Scaling Household Nutrient Data

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Abstract

The validity of the assumptions underlying the 21-Meal-Nutritionally-Equivalent-Person (21-MNEP), an adjustment procedure employed in nutritional analyses of U S Department of Agriculture food consumption survey data, is examined Some assumptions are inconsistent with actual nutrient intake data This study proposes a less restrictive alternative, the Meal-Adjusted-Household-Nutrition-Scale (MAHNS), and applies it to data from the 1977-78 Nationwide Food Consumption Survey, Supplementary Low-Income Sample The two scaling procedures yield similar results, a finding that indicates the simple scaling technique of the 21-MNEP performs as well as the more complex MAHNS

Keywords

Nutrition scales; household surveys

The U S Department of Agriculture's (USDA) food consumption surveys provide an important source of data for analyzing household nutrition and evaluating Government food assistance programs Studies by Adrian and Daniel (*1*), Johnson, Burt, and Morgan (*3*), and Allen and Gadson (*2*) are recent examples of studies using these data [1] Unfortunately, although every effort is made to collect and assemble accurate nutrient data in these surveys, many potential sources of measurement error remain They range from the accurate recall and measurement of the types and quantities of foods consumed from home supplies and adjustments for food waste to the matching of these foods to their nutrient content A potential source of measurement error that has received little attention is the procedure used to adjust the nutrient content of foods used from home supplies for the number of meals consumed and the nutrient requirements of the individuals eating those meals Adjustments of this type are necessary to make comparisons of nutrient data across households of varying composition and eating patterns For example, households whose members eat away from home often or who need smaller amounts of nutrients are "smaller" than other households in terms of their nutritional demands on home food supplies

In this article, we examine four assumptions underlying the adjustment procedure currently used and find that at least two deviate substantially from observed nutrient consumption behavior We then develop an alternative and more complex procedure and compare it with the original procedure using data from a low-income supplemental sample of the most recent USDA food consumption survey Surprisingly, both procedures yield nearly identical results

USDA's Consumer Nutrition Division (CND) of the Human Nutrition Information Service developed the scaling procedure now used in many nutrition analyses of USDA survey data The scale is called "the household size in equivalent nutritional units "[2] Here, we prefer the term, the 21-meal nutritionally equivalent person (21-MNEP) This name more accurately reflects the scaling technique and is consistent with a related measure of household size used by CND

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[1] Italicized numbers in parentheses refer to items in the References at the end of this article

[2] For a description and application of the procedure, see (*7*, p 111)

Given the pervasive use of the 21-MNEP in nutritional analyses of USDA household food consumption data and the importance of subsequent research results for food and nutrition policy formation and program evaluation, investigation of this scale and its possible alternatives is critical Our study examines some of the assumptions underlying the 21-MNEP concept and develops a somewhat less restrictive alternative measure The latter incorporates nutrient scales for meal types by age and sex groups using actual food intake data reported in the individual intake portion of the 1977-78 Nationwide Food Consumption Survey (NFCS)

In this article, we will discuss the NFCS data, examine the 21-MNEP concept, develop an alternative to the 21-MNEP, apply the new technique to the supplemental low-income sample of the survey and compare the results with those from the 21-MNEP, and summarize these results

Data

USDA periodically conducts nationwide surveys of household food consumption Since the midthirties, six such surveys of national scope have been conducted 1935-36, 1942, 1948, 1955, 1965-66, and 1977-78 The information obtained has largely centered on the kinds, amounts, values, and sources of foods used from household food supplies during a 7-day period preceding the survey interview [3]

Information is also collected on household composition and income, expenditures for meals and snacks eaten away from home, and counts of morning, noon, and evening meals eaten at home and away from home by each household member The number of guest meals and snacks eaten from home food supplies are also reported However, information is not reported on the types and quantities of foods eaten from nonhousehold food supplies, such as food from school cafeterias and restaurants Thus, without direct data on quantities of foods consumed from nonhousehold supplies, one must make some fairly strong assumptions to impute or extrapolate the total quantities or nutritive values of the foods consumed The two most recent surveys have an additional section detailing the total food intake of individual household members over a shorter period—1 day of recalled information in both the 1965-66 and 1977-78 surveys and an additional 2 days of diary information in the latter survey The individual intake portion of the survey details the types and amounts of foods eaten at home and away from home for each reporting household member Information also is reported on the type of meal (for example, breakfast, lunch, dinner, or snack) and the time of day consumed Information from these two survey sections is treated independently in most USDA analyses

[3] Included in foods used from household food supplies are (1) food and beverages eaten at home, (2) food carried from home in packed meals, (3) food thrown away, and (4) food fed to pets Excluded from food at home are (1) commercial pet food, (2) household food fed to pets raised for commercial purposes, and (3) food given away for use outside the home, such as food sent to family members in the military service, gifts of food donated to a church supper, and food given to household help to take home

The 21-MNEP Concept

The 21-MNEP is a scaling technique applied in analyses of nutrition that use USDA household food consumption survey data It attempts to evaluate whether nutritional needs are generally met by those using home food supplies

Researchers apply the scaling technique to the 7-day recall data on foods used from home supplies to adjust for the nutritive values of foods obtained from nonhousehold supplies by household members as well as those foods eaten from home supplies by guests

The 21-MNEP concept measures the number of meals eaten from home food supplies during a 7-day period in terms of an adult male nutritionally equivalent person (that is, three meals a day for 7 days consumed in proportion to the Recommended Dietary Allowance (RDA) for an adult male 23-50 years of age) The 21-MNEP is calculated separately for food energy and each nutrient based on the nutritional needs of an adult male Thus, an adult male eating all 21 meals from home food supplies during the survey week is equivalent to one 21-MNEP One can calculate the needs of other persons in equivalent nutrition units by dividing their RDA by the allowance for an adult male and adjusting the result by the proportion of meals eaten at home during the week

Tables 1 and 2 illustrate the derivation of the 21-MNEP Table 1 presents the RDA for food energy

and calcium for males ages 9 and 25 and for females ages 2 and 25 Allowances are expressed in equivalent nutrition units and use a male aged 23-50 as a standard unit Table 2 presents the number of at-home and away-from-home meals per household member, the number of guest meals served, the equivalent nutrition units for food energy and calcium, and the number of adjusted at-home meals multiplied by the equivalent nutrition units

Consequently, the household size in 21-MNEP for food energy is 2 61 (54 86/21 = 2 61) and for calcium is 3 55 (74 49/21 = 3 55) The household size in 21-meal nutritionally equivalent persons (unadjusted for nutritional needs) is 3 47 (72 93/21 = 3 47)

This calculation implies that the 21-MNEP concept is based on four assumptions (1) each meal contributes equally to dietary intake, (2) a meal prepared from household food supplies contributes as much to dietary intake as a meal from nonhousehold supplies, (3) each household member consumes nutrients in proportion to his/her recommended dietary allowance, and (4) nutrients lost from skipped meals or gained from extra meals (that is, less than or more than 21 meals a week) are fully offset by other meals eaten

The first assumption we investigate is whether or not all meals contribute equally to dietary intake For example, the 21-MNEP assumes that if an individual in a given age and sex group eats seven breakfasts and seven dinners from home food supplies and seven lunches from nonhome supplies, that individual is considered to be a 2/3 (that is, (7 + 7)/21 = 2/3) at-home equivalent person Similarly, if the seven away-from-home meals are either breakfasts or dinners instead of lunches, the number of at-home equivalent persons is unchanged Consequently, if the average nutrient intake varies substantially by the type of meal eaten and if the away-from-home meals tend to be more of one type

Table 1—Recommended Dietary Allowance (RDA) and equivalent nutrition units

Household member	RDA[1]		Equivalent nutrition units	
	Food energy	Calcium	Food energy	Calcium
	Kcal	*Mg*		
Male, age 25	2,700	800	1 00	1 00
Female, age 25	2,000	800	74	1 00
Male, age 9	2,550	950	94	1 19
Female, age 2	1,200	725	44	91

[1] Based on 1974 RDA

Table 2—Adjusted meals and equivalent nutrition units

Persons served	Meals during week			Equivalent nutrition units[1]		Adjusted meals times nutrition units	
	At home	Away	Adjusted[2] at home	Food energy	Calcium	Food energy	Calcium
Household meals			*Number*				
Male, age 25	14	7	14 00	1 00	1 00	14 00	14 00
Female, age 25	17	2	18 79	74	1 00	13 90	18 79
Male, age 9	19	3	18 14	94	1 19	17 05	21 59
Female, age 2	21	0	21 00	44	91	9 24	19 11
Guest meals							
Female, age 75	1	n a	1 00	67	1 00	67	1 00
Weekly total	n a	n a	72 93	n a	n a	54 86	74 49

n a = Not applicable

[1] The 1974 Recommended Dietary Allowances are used for illustration because they are used in the 1977-78 Nationwide Food Consumption Survey

[2] The proportion of meals at home times 21

than another—so that the nutritive effects of different meal types do not average out—then the 21-MNEP concept may systematically over- or under-estimate actual nutrient usage The direction of this bias would depend on the percentage of morning, noon, and evening meals obtained from home supplies and the relative nutritive contents of each meal type

To examine the validity of the above assumption, we use data from the individual intake portion of the 1977-78 NFCS low-income supplementary sample. Nutrient information obtained in the 1-day recall portion of this survey is averaged by type of meal and age and sex of the individual Only information on members of housekeeping households is used to compute these averages, and skipped meals are excluded [4] The meal types are defined as follows

Breakfast — Meals classified as breakfast by the respondent.
Lunch — Meals classified as either lunch or brunch and meals classified as dinner but eaten at or before 3 p m
Supper — Meals classified as supper or dinner eaten after 3 p m
Snacks — Meals classified as coffee or beverage break, snack, or "other" meal

Individuals not reporting one of the above names for a meal were excluded from the analysis We tabulated the average nutritive content for meal types by 21 age-sex groupings [5]

Analysis revealed that the nutritive values vary considerably across meal types, nutrients, and age-sex groups Let us use the adult male 23-50 years of age as an example The average breakfast (433 Kcal) contains less than half the calories of the average supper (965 Kcal), and an average lunch (759 Kcal) contains less than 80 percent of the calories of a supper [6] Conversely, the average breakfast and lunch, respectively, contribute 78 percent and 91 percent of calcium as does the average supper Similarly, for boys 9-11 years of age, the average breakfast (307 Kcal) contributes about 43 percent of the calories of a typical supper (707 Kcal), and lunch (703 Kcal) contributes about the same as supper This evidence suggests that one cannot scale the nutritive values of a breakfast or lunch as a constant percentage of a dinner for all nutrients of a given age-sex group or even for a given nutrient across all age-sex groups Thus, it is fallacious to assume that all meals contribute equally to dietary intake

Table 3 reports the average percentages of those meals obtained from home and nonhome supplies by the 21 RDA age-sex groups Lunches are by far the meal most frequently eaten away from home, especially for school-age individuals For individuals of all ages, almost 26 percent of all lunches are eaten from nonhome supplies This figure compares with 41-53 percent for school-age individuals Morning and evening meals are more likely to be eaten from home food supplies Only about 4-6 percent of these meals are eaten from nonhome supplies Because the nutritive values of lunches are generally between those of breakfasts and suppers, the equal weighting given to these meal types by the 21-MNEP may produce average nutritive values closely approximating those obtained from lunches eaten from nonhome supplies However, this hypothesis deserves closer analysis

The second assumption we address is whether or not the average nutritive content of each meal type varies depending on the source—at home or away from home The validity of this assumption has recently been addressed by Kennedy and others (*4*) Their findings for this particular issue are summarized in table 4 The table contains the average percentage of nutrients obtained from each meal type and source of food An examination of table 4 lends support to the statistical analysis of Kennedy and others which reveals that the average nutritive contents of at-home and away-from-home meals are statistically different, but are of little substantive significance Thus, it seems reasonable, at least for the nutrients examined by Kennedy and others, that the average nutritive contents of particular meal types consumed from home supplies are equivalent to those consumed from nonhome supplies

The third assumption made in the 21-MNEP scaling concept requires that individuals obtain nutrients in proportion to their dietary needs Dietary needs

[4] A housekeeping household is defined as one in which at least one member had 10 or more meals from home food supplies during the 7 days preceding the interview
[5] These tables are available on request from the authors
[6] A kilocalorie (Kcal) is the amount of heat necessary to raise 1 kilogram of water from 15 to 16 degrees Centigrade

Table 3—Percentage of meals eaten from home and nonhome supplies, by age-sex group and meal[1]

Age and sex	Meal and source					
	Morning		Noon		Evening	
	At home	Other	At home	Other	At home	Other
	Percent					
Children						
0- 5 years	99 3	0 7	98 3	1 7	98 4	1 6
6- 9 years	98 3	1 7	95 5	4 5	97 2	2 8
1 2 years	97 4	2 6	91 3	8 7	96 3	3 7
3-5 years	93 5	6 5	80 2	19 8	95 8	4 2
6-8 years	90 1	9 9	46 8	53 2	97 7	2 3
Adult males						
9-11 years	87 9	12 1	51 8	48 2	97 5	2 5
12-14 years	91 9	8 1	47 5	52 5	98 3	1 7
15-18 years	95 0	5 0	58 6	41 4	94 4	5 6
19-22 years	88 8	11 2	71 7	28 3	87 9	12 1
23-50 years	92 1	7 9	79 1	20 9	91 1	8 9
51-64 years	90 1	9 9	82 9	17 1	96 8	3 2
65-74 years	96 9	3 1	92 2	7 8	95 7	4 3
75 years and over	98 9	1 1	96 0	4 0	97 9	2 1
Adult females [2]						
9-11 years	88 7	11 3	47 6	52 4	97 8	2 2
12-14 years	92 8	7 2	53 1	46 9	96 6	3 4
15 18 years	94 6	5 4	56 7	43 3	97 1	2 9
19-23 years	94 4	5 6	80 9	19 1	92 5	7 5
23-50 years	97 6	2 4	89 0	11 0	95 7	4 3
51-64 years	98 1	1 9	94 1	5 9	97 0	3 0
65-74 years	98 8	1 2	95 0	5 0	95 7	4 3
75 years and over	99 4	6	94.4	5 6	95 7	4 3
All	94 2	5 8	74 2	25 8	95 5	4 5

[1] 1977-78 USDA Nationwide Food Consumption Survey, Low-Income Household Sample, 7-day recall of foods used from home supplies
[2] Excludes pregnant and nursing women

are assumed to be proportional to the RDA's established in 1974 A potential problem with the RDA scaling is that, except for food energy, it is constructed to exceed the requirements of most healthy individuals and thereby insure that the needs of nearly all members of the population are met [7] Consequently, the scale may be inappropriate for a population subgroup such as the one represented by the 1977-78 NFCS supplementary low-income sample in which some households may be at nutritional risk

[7] See (*5*, *6*)

The validity of the above assumption is examined with data obtained from the individual intake portion of the low-income survey If the assumption that consumption is proportional to one's RDA is correct, then one would expect that the ratio of nutrient intake to the RDA for each nutrient would be identical However, it is not necessary for the ratio to be equal across nutrient groups or to equal 1 because the underlying assumption requires only that the nutritive values of consumption be proportional to the RDA's, not equal to them

Table 4—Percentage of daily nutrient intake provided by specific meals consumed from home supplies and from nonhome supplies (weekdays)[1]

Meal and source	Food energy or nutrient group					
	Energy	Protein	Calcium	Iron	Vitamin A	Vitamin C
	Percent					
Breakfast						
Home	22 1	19 4	30 7	26 3	28 8	32 1
Nonhome	24 4	22 3	28 2	24 6	24 0	24 0
Lunch						
Home	31 5	31 8	30 8	29 3	26 0	3 2
Nonhome	30 8	33 0	31 4	29 8	27 8	26 0
Dinner						
Home	46 0	52 2	37 9	47 3	48 0	45 4
Nonhome	47 0	51 8	37 8	47 3	44 0	42 6
Other						
Home	17 3	11 3	19 2	12 3	13 1	15 0
Nonhome	15 5	8 5	13 1	10 7	7 8	9 0

[1] The percentage of daily nutrient intake provided by specific meals is based only on those individuals reporting that meal Skipped meals are not included because there is no objective means of allocating that meal between at home and away-from-home sources Consequently, the sum of percentages across all meals will not add to 100 unless there are no skipped meals

Source (*4*)

Table 5 reports nutrient intakes per RDA for each nutrient and age-sex group The nutrient intake values are computed from the 3-day averages reported in the low-income sample, and RDA's are based on 1974 standards This table reveals that actual nutrient intake varies considerably from the dietary needs established by the RDA's As noted earlier, this variation suggests that the RDA's do not represent an appropriate scale for adjusting actual nutritional intake, at least not for a population subgroup such as the one represented in the low-income sample

We do not examine the fourth assumption, namely, that nutrients lost or gained from skipped meals or extra meals are exactly offset by the other meals eaten This assumption is no less important than the others, however, it is far more difficult and time consuming to verify One way to measure the potential size of this problem would be to examine the number of household members who report fewer than or more than 21 meals during the survey week

The evidence suggests that two of the three assumptions examined deviate substantially from what actual food intake data indicate A fourth assumption is not addressed because it would require substantial additional research Whether or not the discrepencies in these assumptions create a systematic error in actual use is unknown Some errors may cancel each other out

Meal-Adjusted Household Nutrition Scale: Methodology

We propose an alternative to the 21-MNEP which we call the meal-adjusted household nutrition scale (MAHNS) Unlike the 21-MNEP, which measures the number of away-from-home meals in terms of a

Table 5—Average nutritive values of diets per 1974 Recommended Dietary Allowance, by age-sex group[1]

Age and sex	Food energy or nutrient group												
	Food energy	Protein	Calcium	Iron	Magnesium	Phosphorous	Vitamin A	Thiamine	Riboflavin	Niacin	Vitamin B_6	Vitamin B_{12}	Vitamin C
	Proportion												
Children													
0- 5 years	0 60	0 94	1 18	1 77	0 87	1 23	1 23	1 93	2 22	1 29	0 82	2 81	1 88
6- 9 years	80	1 53	1 32	96	1 28	1 75	1 95	1 57	2 23	1 10	1 22	5 15	1 89
1-2 years	95	2 16	86	59	1 09	1 10	1 69	1 40	1 82	1 29	1 66	3 26	1 48
3-5 years	87	2 06	89	83	97	1 16	1 57	1 32	1 57	1 20	1 43	2 98	1 75
6-8 years	77	1 94	1 10	1 08	90	1 42	1 50	1 14	1 56	1 02	1 18	2 42	1 96
Adult males													
9 11 years	76	1 94	1 09	1 09	86	1 41	1 72	1 14	1 68	1 03	1 14	3 09	2 18
12-14 years	73	1 87	83	76	74	1 14	1 08	1 09	1 41	1 05	97	1 58	1 87
15-18 years	72	1 64	84	82	68	1 20	1 30	1 13	1 26	1 02	82	1 95	1 82
19-22 years	64	1 50	91	1 35	67	1 52	1 15	89	97	98	72	1 79	1 68
23-50 years	81	1 69	94	1 52	83	1 68	1 02	1 06	1 14	1 23	77	1 71	1 52
51 64 years	82	1 47	78	1 43	78	1 51	1 08	1 18	1 11	1 29	72	1 76	1 52
65-74 years	76	1 41	86	1 31	74	1 45	1 20	1 07	1 07	1 15	66	1 36	1 46
75 years and over	63	1 20	72	1 16	59	1 22	1 29	91	1 00	94	53	2 18	1 23
Adult females [2]													
9-11 years	78	1 90	1 00	1 04	86	1 35	1 30	1 18	1 55	1 03	1 03	1 78	1 93
12-14 years	77	1 68	71	67	76	1 00	1 19	1 17	1 40	1 03	82	1 34	1 77
15-18 years	80	1 38	61	58	65	88	1 08	1 07	1 14	1 05	57	1 56	1 44
19 22 years	76	1 44	73	60	64	1 19	94	1 07	98	1 13	57	1 15	1 71
23-40 years	72	1 30	62	56	64	1 09	1 16	1 01	1 03	1 14	51	1 44	1 37
51-64 years	77	1 34	61	1 02	66	1 09	1 40	1 01	1 15	1 26	53	1 55	1 52
65-74 years	72	1 25	69	98	67	1 11	1 50	96	1 15	1 14	53	1 39	1 50
75 years and over	69	1 17	63	98	65	1 03	1 55	95	1 21	1 18	51	1 65	1 47
All	77	1 60	81	93	77	1 24	1 29	1 11	1 29	1 13	83	1 93	1 63

[1] Dietary intake levels are 3-day average, 1977-78 USDA Nationwide Food Consumption Survey, Supplemental Low Income Sample individual intake portion

[2] Excludes pregnant and nursing women

nutritionally standardized person, the MAHNS was developed to expand nutrients used from home food supplies to nutrients in all foods used by household members The MAHNS assumes that the nutritive values of food obtained from nonhousehold supplies are proportional to those obtained from household supplies for similar meal types The relative nutritive contributions of each meal type are assumed to vary by the age and sex of the individual The RDA's are not used in the MAHNS as a scale of dietary intake, this information is developed instead from actual dietary intake data

The MAHNS for each nutrient, j, has four parts (1) the nutritive values of meals consumed from home supplies by household members, NVH^j, (2) the nutritive values of meals consumed from home supplies by guests, NVG^j, (3) the nutritive values of meals consumed from nonhome supplies by household members, NVA^j, and (4) the nutritive values of foods used from home food supplies, N^j The first three components can be calculated from reported survey information on the types of meals (that is, morning, noon, and evening meals) consumed at home and away from home by household members and guests and from a set of nutritive values reflecting the average nutritive content of meal types by age and sex of the individual For our analysis, the nutritive values are constructed from the individual intake portion (1-day recall data) of the 1977-78 NFCS, Supplemental Low-Income Sample

Formally, the MAHNS for each nutrient, j, and household, i, is constructed as follows

$$MAHNS_i^j = N_i^j \cdot \left[\frac{NVH_i^j}{NVH_i^j + NVG_i^j}\right] \circ \left[\frac{NVH_i^j + NVA_i^j}{NVH_i^j}\right]$$

$$i = 1, 2, \quad , n$$
$$j = 1, 2, \quad , 13$$

where

$$NVG_i^j = \sum_{g=1}^{G_i} \sum_{m=1}^{M} w_{m,g} X_{m,g}^h$$

$$NVH_i^j = \sum_{f=1}^{F_i} \sum_{m=1}^{M} w_{m,f} X_{m,f}^h$$

$$NVA_i^j = \sum_{f=1}^{F_i} \sum_{m=1}^{M} w_{m,f} X_{m,f}^a$$

Symbols not previously defined are as follows G_i denotes the number of guests who eat meals in the ith household, $w_{m,g}$ is the average nutritive value of meal type, m, for the age and sex class of the gth guest, $X_{m,g}^h$ denotes the number of meal types, m, eaten by the gth guest from household supplies, h, M denotes the number of differentiated meal types (that is, morning, noon, evening, snack, and refreshment), F_i denotes the number of household members in the ith household, $w_{m,f}$ is the average nutritive content of the mth meal type for the fth household member's age-sex group, and $X_{m,f}^h$ and $X_{m,f}^a$ denote the number of meals of type, m, for family member, f, eaten from home supplies, h, and nonhome supplies, a, respectively

The expression in the first set of parentheses adjusts the nutritive content of all foods used from home supplies, N_i^j, for meals eaten by guests This adjustment proportions out guest meals based on the number and average nutritive values of meals eaten at home by household members and guests The expression in the second set of parentheses is a similar type of adjustment for meals eaten from nonhome supplies by household members

The average nutritive values of meal types by age and sex of individuals used in the computation of the MAHNS are a new and critical element For this study, these values are taken from the 1-day recall data obtained in the individual intake portion of the 1977-78 NFCS Supplementary Low-Income Sample A major advantage of using these 1-day recall data is that they are obtained from the same sample of households and at the same time as the 7-day recall information on foods used from home supplies [8] Thus, it is reasonable to assume that the relative nutritive values of meals for each age-sex group are comparable to those expected in the household portion of the survey

[8] Of course, all 3 days of the intake diary could be used to obtain the average nutritional content of meals by age and sex

A major problem in developing the nutritive value scales is matching meal types reported in the individual intake survey (that is, breakfast, brunch, lunch, dinner, supper, and snack) with those reported in the household survey (that is, morning, noon, and evening) It is assumed that the morning, noon, and evening meals correspond directly with the definitions for breakfast, lunch, and supper presented earlier Furthermore, because snack meals by household members are not reported separately, the nutritive values of snack meals are distributed equally to morning, noon, and evening meals This assignation does not apply to household guests because their meals, snacks, and refreshments are reported separately Guest snacks and refreshments are assumed to be equivalent to 1/2 and 1/4 of the average nutritive values obtained from all snacks eaten daily by household members of the same age and sex group The next section applies the MAHNS to the 1977-78 NFCS Supplementary Low-Income Sample and compares the MAHNS with the 21-MNEP

Comparison of MAHNS and 21-MNEP

The MAHNS and 21-MNEP are alternative techniques for adjusting or otherwise standardizing the nutritive values of foods used from home supplies for meals eaten from nonhome supplies and for guest meals The assumptions implied by each technique differ The reference base, to which these techniques adjust nutritive values, also differ The MAHNS adjusts the household nutritive values upward to that of total food usage by household members The 21-MNEP is a scaling measure of meals eaten from home supplies in terms of the relative nutritional requirements of those eating the meals To compare the two measures, one must adjust both to the same units by combining the actual nutrient content of foods used from home food supplies with each scaling technique and then by dividing the quotient by the dietary requirements (1974 RDA's) corresponding to the units of each technique

Table 6—Nutritive value of diets per nutrition unit Comparison of the 21-MNEP and the MAHNS[1]

Nutrient	Food Stamp Program status					
	All		Participants		Nonparticipants	
	21-MNEP	MAHNS	21 MNEP	MAHNS	21 MNEP	MAHNS
	Proportion					
Food energy	1 380	1 372	1 475	1 449	1 321	1 325
Protein	2 297	2 296	2 515	2 494	2 161	2 173
Calcium	1 239	1 236	1 249	1 241	1 233	1 233
Iron	1 678	1 669	1 716	1 689	1 655	1 657
Magnesium	1 337	1 323	1 414	1 387	1 289	1 284
Phosphorous	2 182	2 160	2 276	2 242	2 122	2 108
Vitamin A	2 188	2 158	2 458	2 398	2 020	2 008
Thiamine	1 825	1 787	1 968	1 903	1 736	1 714
Riboflavin	2 080	2 066	2 220	2 193	1 993	1 987
Niacin	1 955	1 928	2 110	2 057	1 859	1 848
Vitamin B_6	1 262	1 250	1 407	1 385	1 172	1 166
Vitamin B_{12}	2 592	2 566	2 779	2 743	2 475	2 456
Vitamin C	2 986	2 941	3 420	3 358	2 716	2 682

[1] 1977-78 USDA Nationwide Food Consumption Survey, Supplementary Low-Income Sample, household portion Dietary requirements are those established in 1974 as the Recommended Dietary Allowance

Table 6 compares average nutrients per dietary requirement for the two measures The nutritive values ($W_{m,g}$ and $W_{m,f}$) used for this analysis are available from the authors Averages are reported for both Food Stamp Program (FSP) participants and eligible nonparticipants Nonhousekeeping households and FSP ineligible households are excluded from the tabulations The two alternative measures yield almost identical averages for each nutrient group A small discrepency can be found in the third significant digit The closeness of these measures was not expected

Examination of only mean values can be misleading because large disparities may exist for each household, yet cancel out in the average To avoid this potential problem, we computed the correlation between the two measures over each household We also analyzed the differences between the two measures Table 7 reports correlations between the 21-MNEP and the MAHNS In the low-income sample, the correlations between the two measures are extremely high for all nutrient groups The lowest correlation, 0 969, is for iron The highest correlation, 0 993, is for vitamin A These correlations reveal that the 21-MNEP and the MAHNS are almost identical measures

Table 7 shows the disparities between the two measures The mean difference between the two measures is small for all nutrient groups On average, the 21-MNEP scale yields slightly larger nutritive values per dietary requirement than the MAHNS The standard errors of the distributions of the differences also appear in the table However, examining selected percentiles is perhaps more informative for an unknown distribution Table 7 shows the distribution of the differences for selected percentage points The distribution of the differences is narrow Between the 5th and 95th percentiles—into which 90 percent of the households fall—the discrepency is less than ±0 23 Thus, the two measures yield nutritive values of diets which are relatively close for each household We also conducted regression analysis to examine for systematic differences between the two measures These results support the other analyses in that no substantive differences were found

Table 7—Comparison of nutritive values of diets per nutrition unit supplied by the 21-MNEP and the MAHNS[1]

Nutrient group	Correlation	Difference between MAHNS and 21 MNEP						
		Mean	Standard deviation	Percentiles of the distribution				
				5	10	50	90	95
				Percent				
Food energy	0 981	-0 008	0 121	-0 115	-0 066	0 005	0 072	0 109
Protein	978	- 001	209	- 236	- 130	019	150	218
Calcium	978	- 003	131	- 086	- 043	003	087	132
Iron	973	- 010	211	- 185	- 109	[2]	113	185
Magnesium	974	- 013	137	- 096	- 055	003	059	094
Phosphorous	982	- 022	191	- 208	- 126	[2]	100	166
Vitamin A	993	- 031	229	- 259	- 153	- 002	094	185
Thiamine	979	- 038	178	- 175	- 111	- 009	053	098
Riboflavin	971	- 014	237	- 140	- 075	008	114	187
Niacin	977	- 027	205	- 208	- 127	001	075	131
Vitamin B_6	969	- 012	147	- 141	- 078	001	078	122
Vitamin B_{12}	996	- 028	284	- 231	- 120	[2]	123	214
Vitamin C	991	- 042	296	- 168	- 085	[2]	084	159

[1] 1977 78 USDA Nationwide Food Consumption Survey, Supplemental Low-Income Sample Excludes nonhousekeeping households and those classified as ineligible for the Food Stamp Program
[2] Less than 0 001

Conclusion

We have discussed the assumptions underlying the 21-MNEP concept and presented a less restrictive alternative termed the MAHNS The 21-MNEP is a household size adjustment based on recommended daily nutrient requirements and the number of meals eaten at home The MAHNS is a nutrient adjustment factor based on observed nutrient intake patterns with consideration given to meal types and age and sex characteristics

A priori one would expect the MAHNS adjustment to be superior to the 21-MNEP based on their respective assumptions However, for the 1977-78 NFCS Supplementary Low-Income Sample, the measures were almost identical In retrospect, two related factors may account for this similarity First, the characteristics of the sample selected for comparison may have caused this observed similarity Second, and possibly related to sample selection, is the fact that lunches (the meal most often eaten away from home) had values of nutrients close to the mean nutrient levels for breakfasts and dinners combined

It is a welcome finding that we can sometimes do as well with a simple scaling adjustment as with a complex one Perhaps researchers can now place greater confidence in the use of the 21-MNEP However, one should be cautious and not summarily dismiss the MAHNS process based on evidence from one sample Applications of the MAHNS adjustment to the complete 1977-78 NFCS might provide additional insight into differences between the two methodologies

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