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DETERMINATION OF NUTRIENT INTAKES BY A MODIFIED VISUAL ESTIMATION METHOD AND COMPUTERIZED NUTRITIONAL ANALYSIS FOR DIETARY ASSESSMENTS

U S ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE

Natick, Massachusetts

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Assessing the dietary intake of a military population in the field or in a garrison dining facility presents many problems since data collection cannot interfere with the mission or schedule of the soldier, may be done under widely varying environmental conditions, and is limited by the amount and type of equipment that can be used. In response to this challenge, the modified visual estimation methodology (MVEM) was developed to meet all of the above constraints.

This report contains a detailed description of the MVEM, the standardized procedures for training data collectors to be >90% reliable and accurate to within a tenth of a standard portion, and the procedures for analyzing the nutritional data by computer. This methodology is one of the most reliable, accurate, and feasible methods for performing dietary assessments of military populations and is potentially useful for any mass feeding situation. MVEM is an effective method for quantifying the dietary intakes of large numbers of subjects with minimal interference in terms of time and subject cooperation, minimum

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equipment needs, and widespread application to all field and garrison dining settings. MVEM requires training/retraining of data collectors, analysis of training data to determine the accuracy and reliability of data collectors, examples of standard portions of all foods served at each meal, and observation of food preparation.

The computerized nutritional analysis procedures require coding of all food intake data, coding of all recipe preparation data, and analyzing for nutrient intake. Computer analysis of food intake data is not as accurate as chemical analysis; however, these values provide a useful average for population studies, do not delay data processing, and is relatively inexpensive. Using MVEM and observing recipe preparation procedures improve the accuracy of the nutritional analysis information for population dietary assessments.

DISCLAIMER STATEMENT

The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation.

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DETERMINATION OF NUTRIENT INTAKES BY A MODIFIED VISUAL ESTIMATION METHOD AND COMPUTERIZED NUTRITIONAL ANALYSIS FOR DIETARY ASSESSMENTS

MAJ M.S. Rose, Ph.D., R.D.[1]

J.C. Buchbinder, M.S., R.D.[1]

T.B. Dugan, B.A.[1]

CPT E.G. Szeto, MPH, R.D.[1]

J.D. Allegretto, B.S.[1]

R.W. Rose, M.S., R.D.[1]

MAJ D.E. Carlson, M.S., R.D.[1]

K.W. Samonds, Ph.D.[2]

COL D.D. Schnakenberg, Ph.D.[1]

[1]U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760-5007

[2]University of Massachusetts
Dept of Food Science and Nutrition
Amherst, MA 01003

FOREWORD

This technical report establishes a manual for collecting and analyzing food intake data for field and garrison assessments of dietary intake. The report discusses the entire sequence of events from training of the data collectors to analysis of the data.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of SSG Santiago-Morales in conducting the training and testing sessions. We are grateful to Carlo Radovsky for his computer expertise which was instrumental in the development of the data entry and statistical analysis programs for analyzing the reliability and accuracy of the data collectors applying the modified visual estimation method.

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ABSTRACT

Assessing the dietary intake of a military population in the field or in a garrison dining facility presents many problems since data collection cannot interfere with the mission or schedule of the soldier, may be done under widely varying environmental conditions, and is limited by the amount and type of equipment that can be used. In response to this challenge, the modified visual estimation methodology (MVEM) was developed to meet all of the above constraints.

This report contains a detailed description of the MVEM, the standardized procedures for training data collectors to be >90% reliable and accurate to within a tenth of a standard portion, and the procedures for analyzing the nutritional data by computer. This methodology is one of the most reliable, accurate, and feasible methods for performing dietary assessments of military populations and is potentially useful for any mass feeding situation. MVEM is an effective method for quantifying the dietary intakes of large numbers of subjects with minimal interference in terms of time and subject cooperation, minimum equipment needs, and widespread application to all field and garrison dining settings. MVEM requires training/retraining of data collectors, analysis of training data to determine the accuracy and reliability of data collectors, examples of standard portions of all foods served at each meal, and observation of food preparation.

The computerized nutritional analysis procedures require coding of all food intake data, coding of all recipe preparation data, and analyzing for nutrient intake. Computer analysis of food intake data is not as accurate as

chemical analysis; however, these values provide a useful average for population studies, do not delay data processing, and is relatively inexpensive. Using MVEM and observing recipe preparation procedures improve the accuracy of the nutritional analysis information for population dietary assessments.

INTRODUCTION

A. REQUIREMENT FOR METHODOLOGY

In 1985, the Combat Field Feeding System - Force Development Test and Experimentation (CFFS-FDTE) study was conducted to evaluate a newly developed Combat Field Feeding System's capability to provide subsistence support to the Army in the field and to evaluate the nutritional adequacy of the rations consumed by soldiers in a field environment (1). See Appendix A for list of definitions. One objective of the CFFS-FDTE test was to evaluate and compare nutrient intakes of soldiers consuming the various CFFS rations periodically during the 44-day field test. The Military Nutrition Division of the United States Army Research Institute of Environmental Medicine (USARIEM), Natick, MA, was responsible for collecting and analyzing food and water intake data. Therefore, there was a need to develop a dietary intake methodology that was reliable, accurate, and feasible in the sense of minimal interference with field training exercise and food service activities. There was also the need to develop a computerized dietary data analysis system to facilitate rapid data entry, verification, reduction, and statistical analyses.

Quantifying soldiers' nutrient intakes required a dietary collection methodology that could be used during field training exercises to provide a reliable and valid appraisal of soldiers' dietary intakes. The advantages and disadvantages of various dietary collection methodologies, i.e., 24-hour recall, combination record and recall, dietary history, estimated record, weighed record, food frequencies, estimating plate waste, etc. were considered. Large-scale surveys of nutritional intake frequently rely on one person in the family to provide all data through 24-hour recalls or 2- to 3-day recall-record combinations because of cost and response problems (2). These methods usually do not provide an accurate index of the normal eating pattern because of forgetfulness, inaccurate estimations of portions by untrained subjects, or changes in eating patterns because of the burden of remembering and/or recording all foods. Burk and Pao (3) have published an extensive review of the procedures and problems in design, collection, analysis, processing and interpretation of dietary survey data for individuals.

The accuracy of food diaries has been studied by observing and/or weighing the food eaten and comparing this data to that recorded by the individuals in their diaries (4,5). In one study, only 50% (62/133) of the individuals accurately reported their food intake but the reporting of food selections were accurate 80% of the time (4). The diary method significantly underestimated nutrient intake per meal by 16% or less (4,5). Pao (6) reported that men accurately remembered about 85% of what they actually ate when the 24-h recall method was used. About 13-14% of the items actually eaten were omitted during the interview and 5-7% of the items recalled were not observed to have been eaten (6). Therefore, the 24-h recall and food diary methods are only 80-85% accurate. Studies (6-8) have shown that trained and untrained individuals usually overestimate portion sizes of foods. More than 50% of the untrained people who used estimation aids overestimated by more than 50% of the actual portion sizes (7). In contrast, Schnakenberg et al. (8) reported that trained data collectors can estimate average energy intake at a meal with an accuracy of $\pm$ 2%.

It is generally agreed that weighing of foods served and returned is the most accurate method of determining the quantity of food eaten by an individual (9,10). However, weighing foods and keeping records can disrupt customary routines and are time consuming (3). The precision of weighing foods is unnecessary if chemical analyses of the foods are not available and food composition table values are used for nutritional analysis. Burk and Pao (3) discuss the inconsistency and systematic bias when precisely weighed records of food quantities are analyzed with nutrient contents obtained with imprecise shortcut methods.

B. DEVELOPMENT OF A METHODOLOGY

Since the dietary collection methodology had to meet the minimal interference constraints imposed by the field exercise scenario yet still provide a true index of soldiers' food intakes, a specific dietary collection methodology was developed and tested during the CFFS-FDTE (1,8). The dietary methodology is a modification of the visual estimation methodology described by Lachance and others (9-12). This modified visual estimation methodology (MVEM) uses trained data collectors to visually estimate the quantity of food on trays before and after subjects eat. The data collectors compare the food portions to a weighed standard portion of the same food. Using the weighed standard portions which are representative of portions actually served, data collectors are trained to estimate the food that is served and returned to the nearest 0.1 of a portion.

MVEM is a combination of the best attributes of existing dietary assessment methods. Trained data collectors and weighed standards increase the accuracy of the dietary intake data compared to recall methods which depend on the accuracy of memory, judgment of portion sizes of many untrained subjects, and the skill of the interviewers. MVEM reduces the burden on the subject because he shows his tray to a data collector before and after he eats instead of having to record everything he eats. However, this method does have the drawback that some subjects may change their eating patterns when observed. Having each subject weigh his food might further increase accuracy but greatly interferes with the subject's normal routine, is time consuming, requires many weighing scales to make large scale data collection impossible, and is unfeasible for military field or garrison feeding situations.

Since the nutrient composition of foods is influenced by food preparation techniques, there was also a need to develop a procedure to closely monitor recipe preparation. The data from the recipe analysis are used with the food intake data collected by MVEM to calculate quantities of nutrients consumed.

There are two options available to an investigator when nutritional information is desired for a complex food comprised of multiple ingredients. The first option is to sample that food and to have it chemically analyzed. Chemical analysis of foods is expensive and time consuming, and thus involves delay in processing food intake data, but it is unquestionably the most accurate method available. The second option is to rely on food composition tables and to calculate the resulting nutritional profile from the sum of nutrients in the ingredients. This option is relatively inexpensive, would not cause a delay in processing food intake data but is randomly less accurate due to comparability problems between the food ingredients actually used and those in the food composition tables (13). Analysis of food intake data using food composition tables produces values which are not as accurate as chemical analysis but which are useful for population studies (14). With the advent of computerized access to nutrient database systems which contain data from food composition tables, computer recipe analysis is an efficient tool for the analysis of food intake data collected in dietary assessments of populations. The Digital VAX 11/780 computer (VAX) is used with the ORACLE Relational Database Management System (ORACLE) for nutritional analysis of the data.

Presently, a standard version of a computerized nutrient database, the Nutrient Databank (NDB), at the University of Massachusetts at Amherst, MA (UMASS) is used to compute nutrient composition of recipes prepared in Army dining facilities. The nutrient data contained in this Databank are from the USDA's Database for Standard Reference, Release 5, supplemented with data from other food composition handbooks, manufacturers' analyses, scientific literature, and imputation. In the present system, cooking losses are accounted for by selecting cooked ingredients and adjusting final water percentages. A more sophisticated NDB is being developed which will allow for correction of nutrient values for losses during cooking and corrections of yields for fat and/or water changes.

C. PURPOSE OF REPORT

The purpose of this report is to provide a detailed description of the dietary methodology which USARIEM has developed and refined since the CFFS-

FDTE (1) and used in four subsequent studies: Fort Riley and Fort Lewis Garrison Dining Facilities (15), Fort Sam Houston CFFS-Medical (16), and Fort Devens Dining Facility study (unpublished). The report includes a description of the activities and procedures which are utilized before, during, and after dietary data collection including a detailed users manual for training dietary data collectors. The report also includes an evaluation of the reliability and accuracy of the MVEM for estimating portion size.

PRE-DATA COLLECTION ACTIVITIES

A. COLLECTION AND PRE-CODING OF RECIPES

Figure 1 contains a flow diagram of the activities that occur prior to the start of data collection for dietary assessments of field and garrison feeding. When notification is received about a study, a menu is obtained from the dining facility manager which details the foods to be served during the study period. For recipes from the Armed Forces Recipe Service File TM-412, a file of recipe numbers is constructed on the VAX, and is read by the program GET_RECIPE, which searches files of previously coded recipes for those recipe numbers. GET_RECIPE produces five files: (a) RECIPE.FIL which contains all previously coded recipes (Table 1); (b) a second file containing the codes of those single ingredient recipes found in the ORACLE table WHOLE (Table 2), (c) a file containing the codes of special Army rations found in the ORACLE table RATION, and (d) a list of the recipe codes that were found and (e) a second list of those recipe codes that were not found.

For those recipes which were not previously coded, the program CODING is employed to interactively code recipes. CODING accesses an ingredient file of names, NDB codes, and portion options, and allows for quick and easy coding of the most complex recipes. The list of codes for all ingredients and the quantity of that ingredient in the recipe are automatically read into a file of coded recipes (RECIPE.FIL) by the program. CODING can also be used as a recipe entry program, with the actual coding being done with a printed version of the above mentioned ingredient file. The resulting recipe file is appended to the RECIPE.FIL containing the previously coded recipes.

Figure 1
PRE-DATA COLLECTION PROCEDURES USED DURING
THE DIETARY ASSESSMENT OF FIELD AND GARRISON FEEDING

RECIPE & COMPUTER SPECIALIST ACTIVITIES

OBTAIN MENU

↓

CONSTRUCT FILE OF RECIPE NUMBERS

↓

SEARCH FOR PREVIOUSLY CODED RECIPES (GET_RECIPE)

↓

START FILE OF CODED RECIPES FOR STUDY

↓

DUPLICATE RECIPES TO USE IN KITCHEN

↓

CODE NEW RECIPES (CODING)

↓

START STUDYNAME.COD FILE (CODMAKER.FOR)

DATA COLLECTOR ACTIVITIES

TRAINING OF DATA COLLECTORS IN VEM

↓

ANALYSIS OF RELIABILITY AND ACCURACY OF DATA COLLECTORS

Table 1. Sample of computer file named RECIPE.FIL.

```
RECIPE L00071            HAM STEAKS BKD
810140  HAM, CANNED, ROASTED      3.000 POUND, AP      1360.8 GRAMS

RECIPE G030              HAM MAC AND TOMATO
ARB012  HAM-CND-CHNK-DRND        16.250 POUND          7377.5 GRAMS
ARB008  PEPPERS-GREEN-DEHY        5.330 OUNCE           151.1 GRAMS
027010  WATER          .002      38.400                3840.0 GRAMS
013000  TENDER MACARONI           4.500 YLD; LB.       6660.0 GRAMS
804031  SHORTENING, SOY/COT       1.000 POUND           453.6 GRAMS
802020  GARLIC POWDER             1.000 TEASPOON          2.8 GRAMS
811531  TOMATO, CND, WHOLE       19.160 POUND          8691.0 GRAMS
022300  GRANULATED SUGAR           .250 CUP              50.0 GRAMS
ARB009  CHEESE-AMER-DEHY          1.250 POUND           567.5 GRAMS
811540  TOMATO JUICE              1.160 QUART          1127.5 GRAMS

RECIPE L00022            BEEF STEW
002200  BEEF CHUCK RAW            3.000 POUND          1360.8 GRAMS
024390  ALL-PURPOSE FLOUR          .200 CUP              27.4 GRAMS
019630  SALT                       .500 CUP             145.0 GRAMS
802030  BLACK PEPPER               .200 TABLESPOON        1.3 GRAMS
802020  GARLIC POWDER              .167 TABLESPOON        1.4 GRAMS
804518  CORN OIL                   .200 CUP              43.6 GRAMS
811531  TOMATO, CND, WHOLE        1.200 CUP             288.0 GRAMS
802042  THYME GROUND               .100 TABLESPOON         .4 GRAMS
802004  BAY LEAF                   .100 TEASPOON           .1 GRAMS
811125  CARROTS, BLD, NO SALT      .800 POUND           362.9 GRAMS
811144  CELERY, BLD, NO SALT       .400 POUND           181.4 GRAMS
811805  BOILED ONIONS, W/SALT      .300 POUND, AP       136.1 GRAMS
811367  POTATO, FLSH, BLD, WO/S   1.000 POUND, AP       453.6 GRAMS
019630  SALT                       .300 TBSP.             5.1 GRAMS
024390  ALL-PURPOSE FLOUR          .450 CUP              61.7 GRAMS

RECIPE G026              CHILI CON CARNE
007560  CHILI WITH BEANS          1.000                 100.0 GRAMS

RECIPE G009              BEEF STEAK AND GRAVY
ARB020  BEEFSTEAK-DEHY-RAW        1.000 POUND           454.0 GRAMS
804034  HYDROG. SOYBEAN OIL        .400 CUP              87.2 GRAMS
024390  ALL-PURPOSE FLOUR          .600 CUP              82.2 GRAMS
ARB006  SOUP+GRAVY BASE-BEEF       .800 OUNCE            22.7 GRAMS
802030  BLACK PEPPER               .100 TABLESPOON         .6 GRAMS
024390  ALL-PURPOSE FLOUR         1.800 CUP             246.6 GRAMS
WATER PERCENTAGE ADJUSTED TO ******
```

Table 2. Sample of computer file listing single ingredient recipes.

02210 1.		CHUCK, BONELESS, TRIMMED, CKD
02210	1.	
03550 1.		ROUND STEAK, TRIMMED, CKD (CHOICE)
03550	1.	
03702 1.		HAMBURG (LEAN) 21%FAT, WELL DONE
03702	1.	
03720 1.		BEEF STEW, CANNED
03720	1.	
03810 1.		CHIPPED BEEF, CREAMED
03810	1.	
03940 1.		BEER, (4.5% ALC/VOL)
03940	1.	
03941 1.		BEER, LIGHT
03941	1.	
03950 1.		LIQUOR, 80 PROOF
03950	1.	
04070 1.		CARBONATED, GINGER ALE, PALE DRY
04070	1.	
04090 1.		CARBONATED, ARTIFICIALLY SWEETENED
04090	1.	

CODMAKER reads RECIPE.FIL and writes an abbreviated version called studyname.COD which is composed of (a) the three-character access code, (b) the food name, and (c) the standard weight (Table 3). CODMAKER.FOR can also read a studyname.COD file from another study and reformat it for the new study. Having the data collectors and data enterers use the three-character access code reduces the possibility of error during coding and entry of food intake data. The studyname.COD file serves two purposes. In printed form it serves as a codebook for the data collectors, allowing them to code each subject's food choices at each meal for entry by the data enterers. The studyname.COD file also serves as a resource file for the data entry program, translating the access code into the NDB code, and the number of portions into weight in grams. It is helpful to the data collectors if the studyname.COD file is as complete as possible when the study begins. CODMAKER allows the recipe specialist to organize the original foods in the studyname.COD file into categories for easy reference. However, subsequent entries cannot be added to the previously set categories. A studyname.COD file should be printed for each of the data collectors at the beginning of the study and as it is revised during the study.

B. TRAINING IN THE MODIFIED VISUAL ESTIMATION METHOD

To be sure that the data collectors are collecting food intake data that are reliable and accurate, they are trained prior to the start of the study. Training involves repetitive practice estimating portion sizes for different foods on plates, trays, and bowls (Appendices B-E). The training program consists of six sessions administered over a three day period of time.

Table 3. Sample of a studyname.cod file called FTSAM. COD.

A	B	C	D	E	F
1	1	TTT801	PUDDING-CHOCOLATE	1W RND SP	126.00
2	1	TTT901	CHEESE SPREAD	MRE PACK	43.00
3	2	TTT102	BEEF-CREAMED GROUND	3 RND SP	253.00
4	2	TTT103	BACON-CANADIAN W/BRINE	3 SLICES	66.00
5	2	TTT105	SAUSAGE-BRKFST		96.00
6	2	TTT201	PEPPERS-STUFFED		378.00
7	2	TTT202	MEATBALLS-SWEDISH		183.00
8	2	TTT203	BEEF-SWISS STEAK		251.30
9	2	TTT301	PORK-ROAST W/GRAVY	2.5 SL	71.00
10	2	TTT302	MEATLOAF W/GRAVY	2 SL,.5SP	130.00
11	2	TTT303	CHICKEN-GOLDEN, W/GRAVY	2SL,1SP	130.00
12	2	TTT304	BEEF STEW	3 SPOONS	300.00
13	2	TTT305	HAM SLICES	2 SLICES	93.00
14	2	TTT306	BEEF W BARBEQUE SAUCE	2 SC SP	184.00
15	2	TTT307	CHICKEN ALA KING	2 W RND SP	246.00
16	2	TTT308	BEEF-ROAST W MUSHROOM GRAVY	2.5 SL	193.00
17	2	TTT309	STEAK-PEPPER	3 SC SP	251.00
18	2	TTT310	FRANKFURTERS	2 FRANKS	99.00
19	2	TTT311	LASAGNA	3*4 SQ	251.00
20	2	TTT312	TURKEY-SL W/GRAVY	4.5SL,1SP	150.00
21	2	TTT313	BEEF TIPS & GRAVY	2 RND SP	187.00
22	2	TTT314	CHICKEN CACC		251.30
23	2	TTT315	CHILI		249.00
24	2	TTT316	BEEF-POT ROAST		248.00
25	2	TTT317	PORK-BBQ		170.00
26	2	TTT318	SPAGHETTI W/MEATBALLS		251.00
27	3	TTT101	EGGS AND HAM	2SL RND SP	150.00
28	3	TTT106	EGGS-CHEESE OMELET		145.90
29	3	TTT107	EGGS-SCRAMBLED		145.90
30	4	TTT400	BEANS-BAKED	1 HEAP SP	160.00
31	5	TTT104	BREAKFAST BAKE	4*5 SQ	152.00
32	5	TTT108	CEREAL-CORN		170.00
33	5	TTT109	CEREAL-GRITS		170.00
34	5	TTT200	RICE-SPANISH		170.00
35	5	TTT403	NOODLES-BUTTERED	3 HEAP SP	248.00
36	5	TTT404	MACARONI & CHEESE	2 HEAP SP	250.00
37	5	TTT407	RICE-WHITE	2 HEAP SP	188.00
38	5	TTT700	BREAD-WHITE, CANNED	.33 CAN	76.00
39	5	TTT800	APPLE DESSERT	1 SL RND	123.00
40	5	TTT802	CAKE-COFFEE		73.00
41	5	TTT803	DESSERT-BLUEBERRY		154.00
42	5	TTT804	CAKE-BLUEBERRY		75.00
43	5	TTT805	CAKE-CHERRY NUT		143.00

Column A = Three-Character Access Code
Column B = Extra field which may be used to discriminate between food groups or types of rations (i.e., A-, B-, and T-rations)
Column C = Six-digit Nutrient Databank (NDB) code
Column D = Food description or name
Column E = Standard portion in household measurements
Column F = Standard portion weight in grams

The estimations of portion sizes are analyzed for accuracy and reliability before the data collectors start a study.

C. RELIABILITY AND ACCURACY OF THE MODIFIED VISUAL ESTIMATION METHOD

To test the ability of data collectors to estimate the same portion sizes repeatedly, an analysis of variance repeated measures program of SPSSx was used to statistically analyze the training data and to produce a reliability coefficient. Reliability measures the extent to which a test or judge yields the same results on repeated trials (17). Since measurement always contains a certain amount of chance error, unreliability is always present. However repeated measurements of the same phenomenon tend to be consistent from measurement to measurement and this phenomenon is referred to as reliability. The more consistent the results given by repeated measurements, the higher the reliability of the measuring procedure; the less consistent the results, the lower the reliability.

The ability of the data collectors to accurately estimate portion sizes is determined by subtracting the visually estimated fraction of a standard from the fraction obtained from weighing the food sample (estimate - actual). The differences are checked to ensure that the mean is less than a tenth of a fraction of the standard portion.

Criteria to select a person as a data collector are: reliability score greater than (>) 90% and mean accuracy within a tenth of a standard portion size. Statistical information from the training of data collectors from 4 studies are presented here: CFFS-FDTE Hawaii (1), Fort Lewis Garrison Dining Facility (15), Fort Sam Houston CFFS-Medical (16), and Fort Devens Dining

Facility study (unpublished). The reliability data from these 4 studies are categorized into two groups because of differences in the timing and method of collecting reliability data for each of the above studies: (a) testing after portion estimation practice and 12 days of collecting food intake data in the CFFS-FDTE Hawaii study (Group A) and (b) testing after 2 days of practice estimating portion sizes for the Fort Lewis Garrison Dining Facility, the Fort Sam Houston CFFS-Medical, and Fort Devens Dining Facility studies (Group B).

Food items for the training were selected because of their consistency, shape, frequency served, and/or availability. Foods were presented on plates, in bowls, and with multiple foods per plate in an effort to discount method of presentation but all data for a specific food and portion were analyzed together. The subjects observed the portion sizes of the different foods at least three times with 5 being the most frequent number of tests. Portion sizes ranged from 0.1 - 2.5 times a standard portion for the data collectors in Group A. Because studies had shown that portion sizes greater than 1.5 times a standard portion were very infrequent, the data collectors were only tested from 0 to 1.3 times a standard portion for Group B.

Reliability of Data Collectors

Data collectors in group A were tested on their ability to visually estimate a portion size after 12 days of collecting food intake data and showed an overall reliability of 98% in estimating fractions of portion sizes (Table 4). Group B data collectors had mean reliability scores of 95 and 98% with the most frequent score being 98%. Analyzing reliability by food types

Table 4. Reliability of data collectors in estimating fractions of a standard portion using the modified visual estimation method in different Army studies.

STUDY	RELIABILITY(%)	RANGE
GROUP A		
CFFS-FDTE (n=12)	98	97-99
GROUP B		
Fort Lewis (n=4)	95	92-98
Fort Sam (n=12)	98	84-99
Fort Devens (n=4)	98	97-99

showed that the data collectors in the FT Lewis study had more trouble estimating portion sizes for rice and chili with scores of 89 and 82%, respectively (Table 5). The reliability scores for all other foods were greater than 90%.

The data for Group B were analyzed to determine the effects of obvious errors on reliability scores. Obvious errors were described as putting the decimal point in the wrong place (i.e. 2.5 vs .25), mixing the order of the plates of food, etc. The scores for two judges increased from 84 to 99% and from 89% to 97%, respectively when the obvious error of misplacing decimals was corrected. The obvious errors were not corrected when determining the final reliability scores. The data collector with a reliability score of 84% was not used in any of these studies but due to personnel constraints the dietary collector with an 89% reliability score was retained. This data collector received extra training, was given fewer subjects, and data collection sheets were reviewed for major inconsistencies.

Accuracy of Data Collectors

The overall accuracy of the data collectors, taken by averaging the means of the different studies, was an underestimation of 0.03 of a standard portion size. The mean accuracy values for the data collectors in the different studies are found in Table 6. The CFFS-FDTE Hawaii data indicated that the major inaccuracies in estimating portion size occurred when portion sizes 1.7 times or greater than the standard portion were used (1). The accuracy of the data collectors in estimating the portion sizes of different food items is found in Table 7.

Table 5. Reliability (%) of the modified visual estimation method in estimating fractions of a standard portion for various food items in different Army studies.

FOOD	STUDY			
	Hawaii	FT Lewis	FT Sam	FT Devens
Bread, field & cnd	98			
Eggs & Ham	99			
Creamed Beef	98			
Beef Stew	97		94	98
Rice	98	89	96	95
Mixed Vegetables	97	94	94	98
Pineapple, cnd	98			
Pudding, cnd	98			
Potatoes, diced	98			
Baked Product		90	95	95
Fluid		92		97
Spam		93		
Chili		82		

Table 6. Accuracy of data collectors in estimating fractions of standard portion sizes using the modified visual estimation method in different Army studies (Mean ± SD).

	ACTUAL PORTION SIZE	STUDY ESTIMATE	DIFFERENCE
CFFS-FDTE (n=12)	1.10±0.68	0.99±0.63	-0.10±0.27
Fort Lewis (n=4)	0.80±0.39	0.78±0.40	-0.02±0.19
Fort Sam (n=12)	0.52±0.33	0.54±0.32	-0.01±0.09
Fort Devens (n=4)	0.52±0.32	0.52±0.32	-0.00±0.07
MEAN			-0.03

Table 7. Deviation from actual portion sizes (estimate - actual) of data collectors using the modified visual estimation method to estimate portion sizes of food items in different Army studies (Mean ± SD).

FOOD	STUDY			
	HAWAII (n=199)	FT Lewis (n=28)	FT Sam (n=72)	FT Devens (n=24)
Field Bread	-0.11±0.27	-	-	-
Eggs & Ham	-0.02±0.19	-	-	-
Creamed Beef	-0.05±0.28	-	-	-
Beef Stew	-0.14±0.28	-	-0.04±0.09	-0.02±0.06
Rice	-0.06±0.30	0.09±0.18	0.04±0.08	0.02±0.10
Mixed Vegetables	-0.21±0.32	0.12±0.21	0.01±0.09	-0.03±0.05
Pineapple	-0.18±0.27	-	-	-
Canned Bread	-0.07±0.22	-	-	-
Pudding	-0.15±0.22	-	-	-
Potatoes, diced	0.19±0.24	-	-	-
Spam	-	0.00±0.09	-	-
Fluid	-	0.02±0.10	-	-0.03±0.09
Chili	-	-0.21±0.16	-	-
Baked Product	-	-0.12±0.09	0.02±0.07	0.04±0.04

Limitations of the Modified Visual Estimation Method

One of the major limitations of this training program was that it has not been tested for the effects of memory on the data collectors' ability to produce such high reliability scores. To decrease the effects of memory, testing sessions for the data collectors were spread over three days, testing sessions were interspersed with other distractor sessions, and large numbers of foods and portions were included in the test to make memorization difficult.

A second limitation was that the data collectors were not tested for reliability over long periods of time. Testing was usually done in two to three days because of time and material limitations whereas most MND studies extended over a two week period. However, several of the data collectors were retrained and retested over a two month period and their reliability scores increased by 1-2%. This is not a true test of the above problem but the stability of the reliability scores over 2 months and the fact that the reliability scores were very high for the data collectors in the CFFS-FDTE-Hawaii study after 12 days of practice indicate that the variation in accuracy and reliability over a two week time period might not cause a major discrepancy in computing the intake of nutrients in the different studies. Since this method is used to obtain information on population patterns of food consumption and not for metabolic studies, a small difference in reliability scores is not as critical. The CFFS-FDTE-Hawaii study (1) showed that trained and experienced data collectors were able to estimate the caloric content of meals to within 2% (21 kcal). A 2% difference in reliability probably would not affect the final results significantly since variation in daily food intake is usually greater than 2%. However a study needs to be conducted to test the reliability and accuracy of data collectors over the course of a study.

DATA COLLECTION ACTIVITIES

A. COLLECTION OF FOOD PREPARATION DATA AND DATA ENTRY

Collection of Recipe Data

This step starts with a visit to the test site. Figure 2 contains a flow diagram of the activities that occur during the data collection phase of the study at the test site. Information is obtained on the foods, beverages, and condiments which are offered each day. These foods may or may not be listed on the menu i.e.: condiments, type of salad dressing, salad bar ingredients, etc. but information is needed because the soldiers will use these items frequently. Usually food composition data are available for each of these items and they are coded as single ingredient recipes. A standard unit of measure is decided upon for each of the above foods, and an average weight is computed from ten samples. This average becomes the standard portion for each item, and is the unit which the data collectors will use as their standard for portion estimation. In the case of some of the more difficult items for portion estimation, such as salads individually created at the salad bar, subjects are asked to describe their selections in terms of these standard measures. For example, quantities of blue cheese dressing are described in numbers of ladles. This is an example of the least accurate estimation. Standard weights and measures for foods made from recipes which contain multiple ingredients (reciped foods) are not obtained until they are encountered during the study. Standard foods, beverages, and condiments which are served each day and which do not vary in nutritional composition

Figure 2
DATA COLLECTION PROCEDURES WHEN IMPLEMENTING THE MODIFIED VISUAL ESTIMATION METHOD

RECIPE SPECIALIST ACTIVITIES

COLLECT DATA ON SINGLE INGREDIENT FOODS THAT WILL BE OFFERED DAILY

↓

MEET WITH COOKS

↓

OBTAIN PRODUCTION SCHEDULE

↓

DUPLICATE RECIPES IF NOT DONE

↓

OBSERVE PREPARATION OF MULTI-INGREDIENT RECIPES

↓

PREPARE STANDARD PORTION SAMPLES FOR DATA COLLECTORS

↓

UPDATE STUDYNAME.COD FILE W/NEW RECIPE NAMES AND STANDARD WEIGHTS

↓

COLLECT INFORMATION ON MENU SUBSTITUTIONS

↓

CODE AND/OR ALTER RECIPES (CODING)

↓

DATA COLLECTOR ACTIVITIES

FAMILIARIZATION W/DINING FACILITY AND PRACTICE DATA COLLECTION

↓

RECEIVE SPECIAL INSTRUCTIONS FROM RECIPE SPECIALIST & EXAMINE PORTION SIZES

↓

COLLECT FOOD INTAKE DATA (3 MEALS/DAY + DIETARY RECORD OF BETWEEN-MEAL SNACKS

↓

DATA COLLECTION PROCEDURES WHEN IMPLEMENTING THE MODIFIED VISUAL ESTIMATION METHOD (continued)

RECIPE SPECIALIST ACTIVITIES

↓

VALIDATE CODED RECIPES (CODING)

DATA COLLECTOR ACTIVITIES

↓

REVIEW & CODING OF FOOD INTAKE DATA

↓

ENTER FOOD INTAKE DATA INTO COMPUTER FILES (ENTRY)
PRODUCE REPORT AFTER ACCESS TO STUDYNAME.COD (ENTRY)

↓

VALIDATE REPORTS BY COMPARING TO ORIGINAL DATA COLLECTION FORMS

↓

CORRECT DATA FILES

↓

RE-VALIDATE DATA FILES UNTIL CORRECT

↓

VALIDATION BY PROJECT LEADER

are now coded as single ingredient recipes with recipe codes that correspond to the UMASS NDB codes and are appended to the growing file of coded recipes. Multi-ingredient recipes are rarely prepared exactly according to specification and changes in ingredients or their proportions will affect the nutrient content of the recipe. Hence, a recipe specialist observes food preparation and documents actual quantities of ingredients, types of ingredients, and cooking procedures.

The kitchen is a complicated workplace with as many as ten to fifteen cooks preparing different foods at any one time. A meeting is held with all kitchen personnel to describe the purpose of the study and the function of the recipe specialist in the kitchen. A common misconception is that the recipe specialist is an inspector who is checking compliance with recipe and cooking standards. This misconception interferes with the collection of data because it tends to disrupt normal kitchen procedures as cooks try to follow recipes scrupulously. In fact, the sole purpose of the recipe specialist in the kitchen is to record the preparation of each recipe item as it is actually prepared, with no judgement as to right or wrong.

A production schedule is obtained from the head cook, detailing who is cooking what and when. As many cooks as possible are observed at the proper points in preparation. If the menu is available before the study starts, the recipes are duplicated in advance so as not to interrupt the cook's routine to read the recipes. Weights, or at least volumes, are obtained for each ingredient at appropriate steps during food preparation to include final yields. Sartorius scales, which weigh to the nearest 1/10th of a gram, are used to weigh ingredients and yields. Notes are taken on cooking methodologies which differ from that described on the recipe cards or those that require elaboration. When observation is impossible, the cook of that particular item is informed in advance and asked to keep records of weights/volumes for retrieval in a later interview. This kind of information is considered unreliable in the best of circumstances and is kept to a minimum.

It may be too disruptive to weigh every ingredient in every recipe. However, it is important to weigh the ingredients which will have a significant nutrient impact. Always measure salt, ingredients with a high sodium content, fats and oils, and other ingredients which will a˜fect the caloric and macronutrient content of the diet. Final yields are very difficult to obtain. It may be necessary to weigh several serving pans of food to obtain one final weight. When the initial weights of ingredients are not available and the full yield of the recipe is not recoverable from the cooking pot, yield weights will create erroneous correction factors. In these cases, code a water percentage factor into the recipe. It is important to weigh all ingredients in recipes in which the water content changes significantly. If a final yield weight is obtained, it is not necessary to measure water used during preparation. Any difference between the total weight of non-water ingredients and the yield weight is considered to be water unless the fat content is altered.

Recipe Data Entry

Digital Professional 350 (PRO 350) personal computers are taken on all studies so food intake and recipe data can be entered into data files and corrected as soon as possible. As new recipes are encountered, they are assigned an access code and added to the studyname.COD file (Table 3). The studyname.COD file grows continually throughout the study. The recipe specialist is responsible for weighing the standard portions of food for the data collectors and manually entering the data in the studyname.COD file. Using standard portions to improve the accuracy of the MVEM requires a serving of each food that is prepared. Because dining facilities usually must account for all food servings and operate on a tight budget, samples of food that are very close to the standard weight are taken so that excess food does not have to be discarded. Standard portions of foods which may be served at the next meal should be saved if the intervening time will not change the volume of the food i.e., salad. After weighing out the standard portions of foods for a meal, review the foods with the data collectors and give special instructions i.e., separate portions for meat and its sauce. If an alternate food item is used to replace a food that has run out, a standard portion should be weighed out and the data collectors notified. The information on the foods served at the meal should be entered in the studyname.COD file as soon as possible. The data collectors use the three-character access code and the conversion factors to code the food intake records at the end of the meal. The studyname.COD file must be updated before the food intake data for that meal can be entered into a computer file.

CODING has an edit option to allow for alteration of pre-coded recipes to reflect changes in ingredients or their quantities. Most pre-coded recipes require some alteration due to deviations from the standard recipe during preparation. CODING also has a decode option to allow the recipe specialist to validate the coded recipes in the field and thus allow immediate analysis of recipes upon return to USARIEM.

B. COLLECTION OF FOOD INTAKE DATA AND DATA ENTRY

Collection of Food Intake Data

Collection of food intake data involves collection of three types of data from each subject: food served, food not eaten (plate waste), and the extra food/meals that the subject eats in places other than in the studied dining facility (outside food). The computer is used to derive food intake data by subtracting the plate waste from the food served. Data are collected at breakfast, lunch, and dinner. At the beginning of each meal the recipe specialist provides samples of standard portion sizes of all the foods that will be served for that meal.

After collecting their food from the serving line, the subjects take their food selections to their assigned data collectors. The data collectors visually estimate the portion sizes of foods on the trays and the data are entered manually on Ration Record forms (Appendix F). The subjects also are interviewed for pertinent information such as food deposited in pockets, fluids consumed while waiting to be served, or foods covered by other foods (i.e., toast covered by creamed beef), etc. (Appendix E). The pre-meal interview is limited to 1-2 minutes to ensure that the subjects do not have to eat cold food and that their meal time is not unnecessarily prolonged.

When the subject has finished his meal, the tray is presented to the data collector for the recording of plate waste. The post-meal interview takes

3-4 minutes because the subjects are questioned as to whether they added salt to food, how much salt was used, the distribution of the total amount of salt among the different foods (percentage distribution), what food was salted, reasons for not eating a food, hedonic ratings of the foods on a 9-point scale (1=dislike extremely, 9=like extremely), etc.

Since attempts are made to minimally interfere with the habits and eating patterns of the soldiers, they are not limited to eating all meals and snacks in the dining facility during the study. If any foods are eaten outside the dining facility or between data collection periods, the subjects are asked to record the outside food data in dietary diaries (Appendix F). The outside food dietary diaries are reviewed for completeness and accuracy and if errors are discovered in the diaries, the information is reviewed with the subject at the next meal.

Food Intake Data Entry

The food intake data are manually coded by the data collectors using the studyname.COD three-character access codes and food names. If necessary, the conversion factors are used to change portion sizes.

The food intake data entry program, called ENTRY, prompts the data enterer for the food's three-character access code, the multiple or fraction of the standard portion served and returned, the reasons for not eating the food (reason not eaten), the hedonic ratings of each food item, and the amount of salt added to each food item. Once the food intake data are entered for a meal, ENTRY accesses the studyname.COD file. The program keys on the three-character access code and writes a data file containing the subject number, the day number, the meal number, the access code, the recipe code, the food name, the standard weight, the number of standard portions served, the number of standard portions returned, the weight of food consumed, and the percentage distribution of salt among the different food items. A report file (Table 8) is generated by ENTRY which allows the data collectors to validate their work against the original data.

Once a three-character access code and standard weight are accessed by ENTRY, it becomes unchangeable in the studyname.COD file because that same weight must be accessible during later validation and correction. Thus, if a salad dressing serving utensil is changed in mid-study, or white cake appears again and the standard portion differs in weight from the previous one, a correction factor must be calculated and applied to those items by the data collectors when they code. For example, if salad dressing ladles contained 15g and were replaced by ones containing 24g, the data collectors would inquire about the numbers of ladles used. If the answer were two ladles, the data collector would later multiply the two ladles by 24/15 or 1.6, converting the portion to 3.2 portions of the standard 15g ladle listed in the studyname.COD file.

If an incorrect weight is entered in the studyname.COD file, it is necessary to manually search for that food item and correct all food intake data files that contain that food. Some errors can be corrected manually with EDT, others require programming changes. A common error affecting weight is to include unedible portions of a food, such as bone, skin, seeds, etc. in the weight. Some recipes should not be placed in the studyname.COD file as a single recipe i.e., cake with icing or meat with sauce. These

FOOD FILE USED .. TEST.DAT DATE PRINTED .. 10-DEC-87

Table 8: Sample of a food intake report file generated by the computer program ENTRY.

RNUM	T DATE	SUBNUM	FOOD DESCRIPTION	FD CODE	AMT-SERV	AMT-RET	REASON	SALT-ADD	RAT CODE	PORTION WT	MEAL	RATION
1	870123	101	MILK 2%	163	8.00	0.00	0	0.00	9	30.50	B	A
2	870123	101	BLACKBERRY SYRUP	287	1.00	0.40	17	0.00	0	40.00	B	A
3	870123	101	EGG SCRAMBLED	123	0.90	0.00	0	0.00	8	80.00	B	A
4	870123	101	BANANA MINUS SKIN 32	77	1.00	0.00	0	0.00	9	102.00	B	A
5	870123	101	BEVERAGE BASE A	160	7.50	0.00	0	0.00	0	30.00	D	A
6	870123	101	MILK 2%	163	8.00	0.00	0	0.00	0	30.50	D	A
7	870123	101	MILK	162	8.50	0.00	0	0.00	0	30.00	L	T
8	870123	101	BREAD-WHEAT	148	1.00	0.00	0	0.00	0	24.00	L	T
9	870123	101	APPLESAUCE	52	0.90	0.00	0	0.00	9	123.00	L	T
10	870123	101	VEGETABLES-MIXED	66	1.16	0.00	0	0.00	8	77.00	L	T
11	870123	101	BEANS-BAKED	30	1.00	0.00	0	0.20	9	160.00	L	T
12	870123	101	JUICE,GRAPEFRUIT CND	83	7.00	0.00	0	0.00	9	30.00	L	T
13	870123	101	FRANKFURTERS	18	1.00	0.00	0	0.20	7	99.00	L	T
14	870123	101	SALT	136	1.00	0.00	8	0.00	0	1.00	L	T
15	870123	101	BANANA MINUS SKIN 32	77	1.00	0.00	0	0.00	0	102.00	L	T

RNUM	T DATE	SUBNUM	FOOD DESCRIPTION	FD CODE	AMT-SERV	AMT-RET	REASON	SALT-ADD	RAT CODE	PORTION WT	MEAL	RATION
16	870123	102	SUGAR	134	3.00	0.00	0	0.00	0	4.00	B	A
17	870123	102	SUGAR	134	3.00	0.00	0	0.00	0	4.00	B	A
18	870123	102	EGG SCRAMBLED	123	0.90	0.00	0	0.00	6	80.00	B	A
19	870123	102	COFFEE BREWED	157	7.00	0.00	0	0.00	0	30.00	B	A
20	870123	102	BANANA MINUS SKIN 32	77	1.00	0.00	0	0.00	0	102.00	B	A
21	870123	102	CREAMER NON DAIRY	224	1.00	0.00	0	0.00	0	4.00	B	A
22	870123	102	BLACKBERRY SYRUP	287	1.00	0.10	0	0.00	0	40.00	B	A
23	870123	102	BEVERAGE BASE A	160	7.00	0.00	0	0.00	0	30.00	D	A
24	870123	102	MILK 2% CHOC	164	8.00	0.00	0	0.00	0	31.30	D	A
25	870123	102	CRANBERRY SAUCE	178	0.80	0.00	0	0.00	0	0.00	D	A
26	870123	102	GRAVY,TURKEY	176	1.00	0.00	0	0.00	0	0.00	D	A
27	870123	102	BREAD-WHITE	149	1.00	0.00	0	0.00	0	29.00	D	A
28	870123	102	MASHED POTATOES	189	1.10	0.00	0	0.00	6	0.00	D	A
29	870123	102	GREEN BEANS W/MUSHRO	196	1.10	0.00	0	0.00	5	0.00	D	A
30	870123	102	BEANS-BAKED	30	0.75	0.00	0	0.00	7	160.00	L	T
31	870123	102	BREAD-WHITE	149	2.00	0.00	0	0.00	0	29.00	L	T
32	870123	102	APPLESAUCE	52	1.00	0.00	0	0.00	8	123.00	L	T
33	870123	102	FRANKFURTERS	18	1.00	0.00	0	0.00	6	99.00	L	T
34	870123	102	BANANA MINUS SKIN 32	77	1.00	0.00	0	0.00	9	102.00	L	T

RNUM	T DATE	SUBNUM	FOOD DESCRIPTION	FD CODE	AMT-SERV	AMT-RET	REASON	SALT-ADD	RAT CODE	PORTION WT	MEAL	RATION
35	870123	103	GRIDDLE CAKES	113	2.00	0.00	0	0.00	0	0.00	B	A
36	870123	103	BLACKBERRY SYRUP	287	1.00	0.00	0	0.00	0	40.00	B	A

recipes should be separated as their proportions vary depending upon the part of the cake from which the piece is cut or the amount of sauce put on meat.

C. VALIDATION OF FOOD INTAKE DATA

The data collectors validate their data to be sure they did not make mistakes in collecting data and to correct errors made by the data enterers (Appendix G). The data collectors compare the computer report generated by the data entry program to the original data collection sheets. Mistakes are marked on the computer report and returned to the data enterers for correction. Corrected computer reports are compared to the previous computer report until all mistakes are corrected. When a data collector feels that the data is correct, another data collector examines the data for accuracy by comparing the final computer report to the original data collection sheets. All data are validated during the data collection phase of the study to be sure that errors are caught and corrected immediately.

POST-DATA COLLECTION ACTIVITIES

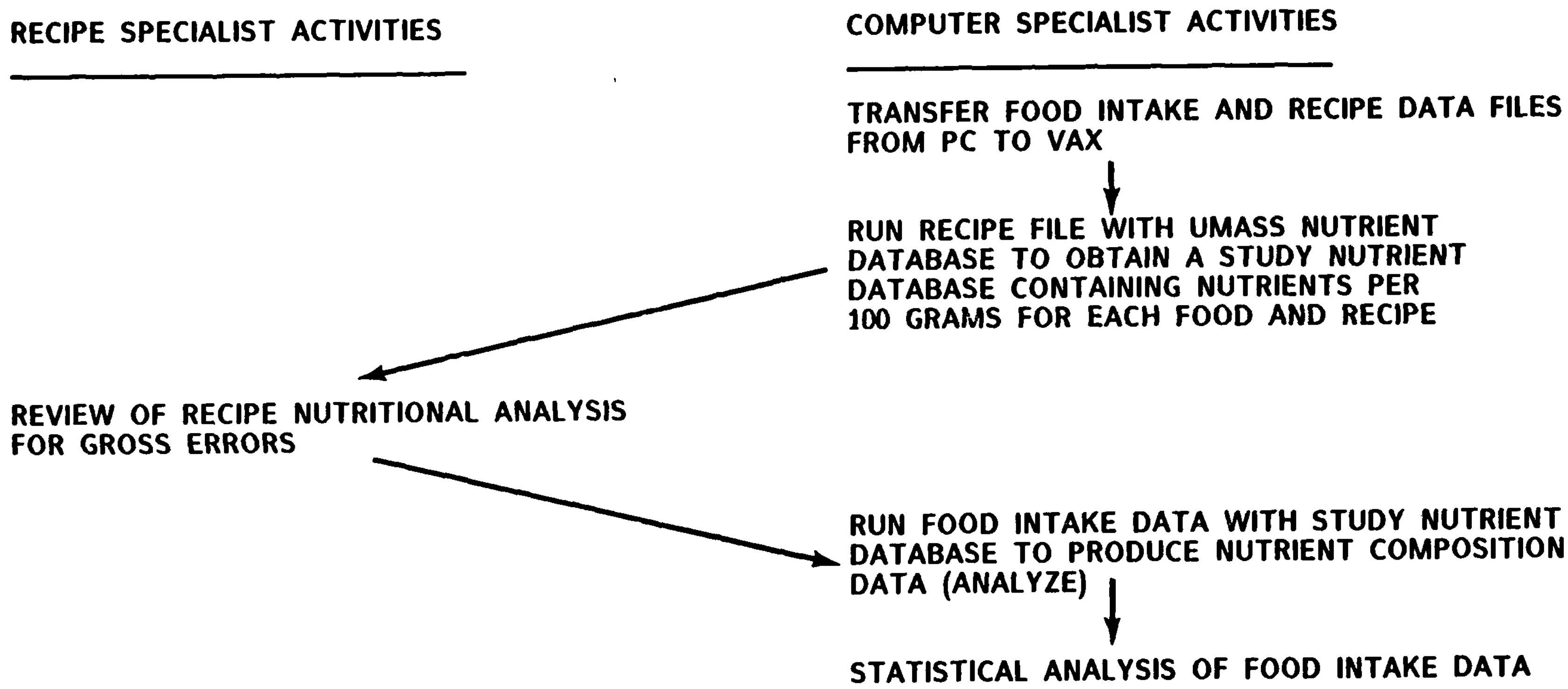
A. TRANSFER OF DATA FILES FROM PC TO VAX

See the flow diagram in Figure 3 for a summary of the activities that occur after the data is collected, entered in computer files, and validated. Since all recipe and food consumption data on a study are entered into computer files on floppy disks in the Digital PRO 350 personal computers, the files must be transferred to the Digital VAX 11/780 mainframe computer upon return to USARIEM.

B. GENERATION OF STUDY DATABASE

Once the coded recipe file is completed, it is sent over telephone lines to UMASS where it is read by a program which accesses the nutrient database and writes a data file containing nutrients per 100 grams for each food and recipe used during the study. A report is generated which describes the nutrients in each recipe item in units of 100 grams and in standard serving weight. These files are retrieved and printed at USARIEM. A dietitian reviews the nutritional analysis and flags recipes with suspect nutrient values. The coded recipe is rechecked against the original data recorded in the kitchen and errors, if any, are corrected. The coded recipe file is then rerun and the report file rechecked. This process is repeated as many times as necessary until the data are correct. The product is a study nutrient database, which is loaded into the ORACLE database management system.

Figure 3
POST-DATA COLLECTION PROCEDURES
TO ANALYZE THE FOOD INTAKE DATA



C. ANALYZING FOOD INTAKE DATA TO DETERMINE NUTRIENT INTAKES

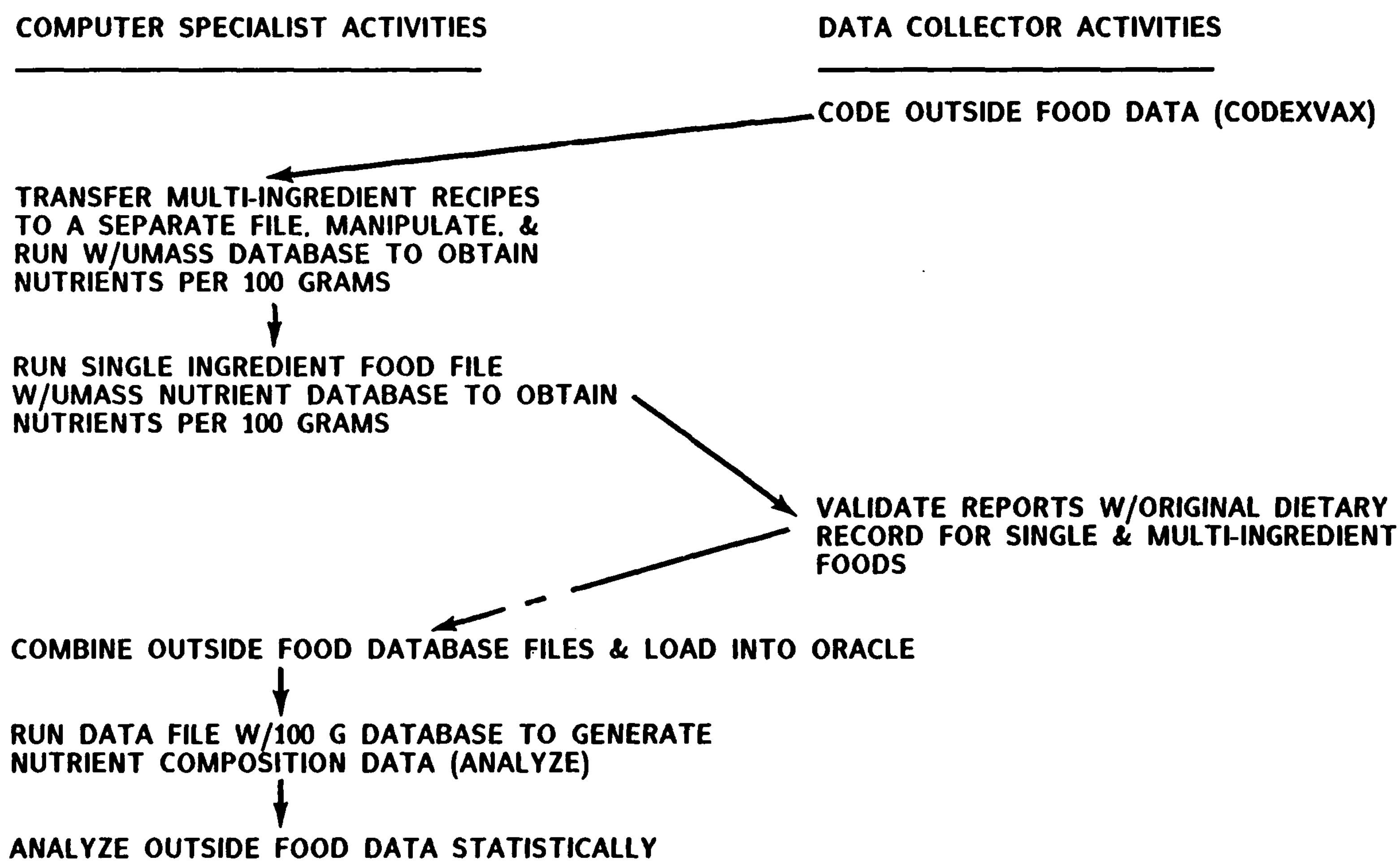
The food intake file which was generated by the data collectors in the dining facility is now read by the program ANALYZE. The program accesses the study nutrient database to compute and write to a file the nutrients contributed by each food consumed at each meal by each person. Meal and day totals are generated by a statistical package (SPSSx). These are closely examined to locate nutrient values indicative of errors in the original food intake data. If such errors exist, they are corrected and the above program is rerun. This process is repeated until the food intake data is accurate.

The dietary assessment data is statistically analyzed by SPSSx programs and graphics generated. The nutritional data can be subdivided or summarized into meal and day totals very simply by computer. Examples of data reduced by this system have been reported elsewhere (1,15,16).

D. ANALYZING OUTSIDE FOOD DATA TO DETERMINE NUTRIENT INTAKES

The outside food data is obtained by the data collectors on a daily basis during the data collection phase. The data could be coded during that phase but due to time constraints the outside food data is usually coded and analyzed during the post-data collection phase either concurrently or after the food intake data is analyzed. Figure 4 contains a flow diagram of the outside food analysis activities. Outside food data is coded as if a dietary analysis is being done on the CYBER. Using the program CODEXVAX, the outside food items are coded interactively and reciped foods which have been analyzed previously are coded manually. The codes for reciped foods are transferred to another file since nutrient information does not exist on the CYBER for

Figure 4
PROCEDURES FOR ANALYSIS OF OUTSIDE FOOD DATA



these foods. The file without reciped foods is sent to CYBER to obtain nutrient data on the outside foods and the nutritional information in 100 g portions is retrieved. The reciped foods file is manipulated to produce a 'recipe' file which is sent to the CYBER to generate another file of 100 g nutrient information for each of the recipes. Both nutrient data files are loaded into ORACLE and the ANALYZE program is run to generate the outside food data for statistical analysis.

SUMMARY

In response to a need for a quick, efficient, and minimal interference methodology for collecting dietary intake data, the Modified Visual Estimation Methodology (MVEM) was developed. This report provides detailed descriptions of MVEM, the methods for training data collectors to be reliable (>90%) and accurate (to within a tenth of a standard portion), and the procedures for analyzing the nutritional data by computer. This methodology is one of the most reliable, accurate, and feasible methods for performing dietary assessments of military populations and is potentially useful for any mass feeding situation i.e., cafeterias, dining facilities, colleges, hospitals, and prisons. MVEM is an effective method for quantifying nutrient intakes for large numbers of subjects with minimal interference in terms of time and subject cooperation.

Expensive and/or extensive equipment are not required and MVEM can be performed under all field and dining facility conditions. Standardized procedures have been developed and are included in the appendices for training data collectors to estimate portion sizes of foods served and returned with a reliability of greater than 90% and with an accuracy to within a tenth of a standard portion. MVEM requires training/retraining of data collectors, analysis of training data to determine the accuracy and reliability of data collectors, samples of standard portions of all foods served at each meal, and observation of food preparation.

The computerized nutritional analysis procedures require coding of all food intake data, analysis of recipe preparation data, and analyzing for

nutrient intake. The accuracy of any nutritional analysis methodology depends on the accuracy of the food composition tables, of the recipe preparation, and of the food intake data. Using food composition tables to analyze food intake data is not as accurate as chemical analysis; however, these values provide a useful average for population studies, do not delay data processing, and is relatively inexpensive. Using MVEM and observing recipe preparation procedures improve the accuracy of nutritional analysis information for population dietary assessments.

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APPENDICES

APPENDIX A

DEFINITIONS AND ABBREVIATIONS

ACCURACY - measurement of the ability of the data collector to accurately estimate portion sizes and is determined by subtracting the estimated fraction of a standard from the fraction obtained from weighing the food sample. Criteria for accuracy is a mean difference less than a tenth of a fraction of the standard portion.

ANALYZE - program which accesses the nutrient database to compute the nutrients contributed by each food consumed at each meal by each person.

OUTSIDE FOODS - foods that are eaten at times and locations other than when data is being collected during meal hours in the dining facility. May include major meals and fast foods that are eaten in place of dining facility meals.

CODEXVAX - program which interactively calls up ingredient names to assist in coding recipes.

CODEX - name of the computer file that contains an index of all the foods and ingredients in the University of Massachusetts database with an assigned six-digit number assigned to each item.

CODING - program employed to interactively code recipes. CODING accesses a file of ingredient names, NDB codes, and portion options, and allows for quick and easy coding of the most complex recipes. CODING can also be used as a data entry program, with the actual coding being done with a printed version of the ingredient file. The resulting file is appended to the file containing the previously coded recipes.

CODMAKER.FOR - program which creates a computer file consisting of the six-digit recipe code, a food description, a standard weight for those foods which have been weighed at this point, and a three-character access code. CODMAKER reads the coded recipe file and writes a studyname.COD file which is composed of the three-character access code, the food description, and the standard weight. CODMAKER.FOR can also read a studyname.COD file from another study and reformat it. CODMAKER allows the recipe specialist to reorganize the studyname.COD file into categories for easy reference. However, subsequent entries cannot be added to the previously set categories.

CFFS-FDTE - Combat Field Feeding System-Force Development Test and Experimentation; project to evaluate the Combat Field Feeding System's capability to provide subsistence support to the Army in the field and to evaluate the nutritional adequacy of the rations consumed by soldiers in a field environment.

CYBER - name of University of Massachusetts' computer

CYBERDIET - program on the VAX used to enter pre-coded between-meal data into a computer file.

EDT - editor to alter USARIEM computer files on the VAX.

ENTRY - program for entering food intake data into a computer file. The program prompts the enterer for the food's access code, the multiple or fraction of the standard portion served and returned, and the percentage of total salt, if any, applied to that item. ENTRY accesses the studyname.COD file, keying on the three-character access code, and writes a data file containing the subject number, the day number, the meal number, the access code, the recipe code, the food name, the standard weight, the number of standard portions served, the number of standard portions returned, the weight of food consumed, and the percentages of total salt added to any food item. A report file is generated by ENTRY which allows the data collectors to validate their work against the original data.

GET_RECIPE - program which searches sorted files of previously coded recipes for requested recipes. GET_RECIPE writes five files, one containing all previously coded recipes that are sought, another containing the codes of those single ingredient recipes found in the ORACLE table WHOLE, another containing the codes of special Army rations found in the ORACLE table RATION, and two list files containing the recipe codes that were found and those that were not found.

MVEM - Modified Visual Estimation Method; Technique of determining food volume by visually comparing to a weighed standard portion.

NDB - Nutrient Databank is a standard version of a computerized nutrient database which belongs to the University of Massachusetts, Amherst, MA (UMASS) and which is used to compute nutrient composition of recipes prepared in Army dining facilities.

ORACLE - a database management program which is available on the VAX computer. It contains the nutrient factor file for the Military Nutrition Division.

PC - Personal Computer; portable stand alone Professional 350 computer which is transported to a study site. Contains a food intake data entry program, recipe entry program, data collector training entry program, and outside food data entry program.

PLATE WASTE - food remaining on a subject's plate after the meal is eaten.

RATION - ORACLE file that contains nutritional composition tables for Army developed rations such as MREs, T-rations, etc.

RNE - Reason Not Eaten - reason supplied by test subject at end of meal when food is not consumed.

RECIPED FOODS - Foods made from recipes containing multiple ingredients.

RECIPE.FIL - The list of codes for all ingredients and the quantity of that ingredient in a recipe. Produced by the GET_RECIPE or CODING programs.

RECIPE SPECIALIST - person with a nutrition or dietetics background who collects data on food preparation in the kitchen. Major duties include weighing ingredients and final yields for reciped foods. Observes food preparation methods.

RELIABILITY - measures the extent to which a test or judge yields the same results on repeated trials. Measurement always contains a certain amount of chance error therefore error-free measurement is never attained. While repeated measurements of the same phenomenon never precisely duplicate each other, they do tend to be consistent from measurement to measurement. This tendency toward consistency found in repeated measurements of the same phenomenon is referred to as reliability. The more consistent the results given by repeated measurements, the higher the reliability of the measuring procedure; the less consistent the results, the lower the reliability.

SPSSx - Statistical Packages for Social Sciences; comprehensive set of programs to manage and statistically analyze data.

Studyname.COD - a computer file created by CODMAKER.FOR for a specific study which is composed of the three-character access code, the food description, and the standard weights of foods used in that particular study. The studyname.COD file serves two purposes. The data collectors use the three-character access codes instead of the six-digit USDA codes to code the food intake data because it reduces the possibilities of error. The studyname.COD file also serves as a resource file for the data entry program, translating the access code into the NDB code, and the number of portions into weight in grams.

TWISTER - program on CYBER computer that converts portion letters and amounts to gram weights.

UMASS - University of Massachusetts, Amherst, MA.

VAX - name of USARIEM computer which is a Digital VAX11/780.

APPENDIX B

PROCEDURES FOR TRAINING DATA COLLECTORS IN THE MODIFIED VISUAL ESTIMATION METHOD (MVEM) SESSION I (4-5 Hours)

Preparation: (2 Hours)

1. Select food items to train and test the data collectors from the list of foods in Appendix C. The list is composed of foods that are representative of the different types of foods that are served. If cooked foods are not available, dried beans, rice, etc. can be used for practice in estimating portion sizes.

2. Determine a standard portion gram weight for each food using the master list in Appendix D, Table 1 as an example.

3. Using a food scale, weigh a standard portion for each food item and place each standard portion on its own plate.

4. For each food item, select (maximum of 6) various tenths of a portion of the standard (i.e., 0.1, 0.2, 0.5, 2, 1.8) and compute the fraction weight.

   a. Using a food scale, weigh the fraction weights for each item.

   b. Place each food portion on a separate plate.

   c. Record the gram weight and the tenth of standard for each food item on a card with an ID number that corresponds to an ID number taped to the underside of each plate for reference. Place cards under the plates.

5. Utilizing 8 oz paper cups, weigh colored water on the food scale in 1.0 oz increments without ice; measurement will be indicated on a card placed under each cup as explained for plates.

6. Utilizing various quantities of cubed ice (i.e., 1/4, 1/2, 3/4 C), add ice to 8 oz paper cups and then, using food scale, weigh various ounce measures of colored water. Ice and varying quantities of liquids will be indicated on cards placed under each cup, as explained in the section on plates.

7. Repeat step 5 utilizing crushed ice.

Training Exercise: Visual Estimation Exercise (1-2 Hours)

1. Place different foods and beverages on separate tables and arrange the following practice situations:

   (a) The trainee will visually observe the different standard portions of a food or beverage item and estimate the respective fractional portions.

(b) Training will involve arranging the plates in increasing order of size and estimating the tenth of standard.

(c) The trainee will match the two portions that are the same size.

(d) Place a standard portion on a plate and the same standard portion in a bowl and have the trainee select the matching portion from the fractional portions in different bowls. Trainee will also estimate the tenth of standard for each portion.

(e) One standard portion and several small leftover portions will be exhibited for the trainee to estimate the tenth of standard for each.

(f) Other training situations may be developed as needed. The above situations may be altered by heaping or spreading foods to change the appearance.

2. The trainee can look at the cards under the plates for immediate feedback on accuracy. The trainer will make sure that the cards are returned to the right plate after a trainee has finished working at each table by matching ID numbers and then will rearrange the plates.

3. The training exercise should be repeated several times until the trainees are comfortable with visually estimating portion sizes.

Testing Exercise (1 Hour)

1. Reorder the position of each plate/cup for each food/beverage item and place a numbered card in front of each plate, utilizing the master list (Appendix D) which also contains the corresponding card numbers for each food portion.

2. Trainee will visually estimate the fractional portion size of each item comparing each to its respective standard portion.

3. Review with trainees their judgments for each plate.

4. Trainees will indicate their error(s) by marking the correct answer for each item next to his/her incorrect estimation(s). The original estimations should not be changed since this data will be used to evaluate the trainees reliability and accuracy.

5. Trainees may review any errors and/or review the foods/beverages for repeated exposure to portion sizes, utilizing the ID cards under each plate/cup.

6. Collect trainees data form.

7. Wrap up food portions for use in Session II.

SESSION II (4 hours)

1. Repeat the Testing Exercise in Session I.

2. Repeat the Training Exercise in Session I.

3. Use this time for other activities to lessen the effects of memory on testing results.

4. Repeat the Testing Exercise in Session I.

SESSION III (4 Hours)

Preparation: (2 Hours)

1. Use the same food items as in Session I and weigh the same standard portion weights for each food (Appendix D, Table 2).

2. Using a food scale, weigh the standard portion for each food item and place each food item onto one compartmented paper tray or dishes that will be used in the study.

3. Weigh the same fractions used in Session I of each food item and place one of each food item onto a compartmented paper tray to portray a typical meal served.

(a) Prepare 3 trays to exemplify typical meals served.

(b) Prepare 3 trays to exemplify typical plate waste.

(c) Number each tray and record the portion weights of each food on that tray.

Training/Testing Exercise: (2 Hours)

1. Trainees will visually estimate the fractions of each food item on each tray, using the standard tray for reference.

2. After each tray has been viewed by all trainees, the data forms will be collected to analyze for reliability and accuracy. Criteria for acceptable reliability scores is >90%. The mean of the differences between the estimated and actual fractions will be used to determine the accuracy of the trainee.

3. Repeat Session I Training Exercise or allow trainees to practice measuring ice/liquids or different food items on food scale themselves.

4. Rearrange or replace the foods and repeat steps 1 and 2.

5. At the end of the session, review the portion sizes in the compartmented trays with the trainees.

SESSION IV (4 Hours)

Repeat the Training/Testing Exercise of Session III. If all trainees meet the >90% reliability score, start on Session V.

SESSION V (4 Hours)

Preparation: (2 Hours)

1. Select food items commonly served over/under other food items (ie: creamed beef and scrambled eggs) from Appendix C and determine standard portions for each food as shown in Appendix D, Table 3.

2. Weigh the standard portion for each food item and place each food onto one compartmented paper tray, with one food item per compartment or onto other dishes that will be used during the study.

3. Weigh a second standard portion for each food and strategically place food items onto a compartmented paper tray with food items covering all or part of other items as may be encountered on a typical tray.

4. Weigh a third standard portion of the foods listed in Appendix D, Table 4 and place the items in bowls as may be encountered at a typical meal service.

5. Weigh various fractions of the different foods (Appendix D, Table 4) and place in bowls.

6. Weigh varying fractions of the standard portions for each food item and place in compartmented paper trays with various food items hidden to portray a typical meal served.

(a) Number each tray and record the portion weight of each food on the tray.

(b) Prepare 3 trays to exemplify typical servings.

(c) Prepare 3 trays to exemplify typical plate waste.

Testing Exercise: (2 Hours)

Follow the Testing Exercise procedures of Session I.

SESSION VI (4 Hours)

Testing procedures for Session V will be repeated so the trainer(s) may evaluate the effect of training on the ability of the trainee(s) to estimate tenths of standard portions.

APPENDIX C

FOODS TO BE USED FOR TRAINING OF PORTION ESTIMATION BY VISUAL ESTIMATION

SESSIONS I-IV

Peas & carrots or other diced vegetable
Spanish rice or other rice
Beef stew or other casserole type dish
Brownie/Nutcake or other baked product
Beverage - water
Salt or sugar packets

SESSIONS V-VI (Bowl)

Creamed ground beef
White rice

Cake
Blueberry dessert

Apple cake or bread
Maple syrup

Pot Roast or other sliced meat with gravy

Creamed Beef
Creamed corn

APPENDIX D

TABLE 1
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS I AND II

FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD	ID NO.	PLATE NO
Beef Stew	250	62	0.25	A	6
		125	0.50	B	1
		200	0.80	C	4
		250	1.00	D	3
		275	1.10	E	2
		325	1.30	F	5
Spanish Rice	150	45	0.30	A	1
		60	0.40	B	6
		75	0.50	C	3
		90	0.60	D	5
		105	0.70	E	2
		120	0.80	F	4
Peas & Carrots	100	75	0.75	A	2
		90	0.90	B	4
		30	0.30	C	6
		75	0.75	D	5
		10	0.10	E	3
		20	0.20	F	1
Brownie	100	5	0.05	A	4
		10	0.10	B	3
		25	0.25	C	5
		30	0.30	D	6
		40	0.40	E	1
		50	0.50	F	2
Salt	4	0	0.00	A	3
		.40	0.10	B	4
		1	0.25	C	6
		2	0.50	D	5
		3	0.75	E	2
		4	1.00	F	1

APPENDIX D, TABLE 1 (continued)
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS I AND II

FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD	ID NO.	PLATE NO
Water	30	30	1.00	A	1
		60	2.00	B	3
		90	3.00	C	6
		120	4.00	D	5
		180	6.00	E	2
		210	7.00	F	4
Water/ Cubed Ice	30	210/25	7.00	A	3
		180/50	6.00	B	4
		150/75	5.00	C	6
Water/ Crushed Ice	30	180/30	6.00	D	1
		150/60	5.00	E	2
		120/90	4.00	F	5

APPENDIX D

TABLE 2
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS III AND IV

TRAY NO.	FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD
Standard	Beef Stew	250		
	Spanish Rice	150		
	Peas & Carrots	100		
	Brownie	100		
	Salt	4		
	Water	30		
1	Beef Stew		250	1.00
	Spanish Rice		105	0.70
	Peas & Carrots		75	0.75
	Brownie		50	0.50
	Salt		4	0.10
	Water		150	7.00
2	Beef Stew		325	1.30
	Spanish Rice		90	0.60
	Peas & Carrots		90	0.90
	Brownie		40	0.40
	Salt		4	0.00
	Water		240	6.00
3	Beef Stew		275	1.10
	Spanish Rice		120	0.80
	Peas & Carrots		75	0.75
	Brownie		100	0.30
	Salt		4	1.00
	Water		60	4.00
4	Beef Stew		200	0.80
	Spanish Rice		60	0.40
	Peas & Carrots		30	0.30
	Brownie		10	0.10
	Salt		1	0.25
	Water		30	1.00

APPENDIX D, TABLE 2 (continued)
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS III AND IV

TRAY NO.	FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD
5	Beef Stew		62	0.25
	Spanish Rice		75	0.50
	Peas & Carrots		10	0.10
	Brownie		25	0.25
	Salt		2	0.50
	Water		45	3.00
6	Beef Stew		125	0.50
	Spanish Rice		45	0.30
	Peas & Carrots		20	0.20
	Brownie		5	0.05
	Salt		3	0.75
	Water		60	2.00

APPENDIX D

TABLE 3
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS V AND VI

TRAY NO.	FOOD ITEM	STANDARD PORTION (G)	FRACTIONAL PORTION (G)	TENTH OF STANDARD
Standard	Creamed Beef	200		
	White Rice	150		
	Apple Cake	100		
	Maple Syrup	30		
Standard	Pot Roast	125		
	Gravy	60		
	Creamed Corn	115		
	Apple Cake	100		
	Blueberry Dessert	50		
	Salt	4		
	Water	30		
1	Creamed Beef		300	1.50
	White Rice		113	0.75
	Apple Cake		50	0.50
	Maple Syrup		60	2.00
	Salt		12	3.00
	Water		120	4.00
2	Pot Roast		156	1.25
	Gravy		120	2.00
	Creamed Corn		86	0.75
	White Rice		75	0.50
	Salt		8	2.00
	Water		210	7.00
3	Pot Roast		100	0.80
	Gravy		15	0.25
	Creamed Corn		173	1.50
	Apple Cake		150	1.50
	Blueberry Dessert		80	1.60
	Water		150	5.00

APPENDIX D, TABLE 3 (continued)
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS V AND VI

TRAY NO.	FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD
4	Creamed Beef		40	0.20
	White Rice		15	0.10
	Apple Cake		30	0.30
	Maple Syrup		3	0.10
	Salt		5	1.25
	Water		75	2.50
5	Pot Roast		56	0.45
	Gravy		30	0.50
	Creamed Corn		6	0.05
	White Rice		30	0.20
	Salt		0	0.00
	Water		45	1.50
6	Pot Roast		75	0.60
	Gravy		9	0.15
	Creamed Corn		173	1.00
	Apple Cake		75	0.75
	Blueberry Dessert		13	0.25
	Water		0	0.00

APPENDIX D

TABLE 4
PORTION ESTIMATION BY VISUAL ESTIMATION
MASTER LIST FOR SESSIONS V AND VI

TRAY NO.	FOOD ITEM	STANDARD PORTION (g)	FRACTIONAL PORTION (g)	TENTH OF STANDARD
Creamed Beef	200	350	1.75	1
		120	0.60	4
		200	1.00	2
		250	1.25	5
		10	0.05	3
		50	0.25	6
White Rice	150	75	0.50	6
		300	2.00	5
		60	0.40	2
		225	1.50	1
		165	1.10	3
		15	0.10	4
Creamed Corn	115	23	0.20	6
		160	1.40	3
		150	1.30	1
		70	0.60	2
		218	1.90	4
		46	0.40	5

APPENDIX E

DATA COLLECTION AND THE 5Ws

Much can be overlooked by a data collector when a test subject presents his/her tray for evaluation, whether in a quiet dining facility, or out on a rainy, dark, remote field site. Portion estimation by direct observation requires: two trained eyes and a repertoire of questions.

The 5Ws are guidelines and hints for data collection efforts to help obtain the best quality data possible.

I. Who: For each test subject.

II. What:

A. Foods:

(1) What type of food (i.e., rye vs. whole wheat bread).

(2) What amount of a food item was served (i.e., how many pieces, scoops, ladles, etc. in tenths of standards).

(3) What, and how much, did test subject eat from his tray (i.e., french fries) before showing tray to data collector (i.e., in tray-line; waiting for data collector).

(4) What, and how much of each ingredient is in a salad-bar salad (i.e., have test subject dissect salad).

B. Sandwiches:

(1) What type of sandwich filler (i.e., tuna salad vs chicken salad).

(2) What type of bread/roll (i.e., rye vs whole wheat).

(3) What amount of sandwich meat used (i.e., how many slices, scoops).

(4) What spread was put on bread (i.e., mayonnaise, mustard, etc.) and how much (i.e., heaping tsp, 1 T, etc.).

(5) What else is in sandwich (i.e., cheese, lettuce, tomato, onion, etc.) and how much of each.

C. Beverages:

(1) What type of:
(a) soda (sugar free vs sugared)
(b) milk (1%, 2%, whole, chocolate, mix of white & chocolate)

(c) koolade (sweetened vs unsweetened)
(d) juice (orange juice vs orange juice mixed with grapefruit)
(e) coffee (caffeinated or decaffeinated)

(2) What type of milk, cream, nondairy creamer was used in coffee/tea.

(3) What type and amount of sweetener was added to coffee/tea, (ie: sugar 2t; equal 1 pkt).

(4) What amount of beverage was drunk while filling the glass and/or while waiting for the data collector.

(5) What amount of beverage was used to refill the glass after drinking at the machine.

(6) What amount of ice was in the glass and what type (i.e., crushed vs large cubes). How much ice melted when the beverage was added (if liquid warm/hot.)

D. Condiments:

(1) What type of salad dressing (i.e., blue cheese vs mayonnaise; low calorie italian vs regular italian) and what amount (i.e., 2 ladles, 2 pkts etc.).

(2) What amount of packets taken: salt, pepper, sugar, artificial sweetener, nondairy creamer, syrup, jelly, peanut butter.

(3) What kind of fat patties: butter or margarine, and how many.

III. Where: Could there be other food items that are not readily seen?

A. Under other foods

(1) Under creamed beef could be found:
(a) white rice
(b) biscuit
(c) scrambled egg
(d) fried eggs
(e) etc.
(f) How many pieces, ladles, scoops of these foods are under the beef?

(2) Any food item may be hidden by another food item on the same plate (i.e., toast covering bacon, margarine patties covering salt packets, chicken ala king over mashed potatoes, etc).

(3) Sandwiches must be carefully dissected to obtain data on unseen filler, spread, vegetables, etc.

(4) Self-made salads must be carefully dissected to obtain data on hidden food items/dressings.

(5) Gravies, sauces, toppings may cover food items. Ask.

B. In Test Subject's Uniform Pockets

(1) fresh fruit
(2) milk cartons
(3) condiments
(4) bag of chips, etc.

C. In Test Subject's Hand
(1) same as above

D. NEVER TOUCH A TEST SUBJECTS FOOD! ASK HIM/HER TO MOVE IT (i.e., top slice of sandwich; toast over plate, etc.).

IV. When

A. After test subject has obtained all foods/beverages and before he/she begins to eat/drink, obtain the "What II A-D" and "Where II A-C" listed above for each "Who".

B. When test subject has completed his/her meal and before discarding tray, obtain the following information:

(1) Was any food/beverage consumed that was not originally shown to data collector (i.e., seconds; trading) and how much of each.

(2) What food/beverage originally accounted for was: spilled?; given away?; thrown out accidentally?; fell?; etc.

(3) Were any additional condiments added to food/beverage,(i.e.: salt from shaker, herb mix, hot sauce, etc.)

(4) What rating (1-9) does test subject assign each food/beverage consumed at that meal (when applicable).

V. Why

If a test subject does not eat/finish a food item that he/she originally had on tray, he/she must be asked "why?" or for a reason not eaten (RNE) i.e., tasted bad, wasn't hungry, full, cold, etc. If $\leq$ 0.05 left over (a scrap) it can be concluded that test subject was "done with meal", and does not have to be asked. For a portion returned $\geq$ 0.06 a RNE must be obtained.

APPENDIX F

SAMPLES OF DATA COLLECTION FORMS FOR FOOD INTAKE AND FOODS EATEN OUTSIDE THE DINING FACILITY

RATION RECORD

BREAKFAST/LUNCH/DINNER

NAME: ______________________ DATE: ______________________

SUBJECT #: __________________ DATA COLLECTOR #: ______________

MEAL: (CIRCLE ONE)

BREAKFAST -- B LUNCH -- L DINNER -- D

DESCRIPTION	CODE #	PORTION SERVED	PORTION RETURNED	ADDED SALT	REASON NOT EATEN/NOT FINISHED	RATING CODE

NATICK Form 1333
1 Aug 87 EDITION DATED 1 Jan 87 IS OBSOLETE.

FOODS EATEN OUTSIDE THE DINING FACILITY

NAME ____

DATE _______________ SUBJECT # __________

INSTRUCTIONS: Write down all foods and beverages eaten outside the dining facility. It is easiest to do this right after eating them. If you use salt or a salty sauce like soy or steak sauce, try to accurately estimate the amount you use. If you eat something that comes in a package like a candy bar or cupcakes etc., look for how much it weighs on the package and write it on this paper.

Here is a sample of how to keep track of what you eat.

FOOD	TIME EATEN	AMOUNT EATEN	DESCRIPTION	SALT
apple	8 am	1 small	Mc Intosh	no
cookie	8 am	2, 2 inch	Chip Ahoy	no
Pepsi	9 am	1, 12 oz	can	no
pizza	3 pm	2, 3 inch slices	Pizza Hut	1 tsp

FOOD	TIME EATEN	AMOUNT EATEN	DESCRIPTION	SALT

APPENDIX G

VALIDATION OF FOOD INTAKE DATA

Objective:

To ensure that:

1. Data on collection forms accurately reflects actual food consumption.

2. Data entered by computer personnel accurately reflect the data on the collection forms.

3. Data used for statistical analysis are without error so that results will be accurately presented in the final test report.

Procedure:

A. Post-Meal Validation

1. Each data collector is responsible for completing and reviewing his/her respective data collection forms after each meal ensuring that all forms include:

(a) Test Subject Name
(b) Corresponding Test Subject Number
(c) Data Collectors Initials
(d) Test Date
(e) Ration Type
(f) Data Collection Meal
(g) Food codes corresponding to food items served; codes obtained from Recipe Specialist.
(h) Appropriate serving sizes for all foods selected, in tenths of the standard portion. For those food items for which standard portions are not provided for visual observation, consult standard portion/code printout. (i.e., normally 1 T catsup = 1 serving; however if a 2 oz ladle = 1 serving, then 1 T catsup = 0.25 serving.
(i) A portion returned (PR) must be indicated for each food item selected. If a test subject ate all of a food item PR=0.
(j) Appropriate conversions of all fractions into decimals (i.e., 1/8 = .13, etc.).
(k) Portion sizes served and returned, any conversion factors (cf) and mathematically generated data are each present, legible, and accurate (i.e., cake = 1.0 x .85 cf = .85 ; frosting = 0.5 x .32 cf = .16. Portions returned must also be multiplied by appropriate conversion factor, as above, when appropriate.
(l) Added salt indicated and quantified when appropriate.
(m) Appropriate Reason Not Eaten (RNE) coded when any food portion returned (i.e., if PR $\leq$ .05, then RNE = "done with meal" since for each PR an RNE must be indicated) otherwise RNE = cold; taste bad; didn't want, etc).

(n) Food ratings must be present for all food items with the exception of: sugar, salt, pepper, nondairy creamer, catsup.

2. All data collection forms should be presented to appropriate data enterer after each meal in a manilla folder which indicates: study, data collector's name, date, meal (i.e., Fort Validate, Val Major, Mon., 25 Jan 87, lunch).

B. Post-Entry Validation

1. Each data collector is responsible for reviewing the computer report generated by the data enterer to be sure that it is accurate.

2. Computer reports are compared to data collection forms to confirm accurate entry of all information/data.

3. Compare the food descriptions on the computer reports to that on the data collection form to ensure accuracy of data, and as a double check against use of incorrect food code(s).

4. Errors found on the computer report should be corrected using colored ink and circled to assure visibility.

5. If an error is found on the computer report, then the original error must also be corrected in colored ink and initialed on the original data form.

6. Folders are to be returned to data enterer for correction after data is validated; validation errors are to be indicated on front cover (i.e., 1st validation - errors - 3 or 4 or 5, etc.; 2nd validation - errors - 2, etc.)

C. When all corrections have been made and data is "clean", compare original data forms to "clean" computer report to insure that no other errors were made inadvertently in the data entry process.

D. If the Project Leader has validated or spot-checked data and found errors, please review findings to confirm interpretation of data.

E. When all corrections/validation have been done, indicate on front cover of folder, FINAL: CLEAN.

Helpful Suggestions

1. Go slowly! "Haste" = Errors.

2. Use rulers so lines are not inadvertently skipped.

3. Validate with another data collector so that one reviews the computer print-out and the other reviews the original data forms.

4. Count the number of items per meal on print-out and data forms to double check that no foods have been excluded or entered twice.

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