NUTRIENT CALCULATION SYSTEMS FOR EDUCATORS AND CLINICIANS: I. EVALUATING MICROCOMPUTER NUTRIENT CALCULATION PROGRAMS

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The issue of which microcomputer programs provide the most accuracy in assessing nutrient intake of clients or patients is one which has been widely reported in the scientific literature in the past few years. (1 - 5) Little has been reported in the literature in regard to the issue of measurement of reliability in regard to computer-assisted nutrition analysis -- measuring whether the program in question could be used by a variety of people to produce similar analysis results. The issue of measurement of reliability is the subject of this presentation.

In 1985 Framingham State College received a Nutrition Education and Training grant from the Massachusetts Department of Education, Bureau of Nutrition and School Food Services to begin a study of the validity and reliability of computer software packages available for microcomputers. The original purpose of this study was to provide information to school lunch directors and teachers in the Commonwealth of Massachusetts about which nutritional analysis software packages were best to purchase.

A total of 23 nutrition analysis software programs were purchased. These included all programs identified during 1985 which performed nutrition analysis and were modest in cost. All of the purchased programs were designed to run on an Apple IIE computer system, although many of the programs were also available in versions for an IBM system as well. The programs were divided roughly into two groups, depending upon their purpose as defined by the author or seller: programs for "professional use", and those programs designed to be used by "consumers".

The original design of this research was to evaluate the validity and reliability of nutrition analysis computer programs. Although the reliability data are being discussed here today, it is important to mention briefly the research design of the validity portion of the study. Validity measurements were done first, in order to eliminate any programs which were deemed not to offer valid results from inclusion in the reliability research.

In all research in this study, a standard menu of food consumption was used (see Figure 1). This standard menu included only simple, plain foods, without the inclusion of mixed dishes or complicated recipes. This menu was chosen specifically for this study, to eliminate as much as possible any interpretation issues. Some food items (i.e., various types of milk, and broiled chicken) were chosen to test the composition of the database, and the variety of foods included in each program.

Figure I. Test Menu

BREAKFAST	LUNCH	SUPPER
4 oz. orange juice (frozen reconstituted 3:1unswt.)	3 oz. broiled chicken breast (skin removed)	4 oz. hamburger patty (21% fat; weight before cooking)
2 boiled eggs	2 Tb. margarine	1 medium baked potato
2 slices whole wheat toast	2 slices whole wheat bread	1 t. margarine
2 t. margarine	1 large apple	1 c. broccoli, cooked
4 oz. skim milk	8 oz. low-fat milk (1% fat; non-fat dry milk added)	1 medium banana
black coffee		4 oz. whole milk
		black coffee

The result of each program's analysis of the standard menu was compared to the analysis of the same standard menu using the latest printed version of USDA food composition data. Programs were compared on the basis of how closely they duplicated the analysis totals from USDA sources. Programs were judged to offer valid results if their totals were within +/- 10% of USDA results. Many programs offered valid results for most or some of the nutrients being examined, but not all nutrients. One program fell outside of the 10% level for a majority of nutrients tested, and was judged to be unacceptable. The remaining 22 programs were judged to offer reasonably valid results, and were considered for the second portion of the study dealing with reliability issues.

Each program was used by a number of junior/senior level food and nutrition students enrolled in a course entitled "Computer Applications in Dietetics" at Framingham State College. Each student received several hours of lecture information about the theory and process of computerized nutrition analysis before doing the laboratory assignment. This assignment involved using the standard menu with two different computer programs -- one geared to professionals and one designed to be used by consumers. Of the 22 programs originally included in the reliability study, 12 are reported in this presentation. These 12 are the programs for which the most complete data is available. Some of the programs were eliminated early in the study for a variety of reasons -- too small database, too limited food selection, technical problems, etc.

Figure 2 lists the twelve programs included in this study, along with the manufacturer's address, the cost, and the number of foods in the database. While some of these programs are no longer available and others have been replaced by newer versions, many of these manufacturers are still involved in making computer analysis programs available to the public.

Figure II. Nutrition Analysis Software Evaluated

PROGRAM	ADDRESS	COST	# FOODS IN D.B.
Eat for Health	Genesee Intermediate School District 2413 W. Maple, Flint, MI 48507	$ 40.00	575
Eat Smart	N.A.	19.75	136
Food Processor I	ESHA Corporation 606 Juntura Way S.E., Salem, OR 97309	120.00	1500
Healthaide	Knossos 422 Redwood Avenue, Corte Madera, CA 94925	79.95	700
Idaho Diet Analysis	N.A.	10.00	322
Nutrition Analysis System (NAS)	Dietary Diet Analysis Box 26, Hamburg, NJ 07419	199.00	1700
Nutricalc	PCD Systems, Inc. 1163 Main Street, Penn Yan, NY 14527	129.00	893
Nutriplan	Micromedx Corp. 187 Gardiners Avenue, Levittown, NY 11756	75.00	420
Nutrition Design	Nutrition Design 3406 S.W.Chintimini Avenue, Corvallis, OR 97333	58.85	881
Nutritionist II	N-Squared Computing 5318 Forest Ridge Rd., Silverton, OR 97381	295.00	847

What Did You Eat Yesterday	The Learning Seed Co. 21250 Andover Road, Kildeer, IL 60047	39.00	600
You Are What You Eat	N.A.		

This presentation provides research results for the reliability measurements of calories, protein, fat and carbohydrate. In all cases the results are based on a sample size of 10 analyses per program. In Tables 1 through 4, data are presented on the minimum, maximum, mean and standard deviation figures for each program.

Table I. Results from Analysis of Calories

PROGRAM	MINIMUM	MAXIMUM	MEAN	STD.DEV.
Eat for Health	1531	2101	1721	220
Eat Smart	1641	1918	1794	102
Food Processor I	1805	1931	1875	47
Healthaide	1895	2403	2147	225
Idaho Diet Analysis	1696	2005	1798	96
Nutrition Analysis System (NAS)	1786	2411	1941	193
Nutricalc	1763	2095	1841	108
Nutriplan	1678	1976	1751	93
Nutrition Design	1553	1934	1786	95
Nutritionist II	1767	2018	1855	71
What Did You Eat Yesterday?	1601	1965	1764	91
You Are What You Eat	1648	1937	1781	76

The data on calories are shown in Table 1. As is evident from these data, there is wide variation in results of calorie analysis. For many of the programs, there is a very large difference between the minimum and maximum figures reported. While some of these differences are due undoubtedly to coder differences, this is a good illustration of the effects of limited food choices in a database upon the results obtained from using that program. One of the more obvious differences in database composition between the programs was in the choices available to the user when searching for a broiled chicken breast. Some of the listings in code books for chicken (when the coder was searching for broiled chicken) include the following:

chicken - fryer, breast, fried, 1/4 breast, 2 oz. raw
chicken - breast, fried
chicken - breast, meat only, roasted
chicken - half broiler, broiled, bones removed
chicken - breast, roast (1 piece)

Many of the programs had only fried chicken entries, thereby increased the total calorie count in the analysis.

Likewise, knowing which database entry to select for hamburger was also a problem. In many databases, there was lack of specification of the fat content, the size of the portion, or an indication of whether the citation in the code book was for a cooked or raw portion. Some of the various ways that hamburger was listed in code books (when the coder was searching for a 4 oz. hamburger patty, 21% fat, weight before cooking) included the following:

beef hamburger - medium cooked, regular, 1 patty, 1/4 # raw
beef - ground regular, cooked
hamburger (ground beef) - cooked, 21% fat
ground beef - broiled, lean with 21% fat (2.9 oz.)
beef - hamburger (3 oz)

Table II. Results from Analysis of Protein

PROGRAM	MINIMUM	MAXIMUM	MEAN	STD.DEV.
Eat for Health	73	143	102	22
Eat Smart	103	112	105	3.3
Food Processor I	100	112	105	3.6
Healthaide	98	147	122	21
Idaho Diet Analysis	96	116	103	5.6
Nutrition Analysis System (NAS)	92	118	101	7.2
Nutricalc	92	99	94	2.9
Nutriplan	77	84	82	22.3
Nutrition Design	93	115	106	5.7
Nutritionist II	92	109	100	4.7
What Did You Eat Yesterday?	96	104	99	2.7
You Are What You Eat	89	97	94	2.9

According to Table 2, results for protein analysis show less variation for the most part between minimum and maximum figures. Some of the larger variations may reflect some improper food coding. These results were not eliminated from the final analysis, since some variations in coding choices are a reality when programs are used by a variety of people in different circumstances. To have eliminated these questionable results would not have been a true test of the reliability of the program results.

Table III. Results from Analysis of Total Fat

PROGRAM	MINIMUM	MAXIMUM	MEAN	STD.DEV.
Eat for Health	71	90	82	6.8
Eat Smart	--	--	--	--
Food Processor I	82	85	83	.8
Healthaide	92	118	104	11
Idaho Diet Analysis	--	--	--	--
Nutrition Analysiss System (NAS)	77	150	91	22
Nutricalc	80	114	86	11
Nutriplan	--	--	--	--
Nutrition Design	71	96	81	6.8
Nutritionist II	78	87	82	2.9
What Did You Eat Yesterday?	48	70	62	5.7
You Are What You Eat	--	--	--	--

The results of the fat analysis is reported in Table 3. As is shown in this table, not all of the programs analyze for fat. The fact that not all computer programs provide for fat analysis is interesting, in light of the great interest in fat composition of food. In general, programs with small standard deviations tended to be those programs that have larger databases and offer a wider choice of food selection. Some variation between programs is undoubtedly due to the choices available to coders for chicken and hamburger, as discussed above.

Table IV. Results from Analysis of Carbohydrate

PROGRAM	MINIMUM	MAXIMUM	MEAN	STD.DEV.
Eat for Health	162	216	174	20
Eat Smart	--	--	--	--
Food Processor I	179	210	192	10
Healthaide	176	195	186	8.3
Idaho Diet Analysis	--	--	--	--
Nutrition Analysis System (NAS)	187	217	198	8.1
Nutricalc	183	209	189	8.2
Nutriplan	169	180	171	3.8
Nutrition Design	177	183	178	2.0
Nutritionist II	187	219	196	9.5
What Did You Eat Yesterday?	--	--	--	--
You Are What You Eat	--	--	--	--

Table 4 lists the results of the carbohydrate analysis. Some of the programs show almost no variation between the figures for minimum and maximum levels of carbohydrate. Others show some variation, which may be due in part to the issue of how broccoli is listed in code books, and how a coder determines exactly how much broccoli is one cup -- the amount listed on the standard menu. Some of the citations for broccoli in these various programs includes the following:

broccoli - flower stalks, cooked, l large stalk, 2/3 c.
broccoli - cooked
broccoli - cooked, from raw, chopped
broccoli - cooked, drained, from raw, stalks cut into 1/2 " pieces (1 cup)
broccoli - cooked, drained, frozen, chopped (1 cup)
broccoli - cooked (.5 cup)
broccoli - one stalk

As can be seen by the above listing, there is a great deal of difference in how one food item may be listed in code books. Nonspecific citations in code books almost certainly has a big influence on reliability issues.

Students who participated in this study were asked to itemize problems they encountered while completing the

analyses. Some of the problems related to the process of coding which they identified included the following:

- no indication if the food is cooked or raw
- "Standard portion" listed in code book; there is no way to select the actual portion eaten
- not enough food choices in the database; too much interpretation of foods of like nutrient composition required
- not enough variation in types of food preparation available in codebook
- foods listed by "piece" or "serving" - no indication of actual weight or measurement given

Reliability issues in regard to computer nutrition analysis are of concern, due to the fact that many consumers who buy and use these programs do not have a background in food and nutrition. They also probably have not received detailed instructions on the limitations of nutrient analysis by computer. So the information in the packages (discs and documentation) must stand alone in offering enough information to users so that the program can produce the information desired, with acceptable reliability. This study looked at reliability issues, but did not duplicate the actual using of computer programs by consumers, since all of the users in this study were nutrition students, with a background in nutrition and some previous experience with computer issues.

In summary, computer nutrition analysis is a process which has become available to a variety of people, many of whom do not have a background in nutrition. Designers of consumer-oriented databases should pay particular attention to the quality of the documentation which accompanies their product. A well-written and complete code book, along with an appropriate selection of food items and a sufficiently large database, can make a difference in encouraging a reasonable level of reliability.

References

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