

Validity for Classifying the Stages of Change among the Dietary Assessment Methods on Eating Fruits and Vegetables for American College Students

Sang-Jin Chung,[†] Sharon L. Hoerr, Ralph Levine,
Won O. Song, Gayle Coleman

Department of Food Science & Human Nutrition, Michigan State University, USA

ABSTRACT

The objective of this study is to establish outcome validity for three instruments that assess whether subjects met recommendations for daily servings of fruits and vegetables for "Stage of Change" research. A convenience sample of 294 college students was recruited from introductory nutrition classes at Michigan State University in the United States. To measure servings of fruits and vegetables, separately, three types of methods (self-rated intake, 24-hour recall and food frequency) were used in comparison to the servings from a three-day food record, the criterion used. The outcome validity was assessed based on whether or not at least two servings of fruits and three servings of vegetables were reported. Validity was assessed by sensitivity, to measure the ability to detect low intakes, and by specificity, to measure ability to detect adequate intakes. Cohen's kappa was used as well to examine the agreement between the three methods and a three-day food record. The results showed, for fruits, the 24-hour recall had the best agreement (recall : 0.54, self-rated : 0.31, food frequency : 0.29) with a three-day food record for servings consumed by people in pre-action or post-action stages. Sensitivity for fruit was also best using a recall (0.81). For vegetables, however, all three methods had low agreement (food frequency : 0.27, recall : 0.21, self-rated : 0.17) with the results of the three-day food record. Self-rated intakes for vegetables had the best sensitivity (0.66) and the food frequency had the best specificity (0.73). Therefore, researcher can use the 24-hour recall method to identify people who consume inadequate servings of fruit. To detect adequate vegetable intake, the food frequency was best of the three methods. Accuracy may be improved by probing for vegetables in mixed dishes and on sandwiches. (*J Community Nutrition* 4(3) : 143~150, 2002)

KEY WORDS : validity · stages of change · fruits and vegetables · college students.

Introduction

Health professionals are urged to increasingly base their interventions on behavioral models. To assess the need for and later evaluate effectiveness of interventions, health professionals need lasting valid instruments with low burden to both them and clients. The Transtheoretical Model (TTM) explains the pattern of people's behavioral change by integrating concepts and techniques from different behavioral theories (Prochaska 1979 ; Prochaska et al. 1992 ; Glanz et al. 1994), and the TTM has been tested with several problem

behaviors (Prochaska et al. 1994). The TTM has a central organizing construct, the Stages of Change, for which the assumption is made that people can recognize their own intentions to change a specific health behavior. Recognition of intention to change behavior is a necessary step to assign people to pre-action stages : Precontemplation (no intention to change) ; Contemplation (thinking about change) ; and Preparation (making plans to change behavior in the near future or have made some recommended changes). Post-action stages include Action, actively changing behavior, and Maintenance, maintaining desired behavior for six months or more.

The TTM has been applied to changing dietary behaviors such as reducing fat intake and increasing fruits and vegetables (Curry et al. 1992 ; Greene et al. 1994 ; Campbell et al. 1998 ; Brug et al. 1997). It has been speculated that TTM is relevant to all health behaviors (Prochaska, Velicer 1997),

[†] Corresponding author : Sang-Jin Chung, Department of Food Science & Human Nutrition, Michigan State University, East Lansing, MI, 48824, USA

Tel : (02) 3280-6130, Fax : (02) 3280-6130

E-mail : sangjinchung@hanmail.net

but dietary applications require an additional step to estimate adoption of the target behavior. Unlike addictive behaviors like smoking, dietary behavior change for disease prevention requires the modification, not cessation, of a specific type of behavior. Whereas cessation of smoking is the target for cessation of a behavior (Glanz et al. 1994), “not eating” is neither possible nor desirable. Rather the target dietary behaviors using the TTM are eating the recommended amounts and types of specific foods, here fruits and vegetables. However, when people do not know dietary recommendations the application of TTM is a problem for health professionals. Previous studies on the TTM which relied only on people’s “perceptions of their behavior” showed a linear relationship in fat intake and in fruit and vegetable intakes across the stages from Precontemplation to Maintenance (Greene et al. 1994 ; Sporny, Contento 1995 ; Laforge et al. 1994 ; Hoerr et al. 1997) . Stage assessment based on self-reported dietary and nutrient intake has failed to show validity in terms of a behavioral criterion of achieving the dietary goal, due to difficulties in self-assessing intake (Glanz et al. 1994 ; Brug et al. 1997 ; Sporny, Contento 1995).

To use the TTM to change dietary behavior, however, health professionals need other objective methods in addition to people’s own generalized perceptions of adequate or inadequate intakes (in this study called “self-rated intake”). Although stage is “motivational readiness to change”, the clients’ self-assessment of behavior is necessary to generate this assessment of motivation. Objective methods are necessary to establish the validity of assessment and evaluation, especially *criterion validity*, which compares the behavioral outcome of stages to a criterion measure or ‘gold standard’ (Cheney 2000). Reliability is also important with staging instruments for behaviors like eating, which typically varies from day to day. The objectives of this study were to establish outcome validity and reliability for three methods to determine whether subjects are eating adequate amounts of fruits or vegetables, for stages of change classifications. Young adults in college were used for convenience, and because young adults have low intakes of fruits and vegetables despite calorie intakes, which are often high (Song et al. 1996).

Subjects and Method

1. Respondents and procedure

A convenience sample of college students aged 18 – 24

years was recruited during the winter from two introductory nutrition classes at a large, north central, land grant university in the United States. The response rate from the two classes was 51% for a baseline sample of 360 subjects. Extra points toward class grades were given as an incentive to complete the baseline questionnaire which included a three-day food record. Subjects with incomplete dietary data (n = 66) were excluded, including 44 subjects with only two days of dietary records. Data was usable from 294 subjects. Eighty percent were female ; 86% were white ; 63% lived in campus residence halls.

From this sample of 294, 123 subjects participated in the test-retest of the three stage classification methods. A coupon to a campus snack shop was given for completion of the retest. The average time between test and retest was 10 days. Separate consent forms were signed for data collected at the baseline and for the retest. The protocol was approved by the Institutional Research Review Board.

2. Questionnaires

A set of questionnaires about fruits and vegetables was distributed at the baseline. The questionnaires included three different methods to classify the stages of change and a three-day food record. The three types of assessments for comparing outcomes with the three-day food record for stages of change were : a) self-rated intake ; b) a 24-hour recall ; and c) a food frequency for fruits and vegetables. Questionnaire included a food frequency first followed by self-rated intake, a 24-hour recall and three-day food records.

Stages for fruit intake and for vegetable intake were measured and classified separately by the three different outcome assessments all using the same concepts of intention and time period of current intake (Glanz et al. 1994 ; Hoerr et al. 1997) (Fig. 1, 2). For evaluating achievement of the outcome criteria by all three methods, the cutoff points were two servings of fruits and three servings of vegetables using the Food Guide Pyramid. Fruits included fruit juice. Vegetables included fried potatoes, vegetable juice and vegetables in mixed dishes.

1) Self-rated intake

The self-rated method for classifying the stages of change (Fig. 1) used the question, “How many servings of fruits/vegetables do you eat a day?” The responses were marked 0 – 4 + for fruits and 0 – 5 + for vegetables with 4 + and 5 + truncated to 4 and 5, respectively, in the calculations. In-

investigators categorized subjects for action or maintenance stages, if their self-rated intake met the outcome criteria. Further divisions were determined with a question about the time period. Investigators assigned subjects who did not meet outcome criteria to one of the pre-action stages of precontemplation, contemplation or preparation. Respondents were classified as in the precontemplation stage when they had no intention of eating two or more servings of fruits or three or more servings of vegetables. Subjects were placed into the contemplation stage when they intended to eat these amounts within six months. They were considered to be in the preparation stage when they intended to eat the recommended servings of fruits and vegetables within 30 days.

2) 24-hour food recalls

A 24-hour recall was self-reported as an outcome assessment for the second staging method at baseline and later for reliability. Subjects were instructed to recall foods according

to the USDA Multiple Pass Method (Moshfegh et al. 1999). Subjects were classified into action or maintenance stages when they met outcome criteria of the recommended number of servings of fruits or vegetables. Further classification was made using the same concepts described for the self-rated intake (Fig. 2).

3) Food frequency

Separate food frequency questionnaires (FFQ) for fruits and for vegetables over the past week included 12 fruit items and 14 vegetable items (Fig. 2). These short FFQ provided three options for serving sizes (small, medium and large) and a seven-level scale for frequency of intake from less than one per week to two times a day or more. Two times a day was considered to be two servings per day. This FFQ, adapted from the National Cancer Institute's Health Habits and History Questionnaire (Thompson et al. 1994), was developed by a 10-state research project team for young adults

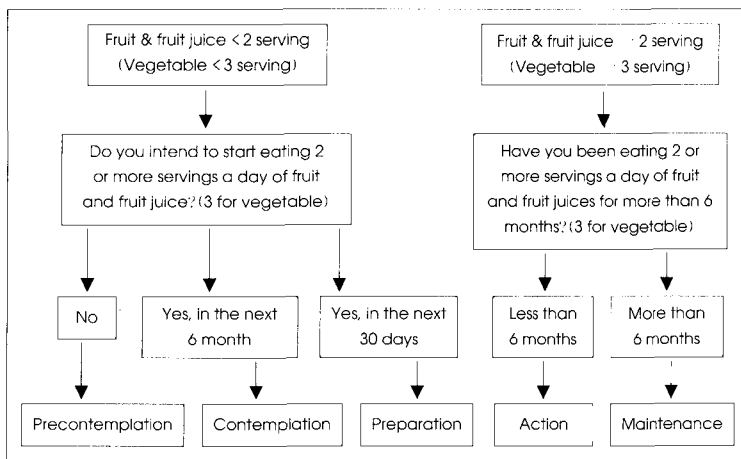


Fig. 1. Self-rated intake of classifying the stages of change.

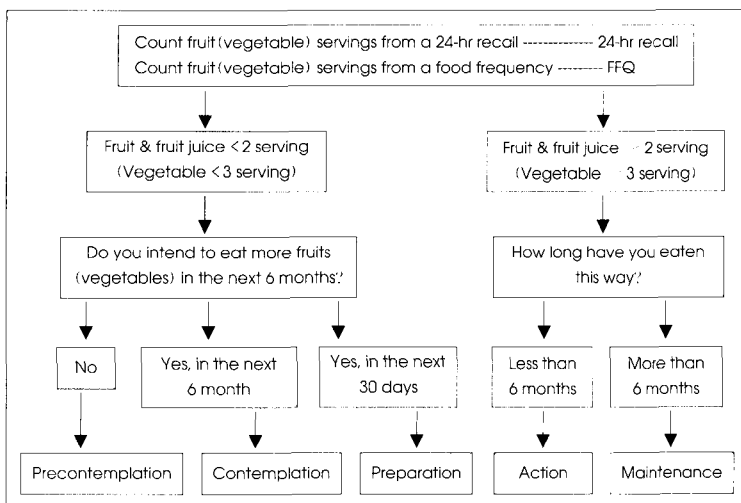


Fig. 2. 24-hr recall and FFQ for classifying the stages of change.

(Ma et al. 2001).

4) Three-day food records

Three-day food records on two consecutive weekdays and one weekend day served as the “gold standard” and were collected at the baseline. Average fruit and vegetable servings were calculated from three days of food records to compare the servings of fruits and vegetables to the three staging methods. Subjects were instructed to report amounts of all food they ate, and detailed instructions were provided to increase the accuracy of recalls and records.

5) Calculation of fruit and vegetable servings

For 24-hour recalls and a three-day record, the food servings database for the 1994 – 1996 United States Department of Agriculture (USDA) Continuing Survey of Food Intakes by Individuals (CSFII) was used to count fruit and vegetable servings (United States Department of Agriculture 1998). The Expanded Food and Nutrition Education Program (EFNEP) Evaluation/Reporting System (United States Department of Agriculture 1994) was used as the nutrition software to calculate servings of fruits and vegetables (Database = 1540 food items). The EFNEP Evaluation/Reporting System (ERS) was selected because it can be used to calculate both food servings and nutrients, it has an accessible database for corrections, and data can be exported easily for further statistical analysis. Because the ERS was designed prior to release of the CSFII Food Guide Pyramid servings database; the database of the ERS was revised for – 200 foods by counting fruits and vegetables on the basis of the CSFII servings using the Microsoft Access program (version 7.0).

3. Analysis

The Statistical Package for Social Science (SPSS, version 7.5 for Windows) was used for data analysis. After running a normality test for the servings of fruits and of vegetables, a square root transformation was performed where needed for analysis and then back transformed for reporting the data. Differences in the average servings of fruits and of vegetables among the stages by all three methods were compared using ANOVA, with post hoc Tukey if significant. Chi-Square tests were used to examine the difference of distribution. Cohen’s kappa was used to calculate the agreement between the three staging methods and averages of fruit and vegetable intake from a three-day food record, here considered as the

“gold standard.” A kappa ≥ 0.40 was considered good agreement (Rosner 1995).

Cohen’s kappa was used because the continuous fruit/vegetable servings were categorized into five discrete stages to examine outcomes by pre- versus post-action Stages of Change. This was done because we were interested in which staging method best predicted eating at least two servings of fruits and three servings of vegetables – the amount achieved only in the post-action stages of action and maintenance. Sensitivity, the ability to detect who had less than two servings of fruits and less than three servings of vegetables (true positives divided by the sum of true positives and false negatives), and specificity, the ability to detect who had at least two servings of fruits and three servings of vegetables (true negatives divided by the sum of true negatives and false positives), were calculated to examine which method measured intakes most accurately (Rosner 1995).

Because the ability to detect people with low intake is more important for nutrition education than the ability to detect people with adequate intake, sensitivity was the focus for validity testing in this study. Significant difference test was conducted with kappa, whereas it cannot be conducted with sensitivity and specificity. A program was written for Microsoft Excel to test the significant difference between kappa for the three staging methods (Donner et al. 1996). Test-retest reliability of all three methods for stage classification was also compared using kappa.

Results

Average intakes for fruits were 2.5 ± 1.2 servings by self-rated intake, 2.1 ± 2.2 by 24-hour recall, 3.1 ± 2.3 by food frequency and 2.0 ± 1.7 by a three-day food record. Average intakes for vegetables were 2.3 ± 1.2 servings by self-rated intake, 3.2 ± 2.3 by 24-hour recall, 4.0 ± 2.6 by food frequency and 3.1 ± 1.9 from a three-day food record.

Similar proportions of the subjects (about 2/3’s) were assigned to the post-action stages of action and maintenance for eating at least two servings of fruits by self-rated intake and FFQ, respectively, but only 42% were in post-action stages by 24-hour recall for fruits (Table 1). For vegetables, 42% by the self-report, 49% by recall and 57% by FFQ were in post-action stages. The distribution of pre- and post-stage among three methods was significantly different using Chi-Square tests. For fruits, all staging methods demonstrated on

Table 1. Percentage of respondents by stages of change for eating fruits and vegetables using three stage classification methods and average servings of fruit and vegetable [Average Svg(SD)] calculated from three-days of intake per stage (n = 294)

	Fruit						Vegetable					
	Self-Rated ¹ (n = 294)		Recall ² (n = 277)		FFQ ³ (n = 288)		Self-Rated ¹ (n = 294)		Recall ² (n = 277)		FFQ ³ (n = 288)	
	%	svg(SD)	%	svg(SD)	%	svg(SD)	%	svg(SD)	%	svg(SD)	%	svg(SD)
Precontemplation	6.8	1.1(1.3) ^o	9.4	1.1(0.9) ^o	6.6	0.9(0.9) ^o	20.1	2.7(1.4) ^o	15.8	2.6(1.5) ^o	14.2	2.4(1.1) ^o
Contemplation	12.6	0.9(1.1) ^o	13.0	0.8(1.0) ^o	11.8	0.9(1.1) ^o	16.7	2.6(1.7) ^o	11.8	2.3(1.5) ^o	12.2	2.5(1.6) ^o
Preparation	15.3	1.5(1.1) ^o	35.4	1.3(1.0) ^o	15.6	1.3(1.4) ^o	21.8	2.7(1.7) ^o	23.2	2.7(1.7) ^o	16.3	2.3(1.5) ^o
Action	15.0	2.4(1.4) ^b	9.4	2.8(1.4) ^p	16.3	2.3(1.4) ^b	6.8	3.4(1.7) ^{ob}	13.2	3.5(1.5) ^{ob}	14.6	3.0(1.7) ^{ob}
Maintenance	50.3	2.5(1.9) ^b	32.9	3.3(1.9) ^p	49.7	2.4(1.9) ^b	34.7	3.8(2.3) ^b	36.0	3.8(2.3) ^p	42.7	3.9(2.2) ^b

1 : Classified by algorithm using self-rated intake question "How many servings do you eat", intention and time frame

2 : Classified by algorithm using svg eaten from a 24-hr. recall, intention and time frame

3 : Classified by algorithm using svg eaten from a FFQ, intention, and time frame

ab : Averages not sharing the same superscripts are significantly different by Tukey's multi-comparison test (p < 0.05)

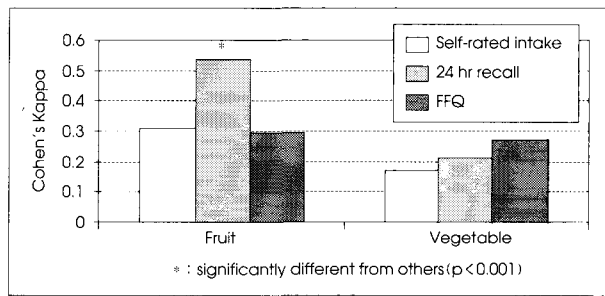


Fig. 3. Agreement comparison among three methods using 3-day food record with behavioral criteria (n = 294).

average < 2 servings in pre-action stages and ≥ 2 post-action stages. For all three staging methods, the average fruits intakes between pre-action and post-action stages were significantly different. Results were similar for vegetables for which three servings per day was the behavioral criterion.

Fig. 3 shows that the recall was best for staging fruits (kappa = 0.54) to detect intakes, using the fruit intakes from a three-day record as the behavioral criterion, when compared to self-rated (kappa = 0.31) and FFQ (kappa = 0.29). Sensitivity, the ability to detect people who ate less than two servings of fruits, was the highest for Recall (0.81) compared to self-rated intake (0.49) and FFQ (0.47) (Fig. 4). The ability to detect people who ate at least the recommended number of fruit servings, specificity, was slightly higher using the self-rated intake (0.85) and the FFQ (0.84) than with the recall (0.73). For vegetables, however, agreement between stages and vegetable servings from a three-day food record was low for all three methods. Self-rated intake (kappa = 0.17) ; recall (kappa = 0.21) ; FFQ (kappa = 0.27). When sensitivity and specificity for vegetables were calculated, self-rated showed the highest sensitivity (0.66) and FFQ showed highest

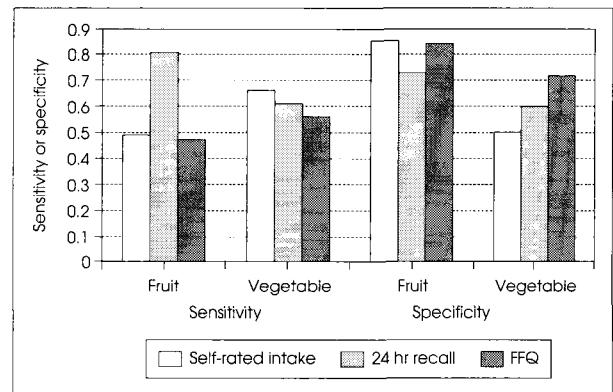


Fig. 4. Ability of three methods to detect low intake (sensitivity) and adequate intake (specificity) of fruit and vegetable intake (n = 294).

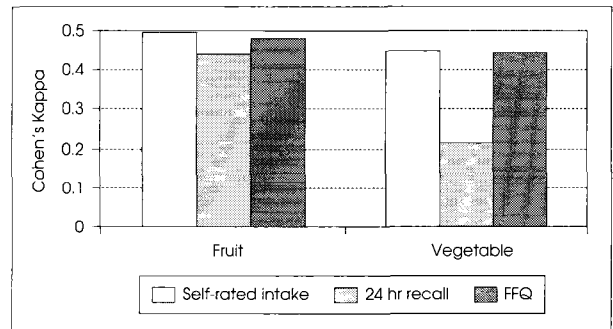


Fig. 5. Test-Retest Reliability of Stage agreements by three methods (n = 123).

specificity (0.72). Reliabilities, or agreements between the stages at the baseline (pre-test) and the stages about 10 days later (post-test), were similar and acceptable for all three staging methods for fruits (kappa's ≥ 0.4) (Fig. 5). For vegetables, the recall had poor reliability (kappa = 0.22). compared to the self-rated intake and the FFQ.

Discussion

When subjects were examined as a group, the average fruit and vegetable servings from all three methods could distinguish between pre- and post-action stages. For individuals, however, different approaches might be needed for fruits and for vegetables to most accurately assign people to behavioral stages because this study showed different results. Stage classification by 24-hour recall had the best validity for fruit. All stage classifications failed to show good validity for vegetable intake using agreement as an indicator of validity, although self-rated intake showed the highest sensitivity and FFQ showed the highest specificity among three methods. All three methods showed good ability to detect people with adequate fruit intakes. However, vegetable intake showed a different pattern. None of the three methods demonstrated good agreement with vegetable servings from a three-day food record. Therefore, neither people's perceptions about their own vegetable intake nor intake from 24-hour recall was good for stage assessment using a behavioral outcome criterion.

All three methods, except the 24-hour recall for vegetables, showed acceptable reliability for both fruits and vegetables. This result may indicate people's fruit intake is consistent, but vegetable intake is not. That means one day's fruit intake using 24-hour recall might be good indicator for usual fruit intake, but not for vegetable. This reason may partly explain best agreements on 24-hour recall for fruit and on FFQ for vegetables.

Early research on TTM did not discuss the reliability of staging instruments, because people can change their behavior without assistance within a certain time period (Cohen et al. 1989 ; Orford 1985). However, it may be worthwhile to measure the reliability of Stages of Change assessment for a fluctuating behavior like food intake, even though the results of the assessment of reliability can be confounded somewhat by real change and by a learning effect from the study itself (Mertens 1998).

After several studies adapting TTM to dietary behaviors using perceived intake failed to show validity in terms of a behavioral criterion to achieve the target behavior (Glanz et al. 1994 ; Brug et al. 1997 ; Sporny, Contento 1995), other staging methods were tried for fat, fruit and vegetable intakes. These studies using behavioral criteria such as a

food checklist or food frequency to reassign people to stages have shown better validity for staging than have the traditional methods of using people's own perceptions (Greene et al. 1994 ; Laforge et al. 1994 ; Greene et al. 1998 ; Lechner et al. 1997, Lechner et al. 1998 ; Van Duyn et al. 1998), but we found self-rating for vegetables to have the highest sensitivity (0.66). Food frequencies have shown good validity as a staging method for dietary fat (Greene et al. 1994 ; Greene et al. 1998). Other investigators have shown, however, that the food frequency tends to overestimate fruit and vegetable intakes compared to self-rated intake, as it did in this study (Serdula et al. 1993 ; Krebs-Smith et al. 1995 ; Calvert et al. 1997). Our food frequency method assigned more people to post-action stages for both fruits and vegetables compared to other methods. Self-rated intake also showed some overestimation of fruit intake, resulting in more people staged into post-action stages. For vegetables, however, the average number of servings of vegetables by self-rated intake was underestimated compared to the intake by a three-day food record. This underestimation by self-rated intake and overestimation by food frequency for vegetables might lead to relatively high sensitivity for self-rated intake and relatively high specificity for FFQ. This same pattern of overestimation for fruits and underestimation for vegetables has been shown in a previous study with low income women (Chung, Hoerr 1998). In the present study, FFQ was assessed with self-rated intake on the same page of the instrument. Thus, the servings from self-rated intake were possibly influenced by the prior completion of the FFQ. Nevertheless, the FFQ still slightly overestimated fruit and vegetable intakes compared to the self-rated intake.

For eating vegetables, further studies on stage assessment are likely needed because all three classification methods failed to show good agreement with vegetable servings in our population. Estimation of vegetable intake is likely to be difficult due to a high proportion of the total consumption from mixed dishes such as pizza, tacos, and spaghetti.

One researcher pointed out that re-classification of stages using an objective estimation for dietary intake poses a separate problem, because it combines people who believe they are eating healthfully and those who do not (Povey et al. 1999). The author suggested that "it may be better to treat maintainers who are not actually eating healthy as a separate group for separate intervention rather than re-classifying them" (Povey et al. 1999). However, to find the maintainers

who are not actually eating healthfully, we still need to estimate people's dietary intake. For a population study, multiple days of food recalls or records for assessment and evaluation would pose a high respondent burden resulting in loss of participants. Therefore, we still need simple dietary assessments such as self-rated intakes or FFQ to determine which people eat healthy and which ones do not.

When the readiness to increase intake, or to eat at least the recommended number of fruits and vegetables has been measured, the distribution of stages has varied according to the population (Hoerr et al. 1997 ; Campbell et al. 1999). Our data showed more people for fruits and fewer people for vegetables in action and maintenance stages using self-rated intake than did a general adult Dutch population (Brug et al. 1997). This difference might reflect cross-cultural factors and/or characteristics of college students who think convenience is the most important factor in food choice, because fruits are considered more convenient than vegetables (Betts et al. 1995).

There are several limitations to this study. First, our subjects were a convenience sample of mostly white college women with 63% living in residence hall in the Midwest U.S. and were people who had some interest in nutrition. Therefore, although ability to detect people's fruit and vegetable intake for three methods were not significantly different between gender or residence type (data not shown), results cannot be generalized to all college students. Baranowski and colleagues have reported that three weekdays and two weekend days were needed to get a consistency of 0.70 intraclass correlation for fruit and vegetable intakes (Baranowski et al. 1997). However, to reduce selection bias by a high respondent burden, we used three days-two weekdays and one weekend day-as the gold standard for agreement. One of the recalls comprised of 33% three day's of intake criterion measure. Further studies are needed to replicate our results using a broader population over different seasons.

Most studies comparing dietary assessments have used correlation coefficients for nutrients. However, our study used sensitivity and agreement for whether the recommended servings of fruits and of vegetables were reported by the three methods. Although most previous studies on TTM for eating fruits and vegetables have not examined them separately, our data showed a clear difference with regard to how people perceived fruits and vegetables. Therefore, further research should separate eating fruits and eating vegetables,

even though the 5-A-Day message for the public has been combined into one slogan. Longitudinal studies to follow people's behavior and psychosocial factors over time are needed to find true relationships in changing food behaviors.

Summary and Conclusion

Health professionals can quickly evaluate a person's usual fruit intake by 24-hr recall when they assess stages of readiness to eat recommended amounts of fruits, especially for pre-action stages.

For vegetables, all methods distinguished between adequate and inadequate intakes for groups by average servings, but none worked well for individuals to discrete whether people eat the recommended serving number. Health professionals must recognize that people are not educated well enough to recognize vegetables or portion sizes recommended for the Food Guide Pyramid and thus, they may need to probe for vegetables in sandwiches and mixed dishes.

References

- Baranowski T, Baranowski J, Doyle C, Wang DT, Smith M, Lin LS, Hearn MD, Resnicow K, Thompson WO (1997) : Toward reliable estimation of servings of fruit and vegetable and fat practices from adults' 7-day food records. *J Nutr Educ* 29 : 321-326
- Betts NM, Amos RJ, Georgiou C, Hoerr SL, Ivaturi R, Keim KS, Tinsley A, Voichick J (1995) : What young adults say about factors affecting their food intake. *Ecol Food Nutr* 34 : 59-64
- Brug J, Glanz K, Ko KG (1997) : Relationship between self-efficacy, attitudes, intake compared to others, consumption and stages of changes related to fruits and vegetables. *Am J Health Prom* 12 : 25-30
- Calvert C, Cade J, Barrett JH, Woodhouse A, UKWCS Steering Group (1997) : Using cross-check questions to address the problem of mis-reporting of specific food groups on food frequency questionnaires. *Eur J Clin Nutr* 51 : 708-712
- Campbell MK, Reynolds KD, Havas S, Curry S, Bishop D, Nicklas T, Palombo R, Buller D, Feldman R, Topor M, Johnson C, Beresford SA, Motsinger BM, Morrill C, Heimendinger J (1999) : Stages of change for increasing fruit and vegetable consumption among adults and young adults participating in the national 5-A-Day for Better Health community studies. *Health Educ Behav* 26(4) : 513-534
- Campbell MK, Symons M, Demark-Wahnefried W, Polhamus B, Bernhardt JM, McClelland JW, Washington C (1998) : Stages of change and psychosocial correlates of fruit and vegetable consumption among rural African-American church members. *Am J Health Prom* 12(3) : 185-191

- Cheney C(2000) : Eight faces of validity. *J Am Diet Assoc* 100 : 256
- Chung SJ, Hoerr SL(1998) : How well can women of limited income identify fruits and vegetables in their diets? Albuquerque, NM : Society of Nutrition Education (Abstract)
- Cohen S, Lichtenstein E, Prochaska JO, Rossi JS, Gritz ER, Carr CR, Orleans CT, Schoenbach VJ, Biener L, Abrams D, DiClemente CC, Curry S, Marlatt GA, Cummings KM, Emont SL, Giovino G, Ossip-Klein D(1989) : Debunking myths about self-quitting : Evidence from 10 prospective studies of persons quitting smoking by themselves. *Am Psychol* 44 : 1355-1365
- Curry SJ, Kristal AR, Bowen DJ(1992) : An application of the stage model of behavior change to dietary fat reduction. *Health Educ Res* 7(1) : 97-105
- Donner A, Eliasziw M, Klar N(1996) : Testing homogeneity of kappa statistics. *Biometrics* 52 : 176-183
- Glanz K, Patterson, RE, Kristal AR, DiClemente CC, Heimendinger J, Linnan L, McLerran DF(1994) : Stage of change in adopting healthy diets : fat, fiber, and correlates of nutrient intake. *Health Educ Quart* 21(4) : 499-519
- Greene GW, Rossi SR(1998) : Stages of change for reducing dietary fat intake over 18 months. *J Am Diet Assoc* 98 : 529-534
- Greene GW, Rossi SR, Reed GR, Willey C, Prochaska JO(1994) : Stages of change for reducing dietary fat to 30% of energy or less. *J Am Diet Assoc* 94 : 1105-1110
- Hoerr SL, Chung SJ, Song WO, Coleman G(1997) : Readiness to increase of fruits and vegetables by limited income women, some pregnant and lactating. Montreal, Canada : Society for Nutrition Education
- Kreb-Smith SM, Heimendinger J, Subar AF, Patterson BH, Pivonka E(1995) : Using food frequency questionnaires to estimate fruit and vegetable intake : association between the number of questions and total intakes. *J Nutr Educ* 27 : 80-85
- Laforge RC, Greene GW, Prochaska JO(1994) : Psychosocial factors influencing low fruit and vegetable consumption. *J Behav Med* 17 : 361-373
- Lechner L, Brug J, De Vries H(1997) : Misconception of fruit and vegetable consumption : differences between objective and subjective estimation of intake. *J Nutr Educ* 29 : 313-320
- Lechner L, Brug J, De Vries H, Assema PV, Mudde A(1998) : Stages of change for fruit, vegetable and fat intake : consequences of misconception. *Health Educ Res* 13(1) : 1-11
- Ma J, Betts NM, Horacek T(2001) : Measuring stage of change for assessing readiness to increase fruit and vegetable intake among 18-24-year-olds. *Am J Health Prom* 6(2) : 88-97
- Mertens DM(1998) : Research methods in education and psychology : Integrating diversity with qualitative & quantitative approaches. Thousand Oaks, CA : Sage Publications
- Moshfegh A, Borrud L, Perloff B, La Comb R(1999) : Improved method for the 24-hour dietary recall for use in national surveys. *FASEB J* 13(4) : A603
- Orford J(1985) : Excessive appetites : A psychological view of addictions. New York, NY : Wiley
- Povey R, Conner M, Sparks P, James R, Shepherd R(1999) : A critical examination of the application of the Transtheoretical Model's stages of change to dietary behaviors. *Health Educ Res* 14(5) : 641-651
- Prochaska JO(1979) : Systems of psychotherapy : a transtheoretical analysis. Homewood, IL : Dorsey Press
- Prochaska JO, DiClemente CC, Norcross JC(1992) : In search of how people change : Applications to addictive behaviors. *Am Psychol* 47 : 1102-1114
- Prochaska JO, Norcross JC, DiClemente CC(1994) : Changing for Good. New York, NY : W Morrow & Co
- Prochaska JO, Velicer WF(1997) : Introduction : The Transtheoretical model. *Am J Health Prom* 12 : 6-7
- Rosner B(1995) : 4th edition. Fundamentals of Biostatistics. Belmont, CA : Wadsworth Publishing Company
- Serdula M, Coates R, Byers T, Mokdad A, Jewell S, Chavez N, Mares-Perlman, Newcomb P, Ritenbaugh C, Treiber F, Block G(1993) : Evaluation of a brief telephone questionnaire to estimate fruit and vegetable consumption in diverse study populations. *Epidem* 4 : 455-463
- Song WO, Schuette LK, Huang YL, Hoerr S(1996) : Food group intake patterns in relation to nutritional adequacy of young adults. *Nutr Res* 16 : 1507-1519
- Sporny LA, Contento IR(1995) : Stages of Change in dietary fat reduction : social psychological correlates. *J Nutr Educ* 27 : 191-199
- Thompson FE, Byers T, Kohlmeier L(1994) : Dietary assessment resource manual. *J Nutr* 124(suppl) : 2245S-2317S
- United States Department of Agriculture(1994) : The Extended Family Nutrition Education Program(EFNEP) Evaluation/Reporting System, Version 4.0. Washington DC : Computers Software
- United States Department of Agriculture(1998) : 1994-96 Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey(CD-ROM)
- Van Duyn MAS, Heimendinger J, Russek-Cohen E, DiClemente CC, Sims LS, Subar AF, Kreb-Smith SM, Pivonka E, Kahle LL(1998) : Use of the Transtheoretical model of change to successfully predict fruit and vegetable consumption. *J Nutr Educ* 30 : 371-380