COMPARISON OF MICRO-COMPUTER PROGRAMS FOR NUTRITION EDUCATORS

Won Song

Food Science and Human Nutrition
Michigan State University
East Lansing, Michigan

With ever increasing interest in health promotion through good nutrition, introductory nutrition courses in college have gained enrollment in the past years. An introductory nutrition class(HNF 102) offered at Michigan State University(MSU) attracts about 800-900 students each term in two sections. A majority of the students in the class are non-nutrition majors who can account the course credits for a general education(natural science) requirement. The support for the following project was from the W.K. Kellogg Foundation as part of a university-wide Health Promotion Grant.

It has been reported that students taught by a personalized system of instruction or computer assisted instruction acquire more nutrition knowledge when compared to students taught by the traditional lecture methods in an introductory nutrition class(Drake, 1988). Furthermore, computer literacy is an expected competency in dietetics(ADA) as in all other fields, and many nutrition classes at different levels have incorporated use of computer software(Orta, 1987; Murphy et al., 1984).

At MSU, a majority(more than 85%) of the students enrolled in the introductory nutrition class responded to a survey administered at the beginning of a term. The students reported that they chose the class to gain nutrition knowledge to improve their health status. The large class with approximately 450 students in each section, however, does not allow a personalized system of instruction, or much interaction between students and instructors.

We examined whether application of computer software would allow students to receive individualized nutrition evaluation and information. The goal was to select and put into service a diet analysis software that could meet the needs of students, and was also feasible to implement for routine use by introductory as well as intermediate level college nutrition classes. In the first step, the instructor and two graduate assistants screened several nutrition software that were available in the market. In the second step, 12 undergraduate students participated in evaluation of selected diet analysis programs for difficulty and feasibility. In the third step we examined variability in the analysis data. An incomplete database as a significant source of variability in the analysis results was examined.

Step I: Screening

In the first screening step, the instructor and two graduate students reviewed 11 diet analysis software to examine which one could possibly be incorporated into existing classes promoting nutrition and health at MSU. The evaluation was based on the health promotion objectives of introductory and intermediate level nutrition classes, and many different features and capabilities of the software.

Computerized diet analysis software included in the screening process were the followings: 1) CBORD's Diet Analyzer system, 2) Food Processor II, 3)Eat for Health, 4) Nutrition Design, 5) Nutrient Analysis System, 6) Nutritionist II, 7) Nutritionist III, 8) The DINE System, 9) Nutridata, 10) NSL Diet analyzer, and 11) Nutredfo.

Many variations among the software were tabulated using the following criteria:

User-friendliness for multiple users with varying experience with computer, ease of initial set up and routine handling by students, and capability of collecting dietary intake data for the purpose of on-going program evaluation and research were given considerations.

Table 1. Variations Among Software

Expense:
a. Hardware required:
b. Cost: for personal use (range $120-1,000) and site license
Database:
c. Number of food items in database: 500-3386
d. Number of nutrients analyzed: 16-55
e. Ability to edit food items in database: 8 of 11
f. Fast and convenience foods included in database: 9 of 11
g. Source of nutrient database: USDA Home and Garden Bulletin #72, Handbook #8, Handbook #456, Pennington and Church, Food Manufacturer's data, and Periodical literature in that order or in combination
System feature:
h. Intended users: educators, practitioners in nutrition, students and lay people can learn(all 11)
i: Input data: demographic information, food data(name and amount), physical activity levels, personal goals
j: Output data: nutrient total, % RDA or personal goal in table and graph, % of energy source, nutrition information on deficiencies.
k. Food description entry: number codes(7) and word(4)
l. Units: common serving units(10) and weight in combination(1)
m. Capability of saving data for on-going program evaluation and research: all(11)
n. Userfriendliness for multiple users with varying experience with computer
Others:
o. Producer's credential:
p. Ease of initial set up
q. Ease of routine handling by students and instructor

Step II. Students' Evaluation

In the second step, a group of 12 sophomore dietetic students participated in evaluation of three selected software: CBORD's Diet Analyzer system(DA), Food Processor II(FP), and Nutritionist III(N3). This trial step was to assess feasibility of incorporating computerized diet analysis software as a class activity. All of the students had used one or more word processor software but had not used any diet analysis software before.

Each student recorded a three-day diet intake(two weekdays and one weekend day) and used the record for nutrient analysis by three software(i.e., 36 records/software). Each student received one-page shortened instructions on installation and operation for each software, and a complete set of diskettes in random order. At the beginning, four students were assigned to one software and asked to analyze their three day diet intake in the same order.

All students worked in a computer classroom where each student had an individual pc computer station with a monitor. Students were not allowed to help each other. The instructor and a graduate assistant were in the computer classroom at all times to monitor and answer questions while students were analyzing the three-day diet record. Data collected from this exercise are summarized in Tables 2 and 3.

COMPARISON OF MICRO-COMPUTER PROGRAMS FOR NUTRITION EDUCATORS

When diet analysis software packages were evaluated by students, variability among students was larger than differences among the software. The large standard deviations among the students in length of time required to learn first time and to rerun, in responses on difficulty, and number of questions asked are note worthy.

Once students learned how to operate a software, time needed for analysis of subsequent two days' food intake was reduced approximately 30% from that for the first run. In subsequent reruns, the number of questions asked was also reduced to approximately 50 % of that for the first run. The type of questions asked at the first run but not at the subsequent runs were related to program operations. Questions asked at both the first and reruns were most frequently related to identification of food items, substitution of food consumed, and estimation of amount.

Table 2. Evaluation of Software With Students

			DA*	FP	N3
a.	Time to teach how to analyze the first 1 day diet (min./program /student)		45 (15-80)	40 (20-45)	50 (25-65)
b.	Time used to analyze subsequent 2 days' diet (min./program/student)		30 (15-45)	30 (20-45)	35 (25-60)
c.	Difficulties reported by students**		2.0 (1-4)	1.9 (1-4)	2.5 (1-4)
d.	No. of questions asked (/program/student):				
	First run		7 (3-17)	5 (2-16)	9 (4-17)
	Subsequent runs		3 (0-7)	3 (1-6)	5 (2-7)
e.	Students' assessment of userfriendliness	yes -	8	8	5
		no -	4	4	7
f.	Helpful in learning food and nutrition	yes -	12	12	12
g.	Helpful in learning computer applications	yes -	12	12	12

Numbers in parenthesis denote ranges

* DA=Diet Analyzer, FP=Food Processor, N3=Nutritionist III

** Scale for difficulties: 1=easy, 2=somewhat difficult, 3=difficult, 4=very difficult

The turned in printouts of analyzed 3-day diet analysis by students were examined against the food record. Three most common errors that students introduced in using computerized dietary analysis systems were as follows:

Table 3. Common errors made by students

	Description of errors	Frequency*
a.	Substitution of food items when the choice was not included in the database	3±2
b.	Identification and estimation of breakdown ingredients of food items (e.g., salads, sandwiches)	3±2
c.	Selection of an item among many choices (e.g. several ice creams with varying % of fat contents)	2±1

* in 3-day diet analysis/student

Step III: Variability of Analyzed Data

In the third step, variability among the analysis results was evaluated by mean and SD's for each nutrient determined by three different computer programs by 12 students(Table 4). ****See Attached.**

We found that there are no significant differences in the means calculated by 3 different software as determined by the least significant difference test. Coefficient of variation(CV) of each nutrient of analyzed data represent the variability due to difference in intake between days and between individuals within software(DA: 17-45% CV; FP: 23-71% CV; N3: 25-125% CV) (with possible confounding factor of coder's error). Numbers in "difference" column represent variations contributed by use of different software (with possible confounding factors of coder's errorJune 11, 1991s and individual intake).

We then examined the completeness of the databases (either with analyzed or imputed data) in two of the three microcomputer databases and one macrocomputer database maintained by a university(Table 5). ****See Attached.** The percentage of the completeness of each nutrient of the three databases was compared with published information on percentage of completeness and imputed values of Nutrition Coordinating Center's database(Schakel et al., 1988).

Table 4. Nutrient intake determined by three different software packages.

Software / Nutrient	Diet Analyzer $\bar{x} \pm$ S.D.	cv	The Food Processor $\bar{x} \pm$ S.D.	cv	Nutritionist III x ± S.D.	cv	Difference[1] $\bar{x}$
Calorie	1620 ± 425	26	1690 ± 480	28	1550 ± 390	25	140
Protein (g)	94 ± 23	24	98 ± 29	30	88 ± 32	36	10
Fat (g)	74 ± 22	30	78 ± 23	30	62 ± 24	39	16
Cholesterol (mg)	450 ± 202	45	480 ± 196	41	360 ± 205	57	120
Carbohydrate (g)	145 ± 49	34	148 ± 57	39	155 ± 68	44	10
Fiber (g)	11 ± 4	36	6 ± 3	50	4 ± 5	125	7
Calcium (mg)	658 ± 238	36	702 ± 218	31	642 ± 304	47	54
Phosphorus (mg)	820 ± 380	46	832 ± 292	35	782 ± 301	38	50
Iron (mg)	14 ± 6	43	17 ± 6	35	13 ± 5	38	4
Sodium (mg)	2796 ± 952	34	3004 ± 1270	42	2647 ± 1005	38	357
Potassium (mg)	2486 ± 550	22	2882 ± 920	32	3006 ± 1306	43	520
Magnesium (mg)	232 ± 84	36	268 ± 89	33	227 ± 103	45	41
Vitamin A (IU)	5800 ± 2360	41	6155 ± 2500	41	5616 ± 3013	54	539
Thiamin (mg)	1.0 ± 0.3	30	1.2 ± 0.5	42	0.9 ± 0.6	67	0.3
Riboflavin (mg)	1.4 ± 0.4	29	1.6 ± 0.6	38	1.3 ± 1.0	77	0.3
Niacin (mg)	24 ± 8	33	30 ± 7	23	22 ± 10	45	8
Vitamin C (mg)	150 ± 64	43	172 ± 76	44	150 ± 88	59	22
Vitamin B_6 (mg)			5.6 ± 2.3	41	4.5 ± 2.6	58	1.1
Vitamin B_{12} (mg)			3.2 ± 1.6	50	2.0 ± 1.2	60	1.2
Folacin (ug)			255 ± 180	71	200 ± 170	85	55
Pantothenic acid (mg)			5.7 ± 2.4	42	4.6 ± 2.8	61	1.1
Vitamin E (mg)			4.6 ± 2.8	61	3.4 ± 1.9	56	1.2

cv = S.D./mean x 100

[1]Difference was computed by subtracting the low mean from high mean for each nutrient.

Table 5. Percent incomplete values of four nutrient databases

Software / Nutrient	Microcomputer database A[1]	Microcomputer database B[2]	Main-frame database C[3]	NCC[4]	
				Incomplete Data (%)	Incomplete %
Calorie	0	11	0.3	0	4
Protein	0.2	12	2.4	0	2
Fat	1	12	2.4	0	3
>Saturated			35	99	28
Cholesterol	5	34	26	99	9
Carbohydrate	3	11	0.3	0	2
Fiber	4	35	53		
Calcium	11	19	8	99	4
Phosphorus	0.4	21	15	98	4
Iron	17	20	7	99	5
Sodium	6	16	6	100	5
Potassium	0.1	21	11	98	4
Magnesium	0	36	29	95	7
Vitamin A	22	30	24	100	7
Thiamin	54	21	8	99	5
Riboflavin	0	20	7	99	4
Niacin	0.2	20	8	99	5
Vitamin C	0.7	29	20	99	5
Vitamin B_6	0	46	36	87	9
Vitamin B_{12}	0	43	32	93	10
Folacin	0	52	43	88	12
Pantothenic acid	0.3	54	44	96	19
Vitamin E (mg)	0.4	65	73	97	76
Copper	5	45		85	8
Selenium	0	53		88	35
Zinc	0.7	41	32	94	11
Vitamin D		82	57	72	6
Vitamin K		92			
Amino acids		44-54			
Alcohol		10	18.6	100	0

Ash	39		99	9
Manganese	66			
Iodine	94			
Monounsaturated fat	51			
Polyunsaturated fat	48			
Caffeine	20	25	100	4
Fluorine	88			
Molybdenum	95			
Biotin	76			
Chloride	97			
Chromium	84			
Sugar	63		98	47
Dietary fiber	53		100	56

[1]Microcomputer database A (commercial): 1500 food records for 26 nutrients
[2]Microcomputer database B (commercial): 2000 food records for 62 nutrients
[3]Macrocomputer database C (university-based): 5000 food records for 74 nutrient
[4]Nutrition Coordinating Center database: 1100 non-recipe foods for 73 nutrients (from Schakel et al., 1988)

We attempted to examine completeness of databases as a factor that contributed to the variability in the results of three databases. None of the software had a complete nutrient database for all nutrients it calculated. The nutrient analysis results are the sum of the nutrients from food items entered. Summation is possible only with the numbers(either analyzed or imputed) aligned in a database. Therefore, regardless of schemes that each database adopted for handling missing values in database(i.e., zeros, blanks, flagged symbols and others), the calculated nutrient analysis results do reflect the missing values as zero. On the other hand, even when a software with missing values in the database indicates in the results what percentage of the food items have missing values for a nutrient, the user(either researcher or practitioner) utilizes the value that the software generated. Hand calculation of the missing values after identification of food items without data for each nutrient, and interfacing the two sums would not be any less demanding than hand calculating the entire intake data.

Completeness of nutrient database varied among software and among nutrients. The coefficient of variation(CV) determined for each nutrient was highly correlated with the percentage of data incompleteness.

Nutritionists who collect dietary intake data for research or nutritional consult should recognize and, when possible, attempt to minimize many other potential sources of errors introduced throughout different stages of data collection and analysis.

Other Sources of Variability

a. Errors introduced in the generation of nutrient database.
   (e.g. Sampling process, sample preparation, analytical methods, technician's error, use of reference materials, other experimental errors, and data handling)
b. Errors in program algorithm
c. Methods of collecting intake data
d. Inherent variation in individual's food intake
e. Bioavailablity

Step IV. A Diet Analysis Software At Michigan State University

A computerized diet analysis program named "MSU NutriGuide", was developed at Michigan State University for an introductory nutrition class with an average enrollment of 800-900 students. The project was supported as part of a campus-wide Health Promotion Project.

Important features of the software for our purposes were 1)simple data entry procedures for massive number of users with varying degree of experience with microcomputers, 2)individualized intake and energy balance information, 3)entry of food names instead of codes to minimize handouts, 4)self-contained extensive nutrition information in the software to maximize nutrition education provided in classes, and 5)ability to collect massive data each term for long term program evaluation and research.

The software has been tested on campus since Fall, 1988. Each term more than 1200 students enrolled in 5 health related courses in nutrition, nursing and exercise physiology have used the software without many logistic or administrative problems. The software is loaded on a mainframe IBM computer along with other instructional software offered as a free instructional service on campus. Students access the instructional software on the mainframe by use of microcomputers in several microcomputer laboratories on campus. Students and staff can also use the software in any microcomputer labs with individual personal computers on campus furnished with program and data diskettes(two in each set).

Individual or group food intake data cannot absolutely be accurate for evaluation of nutritional status, and for prediction of current and future health status. Nonetheless, microcomputer programs offer speed and convenience for nutrition educators to teach the concept and computer application for the most part. Validity and reliability of microcomputer programs can be improved through a complete database, appropriate food items included in the database, and proper instructions provided prior to the assignment.

The discipline of nutrition and foods is still continuously expanding its utilization of the computer technology to its greatest benefit. Under the current system, dietetics students in ADA-approved programs are required to gain competency in knowledge and use of computers. It is the educators' role to assist our future nutrition educators and clinicians to understand the key components of nutrition software, and strengths and weaknesses of each software through as much hands-on experiences as each education system can allow.

References

1. Byrd-Bredbenner, C. (1988) Computer nutrient analysis software packages: considerations for selection. Nutrition Today 23, 13-21.

2. Drake, M.A. (1988). A comparison of two teaching methods in an introductory college nutrition course: lecture vs. personalized system of instruction. J Nutr. Ed. 20, 11-14.

3. Dwyer J., Suitor, C.W. (1984). Caveat emptor: Assessing needs, evaluating computer options. 84, 302-312.

4. Eck, L.H., Klesges, R.C., Hanson, C.L., Baranowski, T., and Henske, J. (1988). A comparison of four commonly used nutrient database programs. J. Am. Diet. Assoc. 88, 602-

5. Food and Nutrition Information Center. (1990). Computer software in nutrition, National Agriculture Library, Beltsville, MD

6. Food and Nutrition News, Software Scan, National Live Stock and Meat board, 444 North MIchigan Avenue, Chicago, IL 60611.

7. Frank G.C., Farris, R.P., and Berenson, G.S. (1984). Comparison of dietary intake by 2 computerized analysis systems. J. Am. Diet. Assoc. 84, 818-819, 1984.

8. Frank, G.C. and Pelican S.(1986). Guidelines for selecting a dietary analysis system. J. Am. Diet. Assoc. 86, 72-

9. Health Action Managers, Health Action Reports, Kelly Communications, 410 East Water Street, Charlottesville, Virginia 22901.

10. Hoover, L.W. (1983). Computerized nutrient data bases: I. Comparison of nutrient analysis systems. J. Am. Diet. Assoc. 82, 501-505.

11. Hoover, L. W.(1988). Nutrient data bank directory, 7th ed. Columbia, MO, University of Missouri-Columbia Printing Services.

12. Mattes, R.D. and Gabriel, S.J. (1988). A comparison of results from two microcomputer nutrient analysis software packages and a mainframe system. J. Nutr. Ed. 20, 70-76.

13. Murphy S.P., King, J.C., and Calloway, D.H. (1984). Choosing a diet analysis system for classroom use. J. Nutr. Ed. 16, 73-75.

14. Nieman D.C., and Nieman C.E. (1987). A comparative study of two microcomputer nutrient data bases with the USDA nutrient data base for standard reference. J. Am. Diet. Assoc. 87, 930-932.

15. Nutrition Today, Computer Software Review, Williams and Wilkins, Baltimore, MD, 21203.

16. Orta, J. (1987). Computer methods in nutrition analysis: report of a prototype undergraduate course for dietetic students. J. Am. Diet. Assoc. 87, 1385-1386.

17. Penfield, M.P. and Costello, C.A.(1988). Microcomputer programs for diet analysis: A comparative evaluation. J. Am. Diet. Assoc. 88, 209-211.

18. Ralston, C.E. and Matthews, M.E. (1988). Software selection: can a demonstration computer package help? J. Am. Diet. Assoc. 88, 1087-1089.

19. Schakel, S.F., Sievert, Y.A., and Buzzard, I.M.(1988). Sources of data for developing and maintaining a nutrient database. J. Am. diet. Assoc. 88, 1268-1271.

20. Shanklin D., Endres, J.M., and Sawicki, M. (1985). A comparative study of two nutrient data bases. J. Am. Diet. Assoc. 85, 308-313.