L. H., Lenart, E.B., & Willett, W. C. (1995). Health implications of Mediterranean diets in light of contemporary knowledge. 2. Meat, wine, fats, and oils. *American Journal of Clinical Nutrition, 61* (suppl 6), 1416s-1427s.

Marshall, J.R., & Boyle, P. (1996). Nutrition and esophageal cancer. *Cancer Causes and Control, 7*, 33-40.

McGinnis, J. M., & Foege, W.H. (1993). Actual causes of death in the United States. *Journal of American Medical Association, 270*, 2207-2212.

Messina, M. & Erdman J. W., (Eds). (1995). First international symposium on the role of soy in preventing and treating chronic disease. *Journal of Nutrition, 125* (suppl 3), 567s-808s.

NIH Consensus Development Panel on Physical Activity and Cardiovascular Health. 1996. Physical activity and cardiovascular health. *Journal of American Medical Association, 276*, 341-246.

Omenn, G., Goodman, G. E., Thornquist, M. D., Balmes J., Cullen, M.R., Glass, A., Keogh, J.P., Meyskens, F.L., Valanis, Bl, Williams, J.H., Barnhart, S., Hammar, S. (1996). Effects of a combination of beta carotene and vitamin A on lung cancer and cardiovascular disease. *New England Journal of Medicine, 334*, 1150-1155.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W.L., Macera, C.A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G.W., King, A.C., Kriska, A., Leon, A.S., Marcus, B.H., Morris, J., Paggenbanger, R.S., Patrick, K., Pollack, M., Rippe, J., Sallis, J., & Willmore, J.H.(1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Society, 273*, 402-407.

Potter, J. D. (1996). Nutrition and colorectal cancer. *Cancer Causes and Control, 7*, 127-146.

Riboli, E., Kaaks, R., & Esteve, J. (1996). Nutrition and laryngeal cancer. *Cancer Causes and Control, 7*, 147-156.

Shephard, R. J. (1993). Exercise in the prevention and treatment of cancer: An update. *Sports Medicine, 15*, 258-280

Steinmetz, K. A., & Potter, J. D. (1991). Vegetables, fruit, and cancer. I Epidemiology. *Cancer Causes and Control, 2*, 325-357.

Steinmetz, K.A., Potter, J.D. (1991). Vegetables, Fruit, and Cancer. II Mechanisms. *Cancer Causes and Control, 2*, 427-442.

Thun, M. J., Peto, R., Lopez, A. D., Monaco, J., Henley, J., Heath, C.W., & Doll, R. (1997). Alcohol Consumption and Death Rates in Middle-aged and Elderly US Adults. *New England Journal of Medicine*, 337, 1705-14.

US Department of Agriculture. (1995). The Food Guide Pyramid. *Home and Garden Bulletin 252*. Washington, DC: US Government Printing Office.

US Department of Agriculture and US Department of Health and Human Services. (1995). Nutrition and Your Health: Dietary Guidelines for Americans, Ed. 4. *Home and Garden Bulletin 232*. Washington, DC: US Government Printing Office.

US Department of Health and Human Services. (1996). Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA: Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion, President's Council on Physical Fitness and Sports.

Willett, W. C. (1994). Micronutrients and cancer risk. *American Journal of Clinical Nutrition, 59* (suppl 5), 1162s-1165s.

Wolk, A., Lindblad, P., & Adami, H-O. (1996). Nutrition and renal cell cancer. *Cancer Causes and Control, 7*, 5-18.

The Work Study Group on Diet, Nutrition, and Cancer. (1991). American Cancer Society Guidelines on Diet, Nutrition, and Cancer: *CA A Cancer Journal for Clinicians, 41*, 334-338.

Zeigler, R. G., Mayne, S.T., & Swanson, C. A. (1996). Nutrition and lung cancer. *Cancer Causes and Control, 7*, 157-177.

Zinc Analyses of Selected Western African Foods with Reference to Nutritional Status

Nathan W. Shier, Ph.D, Isbatou Boukari, M.S.,
Mohammad R. Torabi, Ph.D., MPH, Heather Chamberlain, M.S.

Abstract

Most African diets are plant-based and low in animal products. Plant-based diets are known to be rich in phytate and the consumption of food rich in phytate may lead to mineral deficiency which is of concern in many Western African countries. Unfortunately, mineral food composition data for Western African foods are incomplete. Analysis of foods is essential in order to assess the quality of existing food as well as to estimate dietary intake of various minerals. Of particular interest is zinc. Food samples from 27 commonly consumed Western African foods were collected from Western African markets and retail stores. All foods studied are typically purchased and used in the dry form. The samples were stored frozen to await analysis. Foods were then dried to a constant weight using a vacuum oven. After a constant weight was obtained, an aliquot was placed in a porcelain crucible and ashed at 450 degrees Centigrade for 15 hours in a muffle furnace. The ash was then cooled to room temperature in a desiccator. Several drops of concentrated analytical grade nitric acid were added to the ash and the suspension ashed for another 15 hours at the same temperature. After ashing, 5 ml of 6N HCl were added to the crucible. The dissolved ash was then delivered to a 25 ml volumetric flask and brought to volume with deionized water. Mineral concentrations were determined using an inductively-coupled plasma atomic emission spectrometer (ICP). The procedure was validated by recovery of zinc from a standard leaf preparation from the United States Department of Agriculture. Recovery was 95.9% of the expected value. For all food analyzed, zinc levels ranged from 0.42 - 10.43 mg zinc/100 g dry food. The top five foods in rank order are as follows: dried eggplant leaves, dried amaranth leaves, dried okra leaves, dried okra and dried squash seed without the shell. Green leaves had the highest zinc levels (0.95 - 10.43 mg/100 g dry food) whereas tubers and roots had the lowest (0.42 - 0.90). Dry legumes, seeds, nuts and whole grains had intermediate values. These trends agree well with the established literature. Depending on the region of harvest, food mineral composition can vary greatly. Nonetheless, these data should help in the planning of food-based intervention programs to improve trace mineral nutrition in Western Africa.

Introduction

Mineral deficiencies, such as zinc, are a worldwide problem particularly in developing countries. Zinc is found in many body tissues and fluids with total body zinc averaging 1.5 grams for women and 2.5 grams for men. Zinc deficiency has been associated with impaired wound healing, poor linear growth, reduced cellular and humoral immunity, loss of appetite, loss of hair, pregnancy induced hypertension, and premature delivery of infants (Cousens et al., 1993; Delafuente, 1991; Harland & Oberleas, 1987; Ferguson, Gilson, Opare-Obisaw, & Ounpuu, 1993; Garg, Singhal & Arshed, 1993; Yasodhara, Ramaraju & Raman, 1991; Cherry et al., 1989). Therefore, zinc deficiency can have devastating effects particularly in growing children. One can have adequate zinc intake by selecting good sources like beef, dark meat of chicken and turkey, oysters, shellfish, cheese, whole grains, dried legumes and dried green leaves.

The bioavailability of nutrients and minerals varies with the food source and composition, a person's health status, and the way the food has been prepared. Food processing and preparation methods used in Western Africa, specifically soaking, malting and fermentation, enhance mineral bioavailability. It has been demonstrated that zinc solubility is improved and its absorption increased when one of these food processing methods is used (Sandberg, 1991; Johnson, 1991). Malnutrition still exists in Africa even in countries where plenty of food is present. Chronic undernutrition, the more appropriate term, is widespread in certain African countries; consequently, mineral deficiencies are present (Ferguson, Gilson, Opare-Obisaw, & Ounpuu, 1993). If one can identify foods rich in zinc and then prepare them by methods known to improve mineral bioavailability, it is assumed that nutrition will improve. Unfortunately, Western African food composition tables are outdated and limited (Leung, Busson & Jardin, 1968; Ferguson, Gilson, Opare-Obisaw, & Ounpuu, 1993). The analysis of selected minerals within commonly eaten Western African foodstuffs is therefore needed and was the purpose of the present study. These data should be a valuable resource for nutrition education allowing better food selection and consequently improvement in nutritional status.

Methodology

Food samples were purchased from merchants in various markets in Benin and Mali. Other samples were purchased from a large Western African retail outlet located close to Washington D.C. All foods collected are purchased and used in the dry form. After collection, samples were frozen to await assay. To avoid zinc contamination, all glassware was acid washed in 36 N sulfuric acid. Samples were analyzed using the methods of Ferguson, Gilson, Opare-Obisaw, & OseiOpare, 1993 and the AOAC analytical methods (Padmore, 1990) with modifications made by the authors. Each food sample was put in an aluminum tin and weighed on an analytical balance. The sample was then dried to constant weight at 98 - 100 degrees Centigrade using a vacuum oven. Each sample was then ground using a ceramic mortar and pestle. After grinding, they were again dried to constant weight. The final powders were stored in a desiccator to await dry ashing. A small portion (1g) was weighed out, using an analytical balance, and placed in a porcelain crucible. Covered crucibles were then placed in an electric muffle furnace and burned for 15 hours at 450 degrees Centigrade. After cooling to room temperature, several drops of analytical-grade nitric acid were added to the ash and the suspension was again ashed for the same duration and at the same temperature. After ashing, crucibles were cooled to room temperature in a desiccator. The ash was then suspended in 5ml of 6 N ultra-pure hydrochloric acid. The solution was transferred to a 25 ml volumetric flask and deionized water was added to volume. Zinc analysis was done using an inductively-coupled plasma atomic emission spectrophotometer (ICP). Concentrations in ppm were converted to mg per 100 grams dry food. To verify the reliability of the procedures, a corn husk standard reference material number 8412 (National Institute of Standards and Technology, Gaitheresburg, MA) was analyzed for zinc.

Results and Discussion

A total of 27 different foodstuffs were analyzed as follows: 9 vegetables (mostly green leaves), 6 cereal grains and grain products, 5 tubers and roots, 4 dried legumes, 2 nuts and 1 seed variety. All foods analyzed are typically purchased and used in the dry form. Results of the analysis of the corn husk reference material 8412, done to validate procedures and equipment used, are as follows: expected zinc value equals 32 +/-3 (SE) mcg/g; the mean assayed value was 30.7 giving a percent recovery of 95.9.

The mean zinc data (mg/100g dry weight food) are shown in Table 1. The top five foods in rank order are: dried eggplant leaves, dried amaranth leaves, dried okra leaves, dried okra, and dried squash seed without the shell. For all foods analyzed, the zinc content (mg/100g dry food), ranged from 0.42 to 10.43. Dried green leaves had the highest zinc content ranging from 0.95 - 10.43 mg zinc/100g dry food, whereas, tubers and roots were the lowest (0.42 - 0.90). Other foods were intermediate.

Comparison of these data to other published literature on

Table 1

Mean Zinc Content (mg/100g dry weight) of Commonly Eaten Western African Foods*

Food Name @	Zinc
Okra, dried	5.89
Okra, dried (a)	5.00
Okra Leaves, dried	6.32
Bambara Beans, dried	2.52
Bambara Beans, dried (b)	2.56
Bambara Beans, dried (c)	2.55
Peanut, shelled, dried	3.22
Amaranth Leaves, dried	9.08
Squash Seed, dried, without shell	5.85
Squash Seed, dried, without shell (c)	5.00
Baobab Leaves, dried	1.65
Baobab Leaves, dried (b)	2.27
Baobab Leaves, dried (b)	2.25
Sorrel Leaves, dried	3.66
Formula 1 (#)	3.15
Formula 2 (#)	2.83
Eggplant Leaves, dried	10.43
Jute Leaves, dried	3.61
Onion Leaves, dried (b)	0.95
Onion, dried (b)	2.35
Corn Flour, with bran	1.78
Corn Flour, without bran	0.69
Taro Flour	0.90
Yam Flour	0.82
Cassava, soaked, dried, pounded	0.42
Cassava, soaked, dried, pounded (c)	0.60
Cassava Meal, gari fermented, dried	0.85
Sweet Potato Flour	0.71
Millet	3.56
Sorghum, whole grain, red	2.09
Pigeonpea, whole seed	3.36
Soybean, white	4.37
Soybean, green	4.54
Black-Eyed Peas	3.81
Cashew, roasted	4.00

Table 1, Footnotes

*Each number represents a mean of sample duplicates.

@All foods analyzed originated from Benin unless otherwise indicated.

(a)Samples originated from Western Africa.
(b)Samples were purchased in Mali.
(c)Samples were purchased in a retail store in Washington D.C. (This store sells foods originating in Nigeria.)
(#)Formula 1 is a mixture of corn flour without the bran, with dried milk and added vitamins.
(#)Formula 2 is a mixture of corn flour without the bran, with sorghum flour, fat free soybean flour and vitamins.

African foods shows much agreement with some disagreement. Several foods were analyzed for the first time in this study. (Table 2) Values for amaranth, jute and sorghum differed markedly from the published literature. To explain variances, it should be noted that not all data reported in the literature were on foods originating from Western Africa. Also, for some Western African foods harvested in the same country, the zinc content can vary greatly perhaps due to soil differences. A good example is jute with varying zinc values reported by different authors (Faboya, 1983; Ifon, 1977). The plant state of maturation, genetic variances and environmental factors may also affect mineral content of foods. For all of the other samples, where published comparisons could be found, the zinc content reported here is within ranges documented elsewhere (Leung et al., 1968; Ferguson, Gilson, Opare-Obisaw, & OseiOpare, 1993; Faboya, 1983; Ifon, 1977; Dos-Santos & Damon, 1987; Mbofung, 1982).

Table 2

Mean Zinc Content (mg/100g dry weight) of Commonly Eaten Western African Foods*Compared to Other Western African Published Data

Food Name @	Zinc
Okra, dried	5.89
Okra, dried (a)	5.00
(Ferguson et al., 1993)(b)	5.55
(Faboya, 1983)	8.00
Peanut, shelled, dried	3.22
(Ferguson et al., 1993)	3.90
Amaranth Leaves, dried	9.08
(Faboya, 1983)	5.40
Jute Leaves, dried	3.61
(Ifon, 1977)	7.80
Corn Flour, with bran	1.78
(Ferguson et al., 1993)	1.00
Taro Flour	0.90
(Ferguson et al., 1993)	1.25
Yam Flour	0.82
(Ferguson et al., 1993)	0.93
Cassava Meal, gari fermented, dried	0.85
(Ferguson et al., 1993)	0.80
(Mbofung, 1982)	0.98
Sweet Potato Flour	0.71
(Ferguson et al., 1993)	0.66
Sorghum, whole grain, red	2.09
(Ferguson et al., 1993)	1.53

*Each number from the present study represents a mean of sample duplicates.
@All foods analyzed in the present study originated from Benin unless otherwise indicated.
(a)Samples originated from Western Africa.
(b) Ferguson reference in this table contains the following coauthors: Gilson, Opare-Obisaw, & OseiOpare, 1993.

When possible, values reported here were compared to data published by the United States Department of Agriculture (USDA). (Table 3) As can be seen, most values are in agreement. Here, some differences would be expected since the USDA values were from foods not grown in Western Africa. Mineral composition in food is known to vary greatly depending on where the food was grown. In future research, stress should be placed on additional foodstuffs and on environmental factors that can vary food mineral composition.

Table 3

Mean Zinc Content (mg/100g dry weight) of Comonly Eaten Western African Foods* Compared to United States Department of Agriculture Values (USDA)

Food Name@	Zinc
Okra, dried	5.89
Okra, dried (a)	5.00
USDA	5.76
Peanut, shelled, dried	3.22
USDA	3.49
Amaranth Leaves, dried	9.08
USDA	10.83
Onion, dried (b)	2.35
USDA	1.96
Sweet Potato Flour	0.71
USDA	1.03
Pigeonpea, whole seed	3.36
USDA	3.08
Soybean, white	4.37
USDA	4.13
Black-Eyed Peas	3.81
USDA	3.82
Cashew, roasted	4.00
USDA	5.70

*Each number from the present study represents a mean of sample duplicates.
@All foods analyzed in the present study originated from Benin unless otherwise indicated.
(a)Samples originated from Western Africa.
(b)Samples were purchased in Mali.

Conclusions and Recommendations

A total of 27 different Western African foodstuffs were analyzed for zinc. All foods analyzed are typically purchased and used in the dry form. The zinc content (mg/100g dry food) ranged from 0.42 - 10.43. Green leaves had the highest levels whereas tubers and roots had the lowest. The top five foods in rank order are: dried eggplant leaves, dried amaranth leaves, dried okra leaves, dried okra, and dried squash seed without the shell. Future research should focus on the analysis of additional foods and minerals. More compositional data are needed on foods that have been stored and prepared by traditional methods. Food analyses, as reported here, should allow a better estimate of daily zinc consumption and the establishment of daily zinc allowances for Western African countries thereby improving mineral nutrition.

References

Cherry, F.F., Bennett, E.A., Bazzano, G. S., Johnson, L., Fosmire, G.J., & Hiram, K. (1981).Plasma zinc in hypertension/toxemia and other reproductive variables in adolescent pregnancy. *American Journal of Clinical Nutrition, 34*, 2367-2375.

Cousens, S., Nacro, B., Curtus, V., Kanki, B., Tatt, F., Traore, R.E., Diallo, I., & Mentens, T. (1993). Prolonged breast feeding: no association with the increased risk of clinical malnutrition in young children in Burkina Faso. *Bulletin of the World Health Organization, 71*(6), 713-722.

Delafuente, J.C., (1991). Nutrients and immune responses. *Nutrition and Rheumatic Diseases, 17*(2), 203-212.

Dos-Santos, H.A. & Damon, M. (1987). Manuel de Nutrition Africaine, Paris, France: Karthala Publishing Co.

Faboya, O.O.P. (1983). The mineral content of some green leafy vegetables commonly found in the Western part of Nigeria. *Food Chemistry, 12,* 213-216.

Ferguson, E.L., Gilson, S.R., Opare-Obisaw, C., Ounpuu, S., Thompson, L.U., & Lehrfeld, J. (1993). The zinc nutriture of preschool children living in two African countries. *Journal of Nutrition, 123*, 1487-1496.

Ferguson, E.L., Gibson, R.S., Opare-Obisaw, C., OseiOpare, F., Stephen, A.M., Lehrfelf, J., & Thompson, L.U. (1993). The zinc, calcium, copper, manganese, nonstarch polysaccharide and phytate content of seventy-eight locally grown and prepared African foods. *Journal of Food Composition and Analyses, 6*, 87-99.

Garg, H.K., Singhal, K.C., &Arshed, Z. (1993). A study of the effect of oral zinc supplementation during pregnancy on pregnancy outcome. *The Indian Journal of Physiology and Pharmacology, 37,* 276-284.

Harland, F.B. & Oberleas, D. (1987). Phytate in foods. *World Review of Nutrition and Dietetics, 52*, 235-259.

Ifon, E.T. (1977). The Nutrient Composition of Some Nigerian Leafy Vegetables and the Physiological Availability of Their Iron Contents. Unpublished Doctoral Dissertation, Ibadan, Nigeria.

Johnson, P.E. (1991). Effect of food processing and preparation on mineral utilization. *Advances in Experimental Medicine and Biology, 289*, 483-498.

Leung, W.T.W., Busson, F., & Jardin, C. (1968). Food Composition Table for Use in Africa. (DHEW Publication No. NIH 79-465). U.S. Government Printing Office, Bethesda, Maryland.

Mbofung, C.M.F. (1982). Trace Element Studies in Pregnant and Lactating Nigerian Women. Unpublished Doctoral Dissertation, Ibadan, Nigeria.

Padmore, J. (1990). Animal feed. *Journal of the Association for Official Analytical Chemists, 33*, 69-75.

Sanberg, A. (1991). The effect of food processing on phytate hydrolysis and availability of iron and zinc. *Advances in Experimental Medicine and Biology, 289*, 499-508.

Yasodhara, M., Ramaraju, L.A., & Raman, L. (1991). Trace minerals in pregnancy: copper and zinc. *Nutrition Research, 11*, 15-21.

Acknowledgments: The authors express thanks to the Research Council of the School of Health Physical Education and Recreation, Indiana University, for financial support. Without these funds, this study would not have been possible.

65

Diet and Blood Sugar Control - The Glycemic Index in Older Persons

John R. Warren, Ph.D., Nathan W. Shier, Ph.D., Alyce D. Fly, Ph.D., Susan J. Eklund, Ph.D., Mohammad R. Torabi, Ph.D., David M. Koceja, Ph.D.

Abstract

Twelve women in the age range of 73 to 85 (mean age 80.3 $\pm$ 4.5 SD) participated in the study. Data were collected over a three month period, using procedures that had been approved by the Indiana University Committee for the Protection of Human Subjects. This study applied the concept of food glycemic indices to reduce the area under the glucose response curve. Each subject served as their own control. Subjects were asked to fast for 12 hours on two separate days. Early morning Fasting Blood Sugars were obtained by finger stick and measured with a glucometer. On the first morning, subjects were given a 50 gram loading dose of carbohydrate in the form of 100 grams of white bread, which was considered the control. On the subsequent morning, subjects were given a 50 gram loading dose of carbohydrate in the form of 430 grams of fresh orange slices. Blood specimens were collected and analyzed on 0.5 hr intervals for the first hour and on 1 hour intervals for the next 2 hours. Results indicate that the area under the glucose response curve for elderly women can be cut in half by using a low-glycemic index food such as orange ($p<0.001$). These results indicate that, within a varied diet, the consumption of more low glycemic foods may help to normalize the age-related elevated glucose response curve seen in older women.

Introduction

The glycemic index is a useful ratio used to rank foods based upon the blood glucose response area that they produce in humans. A glucose response area provides considerably more information on blood sugar control than several isolated fasting blood sugars. The total glucose response area is the total area under the glucose response curve down to 0 mg/dL glucose concentration. Just because a food produces a sharp rise in the magnitude of the blood sugar concentration, i.e., from 120 mg/dL to 150 mg/dL does not necessarily imply that the same food would produce a correspondingly high increase in a three-hour glucose response area. The glucose response area is extremely important because it reflects the time interval in which the physiological substances present in the blood and vascular cells are exposed to higher glucose concentrations. This longer glucose exposure may be responsible for some of the pathologies associated with diabetes and may accelerate aging-related pathologies.

Canadian researchers have studied the glycemic index as a nutritional tool which may support new therapeutic measures for the normalization of elevated glycemic responses in both non-diabetic and diabetic people (Wolever, D. Jenkins, A. Jenkins, & Josse, 1991).

A nomogram developed by Andres (1971) shows that half of all individuals at the age of 70 will have a two hour post-prandial blood glucose reading of approximately 145 mg/dL. In comparison, the same nomogram shows that less than three percent of 20 year olds will have a two hour post-prandial blood glucose of 145 mg/dL. The relationship of age and glucose tolerance deterioration indicates that glucose tolerance can be thought of as an aging biomarker.

The need for this study is demonstrated by the following: 1) There are few studies involving intervention into the aging process at the biological or physiological level, and, 2) a literature search failed to reveal any studies utilizing the glycemic index as a means of lowering aging-related elevations of the glycemic response curve in older individuals.

Methods

Subject Selection

Twelve moderately active women in the age range of 73-85 years were selected among volunteers from a residential retirement community and a senior citizen center. The age range was selected, by using the Andres (1971) nomogram, to achieve a group of individuals who would reflect the age-related decline in glucose tolerance. As part of the screening process, subjects were administered a health questionnaire written by the authors, and those with diabetes mellitus or other conditions except age causing hypoglycemia or hyperglycemia were not selected for the study. Subjects were asked to sign an informed consent form that had been approved by the Indiana University Committee for the Protection of Human Subjects.

Selection of Test and Control Foods

The control food portion consisted of white bread (50 grams carbohydrate), and the test food portion consisted of equicarbohydrate portions of fresh orange, 430 grams, which was selected to elicit the minimum glycemic response curve in the subjects. While the control food, white bread, was selected to yield the standard high glycemic response. The white bread used in this study was prepared in the Indiana University Food Laboratory using a formula supplied by Wolever (1991). Using food composition tables, the bread formula was designed to yield a food portion that contains 50 grams carbohydrate (United States Department of Agriculture Handbook, No. 8-9, 1982).

Blood Specimens

Capillary blood specimens were obtained via use of a spring loaded finger-sticking device (Provided with the Ames Glucometer III Blood Monitoring System). Capillary blood specimens were analyzed prior to a test or control food and at one-half, one, two, and three hours on a post-prandial basis. It should be noted that the first blood specimen represents the twelve hour fasting blood sugar in all subjects. Blood glucose determinations were made using whole capillary blood since this technique is relatively noninvasive and because older individuals frequently do not tolerate venous punctures very well. Another reason for selecting capillary blood specimens is the ease and simplicity of the technique, in effect, permitting the subject to use personal blood glucose measuring instruments. The result was more comfort and greater compliance by the subject and less expense to the investigator.

Experimental Protocol

The study was divided into two phases: (a) a baseline phase in which the subjects maintained a dietary history, and (b) an experimental phase in which the subjects participated in the glucose tolerance tests. In the baseline phase of the study, all subjects maintained a three-day dietary history diary. During the experimental phase, subjects were initially given a control food (white bread containing 50 grams of carbohydrate) based upon an experimental formula developed by Wolever (1991). Within one week, subjects were given a test food. Also, in the experimental phase of the study, subjects were permitted to drink water freely. On both occasions, subjects' capillary blood glucose was monitored for a period of 180 minutes past the time that a fasting blood sugar was taken. All experimental data were collected during a three month time interval. Subjects were asked to fast for a period of 12 hours prior to the mornings of their glucose tolerance testing. Early morning fasting blood sugars were obtained from each subject prior to consuming either the test food (orange) or the control food (white bread). All food portions, either test or control, were calculated to be equicarbohydrate, containing 50 gram carbohydrate each. Calculated food portions were then measured, by weighing, in grams (to the nearest tenth gram). For either the control or the test glucose response experiments, subjects were given the food portion and asked to eat the entire portion within 10 minutes. During the glucose response time period of three hours, finger-stick capillary blood samples were obtained at fasting (0 time), and at 0.5 hour intervals for the first hour and on 1 hour intervals for the next 2 hours. Capillary blood specimens were taken and the subsequent analysis was done on an Ames/Miles (Mishawaka, Indiana) Glucometer III Blood Glucose Monitoring System.

Subjects were permitted to consume water ad libitum for the remainder of the glucose response period since this will not affect blood glucose levels, (Gannon, Nuttall, Westphal, Neil, & Seaquist, 1989).

Results

Data Calculations and Analysis

Dietary records were analyzed by using the ESHA Research FP II program. Blood glucose tolerance curves were plotted and the area under the curves calculated for all control and test meals. Glucose response areas were calculated according to the trapezoid method used by Brand et al. (1991) and verified by the geometric method used by Wolever et al (1991). Control and test data were compared by a paired t-test using SPSS (alpha was set at 0.05).

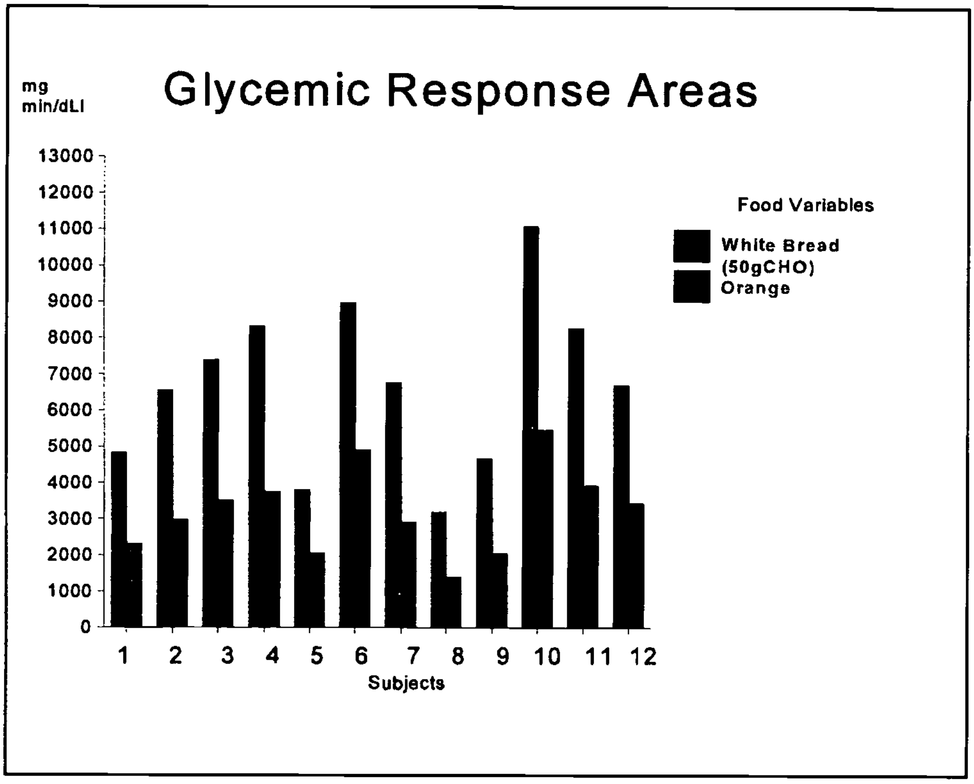
Subject Characteristics

None of the 12 selected subjects presented a history of hypoglycemia or hyperglycemia. All women were community-dwelling and reported themselves to be in good health. Their mean age was 80.3 $\pm$ 4.5 SD years with a range of 73-85 years. They had a mean body weight of 146.7 $\pm$ 36.4 SD pounds (range 100-209 lbs). Their mean height was 62.7 $\pm$ 2.2 SD inches with a range of 60-66 inches. Nine of the subjects were classified as lightly active and the other three were classified as sedentary.

Glycemic Response

The capillary blood glucose concentration increased rapidly after each carbohydrate challenge (white bread or orange). Five data points were collected per glucose response curve. Most subjects consumed their control or test carbohydrate meal within 10-15 minutes. Figure 1 shows the glucose response areas (all subjects) for white bread (50 gram carbohydrate) and orange (50 gram carbohydrate), respectively. Most subjects reached their peak blood sugar concentrations around 60 minutes after starting to ingest the white bread. On the other hand, the orange produced a different effect within the same subject. Few of the subjects' glucose response curves returned to baseline within the 180 minutes of testing with the high glycemic index food, white bread. Just the reverse is found with the low glycemic index food, orange, where the majority of subjects' glucose response curves returned to the baseline fasting level within the 3 hour

Figure 1.
Postprandial Incremental Glycemic Response Areas in Older Women Following Ingestion of 50 Grams Carbohydrate in the Form of White Bread or Orange.



Data are significantly different at $p < 0.001$

testing period.

The glucose response areas for the orange were approximately half of those for the white bread.

Glycemic Indices

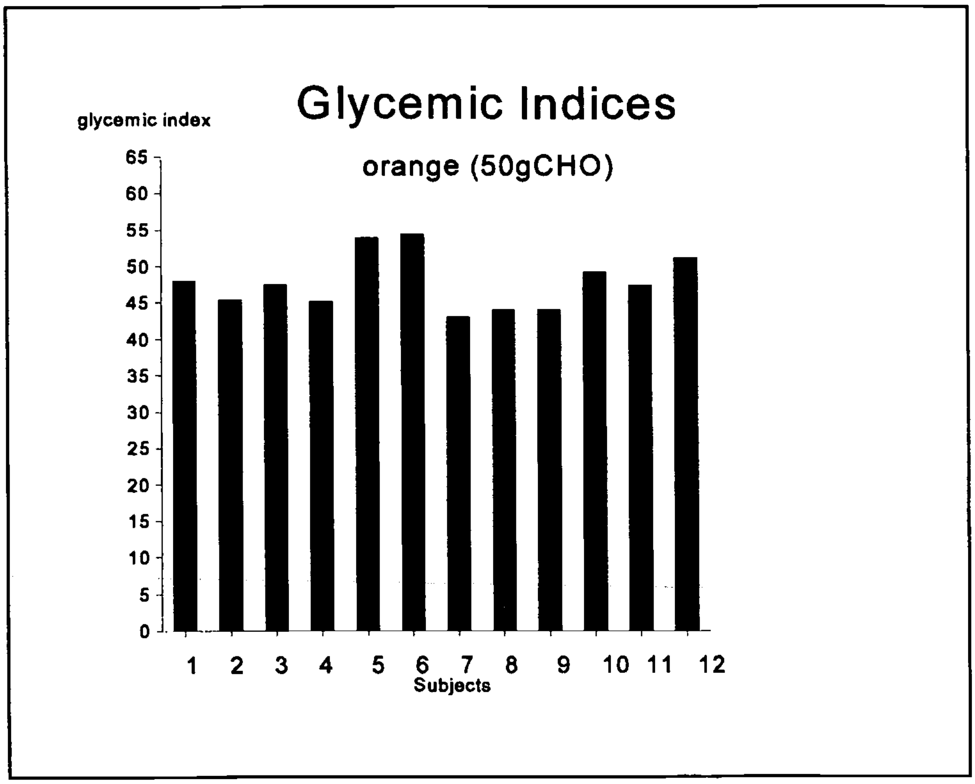
The glycemic index (GI) was calculated by first calculating the area under the glucose response curve for the control meal and then calculating the area under the glucose response curve for the test meal. The ratio of the test meal glycemic response curve area to the control meal glycemic response curve area multiplied by 100 equals the glycemic index. The glycemic indices for all subjects are given in Figure 2. The calculated mean glycemic index for orange is 47.8 ± 3.8 SD. These results were consistent with published values, (Foster-Powell and Miller, 1995).

The mean glycemic index for the orange was significantly lower than that of the white bread ($p<0.001$).

The areas under the two-hour glycemic response curve are frequently used to determine the glycemic index, however, three hours was selected by Wolever *et al.* (1991) for patient compliance and to give non-insulin-dependent diabetes mellitus subjects a chance for the glucose response curve to return to baseline. The non-insulin dependent diabetes mellitus subjects usually have reduced glucose tolerance (elevated glucose response curve) which is very similar to the age-related elevation of the glucose response curve seen in older subjects. Therefore, for this study, the three hour testing period was selected for the glucose response curve.

This study has shown that a low glycemic food, orange, can be highly effective in reducing the normally elevated glycemic response of the elderly as seen with a high glycemic control, white bread. The mechanism by which low glycemic index foods are able to reduce the glucose tolerance curve remains to be identified. Brand *et al* (1991) suggested that the insulin responses between low and high glycemic foods appear to be similar. If this is true, it may mean that low glycemic foods exert some other factor on insulin activity. In

Figure 2.
Glycemic Indices of Orange in Older Women



Data are significantly different from the standard bread index of 100, p<0.001

Mean Glycemic Index = 47.8 ± 3.8

mixed meal experiments, a recent study suggested that variation in protein and fat intake have little effect on postprandial levels of insulin or blood glucose (Wolever & Bolognesi, 1996). On the other hand, in a different study, the same researchers found that the source and amount of carbohydrate had a significant effect on the subjects' postprandial blood levels of glucose and insulin (Wolever & Bolognesi, 1996).

The shapes of the glycemic response curves to white bread and to orange, in this study, show that the glycemic response to a starch-containing food like bread is significantly higher than the glycemic response to the simple sugar containing fruit, orange. In both the test and in the control glycemic response curves, subjects received the same amount of carbohydrate in both the control food and in the test food, yet the test food produced a highly significant reduction in the incremental glycemic response area. Furthermore, the glycemic responses to white bread were extended over a longer period of time. Many individuals eat three meals per day with additional interspersed snacks. Such a dietary regimen could result in a prolonged and highly elevated glucose tolerance curve over a substantial percentage of the 24 hour day. Also, the consumption of an orange (or other low glycemic index food) with bread (or other high glycemic index food) may be of use in the control of age-related elevated post prandial blood glucose levels.

There exists a possible utility in using the glycemic index in correcting age-associated changes in glucose-reponse areas. In other words, a diet of low glycemic foods may be useful in treating aging-related elevations of blood glucose levels that extend normal physiological limits. The use of glycemic indices could greatly improve the outcome of dietary intervention programs.

The significant reduction of the area under the glucose response curve suggests that repetition of the process, over days or weeks, could result in sustained reduction in the exposure of tissues to high and prolonged elevated blood glucose values. If all meals and snacks contained primarily low glycemic foods, then long-term reduction of 24-hour blood glucose levels might be possible. It is interesting to note that none of the women in this study had excessively high blood glucose peaks in response to the orange carbohydrate challenge nor did they experience rebound hypoglycemia at the end of the orange glucose response curve.

The glycosylation theory of aging (Cerami, 1985) would suggest that the lowering of the glucose concentrations in the blood and other bodily fluids throughout the day would lower the rate of glycosylation reactions involving structural and functional proteins throughout the body. Undoubtedly, other reactions would be affected by lowering blood glucose concentrations, for example, the Maillard reaction. Since the Maillard reaction is non-enzyme dependent, glucose reacts with proteins and other substances on contact. The rate of the reaction is accelerated by high concentrations of monosaccharides such as glucose (Cerami, 1985). Therefore, one could conclude that the glucose response curve of orange is more appropriate than the glucose response curve of white bread.

The Glycoslation Theory of Aging suggests that many of the physiological changes that occur as a result of the aging process are based upon the reaction of glucose with various components of the cellular and systemic systems. For example, the longer the protein hemoglobin is exposed to glucose, the more glycosylated hemoglobin is produced (Cerami, 1985). Kristal *and Yu* (1992) have proposed the Free Radical-Glycation/Maillard Reaction Theory of Aging. They suggest that interactions of free radical, glycosylation, and Maillard reaction may synergistically affect the aging process. Furthermore, they present evidence that a significant degree of aging at the cellular and molecular level may be due to the combined effects of these three aging factors.

Additional studies need to be done to explore the possible benefits of dietary intervention on the age-related elevation of blood glucose levels. One area of study would be the longterm monitoring of the blood glucose levels of subjects relative to their dietary intakes. Another study would compare the glycemic response of individual foods with the glycemic response of a meal (several foods). For example, the addition of an individual food item like an orange may favorably affect the entire glycemic index of a mixed meal.

If the glycemic index is to become a useful tool for the clinician and the researcher, greater efforts will have to be made towards compiling a comprehensive data bank of glycemic indices for individual and mixed foods (meals). An initial effort has been made to compile all of the published data on the glycemic indices into a set of tables (Foster-Powell & Miller, 1995).

Several conclusions can be made based on the results of this study. Glucose challenges with orange versus white bread demonstrated the effectiveness of orange at lowering post-prandial or post-glucose challenge blood glucose values in 73-85 year old women. And finally, the post-prandial blood glucose response areas to orange were considerably lower than the post-prandial blood glucose areas to white bread in this group of subjects.

References

Andres, R. Aging and diabetes. (1971). *Medical Clinicians North America,55*, 835-845.

Brand, J.C., Colagiuri, S. Crossman, S., Allen, A.,Roberts, D.C.K., and Truswell, A.S. (1991). Low-glycemic index foods improve long-term glycemic control in NIDDM. *Diabetes Care, 14*(101).

Cerami, A.(1985). Hypothesis / glucose as mediator of aging. *Journal of the American Geriatrics Society, 33*, 626-634.

Foster-Powell, K. and Miller, J.B. (1995). International tables of glycemic index. *American Journal of Clinical Nutri tion, 62,* 871S-893S.

Gannon, M.C., Nuttall, G.Q., Westphal, S.A., Neil, B.J., and Seaquist, E.R. (1989). Effects of dose of ingested glucose on plasma metabolite and hormone responses in type II diabetic subjects. *Diabetes Care, 12*, 544-552.

Kristal, B.S. and Yu, Byung P. (1992). An emerging hypothesis: synergistic induction of aging by free radicals and maillard reactions. *Journal of Gerontology: Biological Sciences, 47*, B107-B114.

United States Department of Agriculture, Human Nutrition Information Service. (1982). *Composition of Foods,* Agriculture Handbook No. 8-9. Washington, D.C.: U.S. Government Printing Office.

Wolever, T.M.S. (1991). Control white bread formula with 250 grams of carbohydrate yield. Department of Nutritional Sciences, Faculty of Medicine, University of Toronto: Personal Communication.

Wolever, T.M. and Bolognesi, C.(1996). Prediction of glucose and insulin responses of normal subjects after consuming mixed meals varying in energy, protein, fat, carbohydrate and glycemic index. *Journal of Nutrition, 126,* 2807-2812.

Wolever, T.M. and Bolognesi, C.(1996). Source and amount of carbohydrate affect postprandial glucose and insulin in normal subjects. *Journal of Nutrition, 126*, 2798-2806.

Wolever, T.M.S., Jenkins, D.J.A., Jenkins, A.L., and Josse, R.G. (1991). The glycemic index: methodology and clinical implications. *American Journal of Clinical Nutrition, 54,* 846-854.

Acknowledgements: A special thanks is given to the women who participated in this study and gave of their time to further our understanding of the concept of the glycemic index. This research was supported in part by the Seberger and Griswold Scholarships, Department of Applied Health Science, Indiana University and by research grants from the Graduate School and the School of HPER Research Council, Indiana University, Bloomington, Indiana.

Contributors

Diane Demuth Allensworth, Ph.D., RN, CHES, Professor Emeritus, Kent State University.

Anne L. Binkley, ReD, Victoria University of Technology, Department of Physical Education and Recreation, Footscray Campus, P.O. Box 14428 MMC, Melbourne, Victoria, Australia 3000.

Isbatou Boukari, MS, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405.

Heather Chamberlain, MS, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405.

Darwin Dennison, Ed.D, CHES, DINE Systems, Inc., 586 N. French Rd., Amherst, NY 14228-9965, SUNY Buffalo, School of Health Related Professions.

Kathryn F. Dennison, Ed.D., Vice President, DINE Systems, Inc. Amherst, NY.

Thomas E. Dinero, Ph.D., Professsor Emeritus, Retired from Department of Evaluation and Measurement Program, Kent State University.

Susan J. Eklund, Ph.D., Indiana University Center on Aging and Aged, Smith Research Center, Room 197, Education 4012, Indiana University, Bloomington, IN 47405.

Alyce D. Fly, Ph.D., Assistant Professor of Nutrition Science, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405.

Janet K. Grommet, Ph.D., R.D., Department of Health Sciences, Program in Nutrition, Long Island University, C.W. Post Campus, Brookville, New York 11548.

Barbara A. Hawkins, ReD, Department of Recreation and Park Administration, HPER 133, ISDD, 2853 E. 10th Street, Indiana University, Bloomington, IN 47405.

Delores C.S. James, Ph.D, R.D., L.D., Department of Health Science Education, FLG-5, P.O. Box 118210, University of Florida, Gainesville, Florida 32611-8210.

Yang Jingyi, Ph.D., Beijing University of Physical Education, Yuan Ming Yuan East Road, Beijing, China 100084

David M. Koceja, Ph.D., Department of Kinesiology, HPER 112E, Indiana University, Bloomington, IN 47405.

Alice K. Lindeman, Ph.D., R.D., Associate Professor, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405.

Susan Massad, HSD, R.D., Department of Health Sciences, Springfield College, 263 Alden St., Springfield, MA 01109-3797.

Kweethai Chin Neill, Ph.D., CHES, Assistant Professor, Deparment of Health and Kinesiology, Sam Houston State University, P.O. Box 2176, Huntsville, TX 77341-2176.

John R. Seffrin, Ph.D., Executive Vice President, American Cancer Society, 1599 Clifton Road, NE, Atlanta, GA 30329.

Nathan W. Shier, Ph.D., Associate Professor, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405.

Mohammad R. Torabi, Ph.D., MPH, Chancellor's Professor and Assistant Chairperson, Co-Director of the Rural Center for HIV/STD Prevention, Department of Applied Health Science, HPER 116, Indiana University, Bloomington, IN 47405

John R. Warren, Ph.D., Division of Health and Human Services, Ivy Tech State College, Bloomington, IN 47404.

71

ETA SIGMA GAMMA
CL325
2000 University Avenue
Muncie, Indiana 47306

ADDRESS CORRECTION REQUESTED

NON-PROFIT ORG.
U.S. POSTAGE
PAID
Muncie, Ind.
Permit No. 141

NOTICE

REPRODUCTION BASIS

- [X] This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

- [ ] This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").