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VALIDITY AND RELIABILITY OF STAGE OF CHANGE INSTRUMENTS AND PROCESSES OF CHANGE TO EAT FRUITS AND VEGETABLES

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VALID

VALIDITY AND RELIABILITY OF STAGE OF CHANGE INSTRUMENTS AND PROCESSES OF CHANGE TO EAT FRUITS AND VEGETABLES

By

Sang-Jin Chung

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ABSTRACT

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The purposes of this study were: 1) to establish validity and reliability of staging instruments for eating adequate servings of fruits and vegetables; 2) to identify processes of change for eating adequate servings of fruits and vegetables; and 3) to find factors associated with inadequate servings of fruits and vegetables. Food intake and psychometric data were obtained from a convenience sample of 294 college students: 80% female and 86% white. To establish outcome validity of several methods used to assign stage of readiness to eat adequate fruits or adequate vegetables, servings from a 3-day food record were calculated. The methods differed only by how fruit and vegetable information was collected, i.e., self-rated intake; a 24-hour recall; or food frequencies of fruits and vegetables for the past week. The criteria for validating post-action stages in all methods were at least 2 servings of fruits or 3 servings of vegetables from a 3-day food record. Average fruit and vegetable servings by all methods distinguished pre- from post-action stages. For fruits, however, the 24-hour was concluded recall showed a higher agreement with the criteria (Cohen's $\kappa=0.54$, $p<0.05$)), had good reliability and the highest sensitivity compared to the other two methods. For vegetables, all methods showed only marginal agreement (Cohen's $\kappa<0.40$, $p<0.05$). A 24-hour recall was concluded to accurately assess an individual's stage of change in eating fruits, but further research is necessary to develop a good way of assessing vegetable intakes.

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By adapting processes of change items from previous studies, 29 items for seven change processes for eating fruits and vegetables (Health Concerns, Self Reevaluation, Social Liberation, Health Commitment/Action, Interpersonal Control, External Reinforcement and Helping Relationships) were developed using confirmatory factor analysis. When subjects' uses of these change processes were compared to their stages of readiness to change for fruit, use of self-reevaluation differed from health commitment/action. For vegetables, use of health commitment, health concern and self-reevaluation processes differed among stages. Health commitment/action along with self-reevaluation of intakes appeared to be important processes used to eat enough fruits and vegetables. The process of health concerns was associated only with eating enough vegetables.

For college students, when less than 2 servings of fruit and less than 3 servings of vegetables were used to indicate inadequate intakes from a 3-day food record, 58% and 82% of respondents reported inadequate intakes of total fruit and fruit without juice, respectively. Fifty-three and 63% reported inadequate intakes of total vegetables and vegetables without fried potatoes, respectively. Inadequate fruit consumption was less prevalent in females, university housing residents, non-smokers, regular exercisers and regular breakfast eaters. Self-efficacy was inversely associated with inadequate intakes of both fruits and vegetables. Inadequate fruit intake was positively associated with higher discretionary fat intakes, but inadequate vegetable intake was not. Therefore, eating fruit was more associated with other positive health behaviors than was eating vegetables. When fruit juice and fried potatoes were excluded, fruit and vegetable intakes were positively associated with each other.

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Chapter One

Introduction

Adequate intake of fruits and vegetables, including beans, is important for many essential vitamins, minerals, dietary fiber and to reduce risks for chronic disease (Block et al., 1992; Ness and Powles, 1997; Appel et al., 1997; Pillow et al., 1997; Freudenheim et al. 1996). People in the U.S. have low intakes of fruits and vegetables (Subar et al., 1995). For these reasons, various public policies have been set to increase intakes of fruits and of vegetables such as the Food Guide Pyramid, Dietary Guidelines, Healthy People 2010 and Five-A-Day (USDA & USDHHS, 1992; USDA & USDHHS, 1990; National Research Council, 1989; U.S. Department of Health and Human Services, 2000; Subar et al., 1995).

Establishing sound dietary habits in young adulthood has been shown to be important for good health in later adulthood (Lau et al., 1990; Hampl and Betts, 1995). If people establish good habits while young, it is easier to maintain these good behaviors than to change later. Because young adults' fruit and vegetable intakes have been reported as low (Georgiou et al., 1997), targeting dietary intervention to this age group should be cost effective in the long term (U.S. Department of Health and Human Services, 2000).

Stages of Change Theory, a Transtheoretical theory which integrates concepts and techniques from many different behavioral theories (Prochaska, 1979; Prochaska et al., 1992a; Glanz et al., 1994), has been a successful model used to change smoking and drug abuse behaviors (Prochaska et al., 1992a; DiClemente et al., 1982). Therefore, it

encourages nutrition educators to become interested in applying Stages of Change Theory to dietary habits. However, eating habits differ from smoking or drug abuse behaviors in complexity, definition and subject recognition of the behaviors involved. Although Stages of Change Theory has potential as a useful behavioral model based on the findings of a linear relationship in intake of fat across the stages from Precontemplation to Maintenance (Greene et al., 1994; Sporny and Contento, 1995; Hoerr et al., 1997), stage assessment based on self-reported dietary intake has often failed to show validity in terms of behavioral criterion of achieving the dietary goal. Thus, Stages of Change Theory may misplace people into inaccurate stages, likely because people were unaware of whether they were eating the recommended amount of food or nutrient (Brug et al., 1997; Glanz et al., 1994; Sporny and Contento, 1995). Because the Stages of Change Theory in dietary intervention has shown some promise of effectiveness via tailored intervention messages (Campbell et al., 1994), correctly identifying a person's stage or readiness to change dietary behavior is needed to appropriately target interventions.

Prior to specific dietary interventions, a first priority is developing a valid and reliable Stage of Change instrument to satisfy the behavioral criterion of achieving the dietary goal and of understanding the processes of change behavior for intakes of fruits and vegetables. Therefore, the objectives of this study were:

1) To develop valid and reliable Stages of Change staging instrument(s) for eating the recommended number of servings of fruits and of vegetables based on actual intakes, decisional balance for making the change and self-efficacy for fruit and vegetable intake by college age young adults (Chapters Three & Six);

2) To identify processes of change for eating at least 2 servings of fruit and 3 servings of vegetables and the different use of processes among stages (Chapter Four);

3) To identify relationships between actual fruit and vegetable intake and related factors such as psychosocial factors (self-efficacy, temptation, decisional balance), other food group intake and demographic factors in this population (Chapter Five).

Chapter Two

Review of Literature

Eating diets rich in fruits and vegetables has been a public policy focus due to its association with a decreased risk for chronic diseases such as heart disease, colon cancer, lung cancer and breast cancer (Block et al., 1992; Ness and Powles, 1997; Appel et al., 1997; Pillow et al., 1997; Freudenheim et al 1996; Djuric et al., 1998; Kant et al., 1992). One of the Year 2010 Health Objectives for the United States is to increase the intake of fruits and vegetables to five or more servings per day (National Research Council, 1989; U.S. Dept of Health and Human Services, 2000). Many studies have been published related to intake of fruits and vegetables and associated psychosocial factors and health effects. This literature review relates to the current intake of fruits and vegetables in the U.S. and studies about increasing fruit and vegetable intake include those examining the psychosocial factors for eating fruits and vegetables. Stage of Change Theory is described and studies related to its use with food reported. A short discussion on validity and reliability as related to assessment tools for Stages of Change to increase fruits and vegetables concludes this chapter. Finally, within each subsection the research is evaluated in terms of how findings relate to this proposed study.

Fruit and vegetable consumption in the U.S.

Many studies showed that most people in the U.S. have low intakes of fruits and vegetables. Dietary data from 8181 adults (>20 yr old) in the USDA's 1989-1991 Continuing Surveys of Food Intakes by Individuals (CSFII) over 3 days, using a one-day

24-hr recall and two-day food records, showed 1.2 mean servings of fruits consumed and 3.1 mean servings of vegetables. Adults' vegetable intake relied heavily on potatoes (1.0 servings per day), including french fries (0.4 servings). Although the absolute number of servings of fruits and vegetables were higher for men than for women, women consumed more servings per 1000 calorie diet than men (2.8 vs 2.3 servings). Average total intakes rose by age and income. Only 32% of adults met the objective of five or more servings of fruits and vegetables per day (Krebs-Smith et al., 1995a).

Surveys of 3148 children and adolescents in 1989-1991 CFSII data showed only 20% ate more than 5 servings of fruits and vegetables (Krebs-Smith et al., 1996). Although intakes of fruits and vegetables slightly increased in 1994-1995 CFSII compared to 1989-1991, the national objective of 5-A-Day was still not met (Enns et al., 1997).

The median intake of fruits and vegetables from a baseline assessment for the 5-A-Day in the summer of 1991 was 3.4 servings per day. The Center for Disease Control estimated this number from a frequency checklist of intake of 33 fruits and vegetables. This survey was done on a nationally representative adult sample (n=2811; 48% response rate) by random digit dialing. Increased years of education, income and nonsmoking status were important predictors of increased fruit and vegetable intakes. Women showed higher intakes of both fruits and vegetables than men at all ages (Subar et al., 1995).

The results of the Behavioral Risk Factor Survey in 16 states (n=23,699; 82% response) showed a median of 3.5 daily servings of all fruits and vegetables. Direct questions with sub-categories like, "How often do you eat green salad?" were used.

Young adults 18-24 years of age reported the lowest median intake of fruits and vegetables, 2.8 servings for men and 3.0 servings for women (Serdula et al., 1995).

A study focused on young adults (18-24 years of age) in a random mail survey in 9 states (n=1338; 43% response) showed 1.4-1.6 servings of fruits and 1.7-1.9 servings of vegetables per day as median intakes (Georgiou et al., 1997). College students were at the high end of the ranges, and non-students were at the lowest.

The average fruits and vegetables intake, including french fries, from 2-day intakes for Expanded Food and Nutrition Education Program women in two counties in Michigan, 1996, was 1.0 ± 1.2 servings of fruits and 2.7 ± 1.5 servings of vegetables (Hoerr et al., 1997). The mean from 2-day intakes of adolescent mothers (mean age 21 years) has been reported also to be low, with 0.8 servings of fruits and 2.2 servings of vegetables, including french fries (Hoerr et al., 1998).

Fruit and vegetable intake by 2- or 3-day food records averaged 4.4 servings in both the general U.S. population and for Expanded Food and Nutrition Education Program women (Hoerr et al., 1997; Chung and Hoerr, 1998). Median intakes of fruits and vegetables reported in various studies appeared to be about 3.5 servings (See summary in **Table 1**). Only 20-30% of the people in several studies ate 5 servings of fruits and vegetables, combined. If 2 servings of fruits and 3 servings of vegetables are set as the minimum objective, then the percentage of people who meet this goal will be even less. Therefore, increasing fruit and vegetable intake should be a goal for the entire U.S. population.

Table 1. Recent studies of fruit and vegetable consumption in the U.S.

Study	Subjects	Instruments	Method to count FV	Results
Krebs-Smith et al., 1995a	8,181 >20 yr 1989-91 CFSII	1 d recall + 2 d recall	Food Grouping system by USDA (calculate ingredients)	Mean: 1.2 F, 3.1 V 32% ate ≥5FV
Serdula et al., 1995	23,699 adults in 16 states BRFSS	Questions w/ sub-categories like juice, salad	Total FV in each category, excluding fried potato	Median: 3.5 FV 20% ate ≥5 FV
Subar et al., 1995	2,811 adults, 1991	33 item FV FFQ	Excluded fried potato	Median: 3.4 FV 23% ate ≥ 5 FV
Krebs-Smith et al., 1996	3,148 youth 1989-91 CFSII	1 d recall + 2 d record	Food Grouping system by USDA	Mean: 1.2 F, 2.4 V 20% ate ≥5FV
Georgiou et al., 1997	1,338 young adult, 18-24yr	60 item FFQ		Median: 1.4-1.6F 1.7-1.9 V
Hoerr et al., 1997	EFNEP women ~28yr	1 d recall +1 d record	Calculate ingredients	Mean: 1.0 F, 2.7 V
Hoerr et al., 1998	Adolescent Mothers ~21yrs	1 d recall +1 d record	Calculate ingredients	Mean: 0.8 F, 2.2 V

F=fruit, V=vegetable
FFQ= Food Frequency Questionnaire
BRFSS= Behavioral Risk Factor Surveillance System
CSFII= Continuing Surveys of Food Intakes by Individuals

Young adults as sample population

Early practice of sound dietary habits in young adulthood is associated with reduced risk for chronic disease later in life (Raitakari et al., 1994). Establishing good habits early makes it easier to maintain good behaviors as an adult rather than to have to change later (Lau et al., 1990). Therefore, targeting dietary change intervention during this time should be cost effective in the long term (U.S. Department of Health and Human Services, 2000).

People's dietary habits do not change easily, but changing behavior is possible even though behavior typically changes slowly (Gifft et al., 1972). Furthermore, while preadolescent children likely do not have the cognitive development to have concerns about future health risks (Domel and Baranowski, 1995), young adults have the necessary mental processing equipment to do so, at least biologically. Young adults in college are usually also in a transitional period between living and eating at home and living on their own and feeding themselves (Lau et al., 1990).

Unfortunately, young adults' fruit and vegetable intakes have been reported to be low although college students and graduates have more healthful habits than nonstudents (Georgiou et al., 1997). The determinant factors of young adults for what they eat are reported as time and convenience, health concerns and money (Betts et al., 1995). However, habit is also an important factor (Betts et al., 1997).

Assessment and current consumption of fruits and vegetables in the U.S.

Measuring fruit and vegetable intake accurately is necessary to assess consumption. However, validation of actual fruit and vegetable intake is difficult,

because there is no "gold standard" or criterion method for finding the true and usual dietary consumption in populations. Self-estimation of fruit and vegetable intake often appears inaccurate compared to self-reported food records from which nutrition professionals calculate the fruit and vegetable servings (Smith-Warner et al., 1997; Chung and Hoerr, 1998). (See summary in **Table 2.**)

Self-rated fruit and vegetable intakes generally are higher than the self-reported food records, recalls or food frequency questionnaires. A food frequency questionnaire given to a Dutch adult population via telephone interview (n=367) was used to assess objectively the consumption of fruits, salads and processed vegetables using an 8-item food frequency (Lechner et al., 1997). Subjective estimation of fruit and vegetable intake was assessed by asking subjects to rate their own intakes of fruits, salads and processed vegetables with a 5-point scale from very low to very high. Eighty-eight percent of the respondents who did not eat enough vegetables (<150 grams per day) answered that they ate enough vegetables; and 65% of the respondents who had low fruit intake (< 2 pieces per day) reported themselves to eat enough. Another study with EFNEP women using 2-day food records compared to a self-rated, one item food frequency question, showed these women overestimated by 0.7 serving of fruits and underestimated by 0.4 serving of vegetables per day (Hoerr et al., 1997). A study with a college population comparing fruit and vegetable consumption between a 7-item food frequency and a 2-day diet record also showed a 0.3 serving per day overestimation of fruit intake and 0.4 serving per day underestimation of vegetable intake by food frequency (Plesko et al., 2000). In a study of similar comparisons with parenting young moms, subjects underestimated 1 serving per day of fruit and vegetable intake combined (Chung et al., 1998).

Three food checklists or short frequency questionnaires used in three national surveys were compared and mean servings reported (Krebs-Smith et al., 1995c). The 20 questions for fruits and vegetables in the 1987 National Health Interview Survey showed 23.8 times per week as a median frequency of intake (3.4 servings/day). The median intake was 34.6 (4.9 servings/day) using the 33 questions in the 5-A-Day for Better Health Program. The 40 questions in the NHANES I Epidemiologic Follow-up Survey showed 38.8 (5.5 servings/day) as a median intake. Researchers concluded that estimating the total frequency by summing up individual foods from checklists might not be valid for fruit and vegetable intake, because the larger number of frequency questions about fruits and vegetables appeared to increase the estimation of total fruit and vegetable intake (Krebs-Smith et al., 1995c). A study in which findings supported this conclusion was done in the United Kingdom. In this cohort study, women (35-69 years of age) reported a higher intake of fruits and vegetables from 19 fruits (excluding dried fruits and fruit juice) and 31 vegetables (excluding potatoes) on a food frequency questionnaire compared to a simple cross-check question (Calvert et al., 1997). An example of a cross-check question is, "How many servings of fruits and fruit containing dishes do you eat per week?" Eighty-one percent of respondents had overestimated their fruit intake compared to the cross-check questions and 93% of the respondents overestimated vegetable intake. Some survey researchers suggest that frequency questionnaires or checklists with many items lead to higher estimates of food consumption than do food records or recalls (Block, 1982; Feskanich et al., 1993).

In Minnesota three dietary assessment methods were compared from 201 participants (30-74 years of age) diagnosed with colorectal adenomas. Investigators used

15 days of diet records (five 3-day records at 3 month intervals), two 1-month and one 1-year food frequency questionnaires with 59 fruit and vegetable items, and six question modules with sub-categories for the estimation of fruit and vegetable intake used in the Behavioral Risk Factor Surveillance System. The number of servings of fruit and vegetable intake, excluding fried potatoes, showed similar results between the records and frequencies, 6.3 and 6.5, respectively. However, different results from the 6-item module, 3.8 servings, was reported (Smith-Warner et al., 1997). In this study, reproducibility between the baseline and 3 months of each assessment was reported using the Pearson correlation coefficient. The correlation for 3-day diet records was r=0.52 which increased to 0.82 after correction for the ratio of within- to between person variability. Correlations of r=0.70 for the 1-month food frequency and 0.49 for the 6-item module were reported.

Another study examined the six questions for fruits and vegetables from the Behavioral Risk Factor Surveillance System compared to multiple diet records or recalls or food frequency in several separate studies of various U.S. regions: Wisconsin, Chicago, Arizona, and Georgia. Results showed similar mean intakes between the six questions and multiple food records or recalls except for an overestimation of fruit and vegetable intakes by the six questions in Arizona (Serdula et al., 1993). However, the intake estimations by the six questions were lower than those estimated from 29 to 40 fruit and vegetable item food frequencies. In this study, total fruit and vegetable intake excluded fried potatoes, fruit pastries and dried beans. Total fruit and vegetable intake was 2.1-4.0/day using six questions and 2.1-4.3/day using multiple food records or recall and 3.6-5.6/day using food frequencies.

Classification of foods as fruits and vegetables and estimating serving size are some of the important factors affecting validity for estimating people's intake. One study compared three methods to count fruit and vegetable intake with 24-hour dietary recalls in 617 fourth-grade students. Different results were obtained from different counting methods (Eldridge et al., 1998). Students average 3.9 servings by the 5-A-Day method, 4.1 servings by the U.S. Food and Drug Administration Reference amounts and 5.1 servings by the Minnesota Cancer Prevention Research Unit Method. All these methods excluded fried potatoes from FV intake. The 5-A-Day method did not include pickled fruits and vegetables or soy products. The University of Minnesota Method counted 1/2 cup of fruit instead of 1 medium fruit as 1 serving of fruit. The amount of one serving of each food in the U.S. Food and Drug Administration Method is described using grams, not by using cups or individual units of food. Investigators recommended choosing the best method to fit the purpose of the study when counting fruit and vegetable intake.

Self-rated fruit and vegetable intake from one direct question or several questions tends to overestimate intakes compared to those counts from short food frequencies. Whereas fruit and vegetable intakes were underestimated by self-rated questions when compared to more detailed food frequencies, when self-rated fruit and vegetable intake was compared to dietary records or recalls, the results were inconsistent. Healthy normal adult populations tended to report similar intakes or overestimate fruit and vegetable intakes, and populations with disease or young moms tended to underestimate fruit and vegetable intakes. Most researches showed similar results in fruit and vegetable intake between food frequencies and food records, except for one study which reported 1 serving more of fruit and vegetable intake from food frequency than food records.

Subjects' ability to define foods as fruit and vegetable can also affect the number of servings of fruits and vegetables reported. One study using 153 female elementary school teachers showed the number of days' records necessary as the gold standard to get reliable fruit and vegetable intakes. Five weekdays of food records were necessary to achieve 0.80 intraclass correlation reliability and 3 weekdays of food records were necessary to get 0.70 reliability for fruit and vegetable intake (Baranowski et al., 1997).

Most studies have compared the average fruit and vegetable intakes or reported the correlation coefficient between assessment methods, but a correlation is not necessarily the best way to examine which assessment method detects people with adequate and inadequate fruit and vegetable intakes most accurately. For this dissertation research, the evaluation methods for detecting adequate versus inadequate intakes such as Cohen's κ, sensitivity and specificity will be used to compare three assessment methods: self-rated, 24-hour recall and food frequency using average fruit and vegetable servings from 3-day intakes as the gold standard. The criterion for adequate fruit and vegetable intakes will be at least 2 servings for fruits and 3 for vegetables, instead of the combined total of 5 fruits and vegetables.

Table 2. Recent studies comparing assessment tools for fruit and vegetable intake

Study	Subjects	Test assessment	"Objective" assessment	Results
Serdula et al., 1993	US adults 4 states	multiple d food records, 29-40 FV FFQ, 6-item FV modules used in BRFSS		FV intake by multiple records and by 6 item modules were similar, except in Arizona. FV intake by 6 item was lower than those by FFQ (excluded fried potato, fruit pastries and dried beans)
Krebs-Smith et al., 1995c	US adults, - 1987 NHIS survey - 5 A Day survey - NHANES I	 20 items FV 33 items FV 40 items FV		More FFQ items about FV increased estimation of FV intake
Calvert et al., 1997	US women, 35-69yr	19 fruit FFQ 31 veggie FFQ	Cross-check[1] questions	81% underestimated fruit intake. 93% underestimated vegetable intake.
Hoerr et al., 1997	EFNEP women (~28yr)	Self-rated intake of FV separately	2 d recalls	Women overestimated by 0.7 serv F and underestimated by 0.4 serv V/day
Lechner et al., 1997	Dutch adults	Self rated intake w/ 5-point scale	8-item FFQ	88% of those w/ low vegetable intake thought they ate enough. 65% of those w/ low fruit intake thought they ate enough.
Smith-Warner et al., 1997	201 US adults w/ cancer, 30-74yr	15 d diet records, 59 items FV FFQ, 6 item FV modules used in BRFSS		6.3 serv FV by record, 6.5 serv by FFQ, 3.8 serv by module (no fried potatoes)
Chung and Hoerr, 1998	Young moms (~ 21yr)	Self-rated intake of FV combined	2 d recalls	Adolescents underestimated by 1 serving F/V
Plesko et al., 2000	109 College students	7 item FV FFQ, separately	2 d records	4.2 serv FV by FFQ, 4.1 serv FV by records (r=0.24). Fruit was overestimated and vegetable was underestimated

[1] Example : How many servings of fruit and fruit containing dishes do you eat per week?

Factors related to eating fruits and vegetables

There have been several studies about determinants or psychosocial factors related to eating fruits and vegetables. Although habitual behaviors have been reported to be less affected by self-efficacy, attitude, knowledge and social influence (Triandis, 1977), generally, knowledge of food selection, belief in diet-disease relationships and good attitudes toward dietary change goals have had positive associations with high fruit and vegetable intakes (Smith et al., 1995; Patterson et al., 1995). (See summary in **Table 3.**)

Cancer-prevention knowledge and perceived ease of eating a healthful diet were strong predictors of intake for 10,286 U.S. adults aged 18 years and older in the 1992 National Health Interview Survey Cancer Epidemiology Supplement (Harnack et al., 1997). A study of attitudes toward fruit and vegetable consumption in a WIC population (>19yr old, 48% African American) showed positive perceptions of fruits and vegetables were important to intakes. However, low income women in the study also reported barriers to increase consumption such as lack of availability, time and effort to prepare, and preference for other foods (Treiman et al., 1996). Another study reported that the nutrition behavior scores of randomly sampled Washington state residents were largely dependent on the barriers to fruit and vegetable intake. In the Washington study, elements of the Health Belief Model - including benefits of and barriers to fruit and vegetable intake, susceptibility to cancer and nutrition concerns - explained 16% of the variance of FV intake behaviors (Dittus et al., 1995).

The Minnesota Adolescent Health Survey, completed by 36,284 adolescents in grades 7-12 using simple, direct questions about fruit and vegetable intakes, reported that

adolescents with low socioeconomic status were twice as likely to eat inadequate fruits and 1.5 times more likely to eat inadequate vegetables than those of middle income parents (Neumark-Sztainer et al., 1996). African-Americans were at lower risk for inadequate fruit intake with an 0.73 of odds ratio (OR) and at higher risk of inadequate vegetable intake (OR : 1.73), compared to Whites ($p<0.001$). Approximately 40% of adolescents from low socioeconomic backgrounds reported less than one serving a day of fruits or vegetables. Native American youth were at highest risk for inadequate fruit intake. Psychosocial factors related to inadequate intake of fruits and vegetables were low family connectedness (OR: 2.1, $p<0.001$), weight dissatisfaction (OR:1.3, $p<0.001$) and poor academic achievement (OR: 1.6, $p<0.001$). Frequent dieting was associated with inadequate vegetable intake (OR: 1.3, $p<0.001$), but not with fruit intake in this population (Neumark-Sztainer et al., 1996).

Psychosocial factors related to fruit and vegetable intakes have been also reported in other studies. Knowledge about recommended servings of fruits and vegetables in the 5-A-Day Baseline Survey was reported as the most important determinant of actual fruit and vegetable intake (Krebs-Smith et al., 1995b). Self-efficacy and positive attitudes in a study of Dutch adults were significantly associated with consumption of cooked vegetables, of salads or of fruits. Social influence was significantly associated with only salad consumption, but not with consumption of boiled vegetables or fruits (Brug et al., 1995). Another study with Dutch adults showed that for eating salads, attitude, social influence, self-efficacy and intention were important predictors in both fruit and vegetable intakes measured both subjectively and objectively (Lechner et al., 1997). Self-efficacy and intention were important predictors for fruit and processed vegetable

intake measured objectively, and attitude was important for fruit intake measured subjectively. Attitude and social influence were important for processed vegetable intake. Other research with 407 adults by a random-digit dial telephone survey in Rhode Island showed that respondents with children at home were at greater risk for eating 2 or fewer servings of fruits and vegetables a day than those without children at home (Laforge et al., 1994). In another study of 1398 3rd grade children, food preferences and positive outcome expectations were significantly associated with fruit and vegetable intake obtained by a 7-day food record (Resnicow et al., 1997).

In this dissertation research, the association of inadequate fruit and vegetable intakes with demographics, other health behaviors, other food intakes and psychosocial factors will be examined to identify the important factors for eating fruits and vegetables for collegiate young adults in order to develop the effective interventions.

Table 3. Factors related to increased intakes of fruits and vegetables

Study	Subjects	Results
Laforge et al., 1994	407 US Women & children	Mothers with children at home were at greater risk of eating less than 2 serv of FV than those without.
Brug et al., 1995	367 Dutch adults	Self-efficacy and positive attitudes were associated with intake of cooked vegetables, salad and fruits. Social influence was associated only with salad intake.
Dittus et al., 1995	Washington state residents n=1066	Health Belief Model explained16% of the variance of FV intake behaviors. Nutrition behavior score for FV intake depended on barriers to intakes.
Krebs-Smith et al., 1995	2,811 US adults, 1990 Current Population Survey	Knowledge of recommended servings of FV was most important determinant of FV intake.
Neumark-Sztainer et al., 1996	36,284 adolescents (7-12 grades)	Low socioeconomic status, low family connectedness, weight dissatisfaction and poor academic achievement related to inadequate intake of FV. African-American were at lower risk of inadequate fruit intake and at higher risk of inadequate vegetable intake.
Treiman et al., 1996	WIC, n=207 >19yr, 48% Afr–Am	Barriers of increasing FV intake were lack of availability, time and effort to prepare, preference for other foods.
Harnack et al., 1997	10,286 US adults in 1992 NHIS Cancer Epi Supplement	Cancer-prevention knowledge & perceived ease of eating a healthful diet were strong predictors of intake.
Lechner et al., 1997	367 Dutch adults	Attitude, social influence, self- efficacy and intention were important predictors of eating salad measured subjectively and objectively. Self-efficacy and intention were important predictors for fruit and processed vegetable intake measured objectively.
Resnicow et al., 1997	1,398 3rd graders	Food preferences and positive outcome expectation were associated with FV intake.

Transtheoretical Model

Efforts to improve food intake must be on a theoretical model for behavioral change in order to be effective (Glanz et al., 1994). In this section the Transtheoretical Model which has shown recent promise for dietary change is described and recent research evaluated.

Three dimensional model

The Transtheoretical Model has a central organizing construct, Stage of Change. The model also includes a set of intervening or dependent measures, which are the pros and cons for the behavior from Decisional Balance, Self-efficacy and Temptation, and a set of independent variables, including the processes of change. Researchers have described the Transtheoretical Model as three dimensional for: 1) the Stages of Change; 2) the processes of change; 3) the decisional balance, self-efficacy and temptation, and outcome behaviors specific to the problem (Prochaska and DiClemente, 1984b). (See **Table 4.**)

The Stages of Change, the first dimension, represents the temporal, motivational, and constancy aspects of change (DiClemente and Prochaska, 1985). The second dimension, called processes of change, focuses on activities and events to create successful modification of a problem behavior. The ten processes of change from smoking cessation and twelve processes of change from weight control (**Table 5**) represent coping activities (Prochaska et al., 1988; DiClemente et al., 1991; Prochaska et al., 1992). The third dimension includes decisional balance, self-efficacy, temptation and the outcome behavior (Martin et al., 1996). Most researches to date have focused primarily on a single construct of the model, the stage and outcome behavior. Some

researchers are now also including the decisional balance, self-efficacy and temptation constructs (Brug et al., 1997; Prochaska et al., 1994, Betts et al., abstract). The processes of change are the least studied aspect of the Stages of Change model, especially for dietary behaviors.

More research is clearly needed on the entire model, instead of just a focus on the Stages of Change in isolation from the other dimensions especially as related to intervention (Prochaska and Velicer, 1997a).

Stage of Change-1st dimension

The Transtheoretical model of Stages of Change theory of behavior change was formulated to understand and influence how people change health behaviors and originated to explain smoking cessation (DiClemente et al., 1991; Prochaska and DiClemente, 1983). Stages of Change theory has been tested with several problem behaviors (Prochaska et al., 1994). The assumption is made for the Stages of Change theory that people recognize their own intentions to change a specific health behavior and that this is a necessary step to assign people to pre-action stages: Precontemplation (unaware, no intention to change); Contemplation (thinking about change); and Preparation (making plans to change behavior in the near future or have made some changes but have not reached a particular criterion). Likewise, people must be able to recognize the time period within which they are making current health changes in order for health practitioners to determine those people in post-action stages. Post-Action stages include Action, actively changing behavior, and Maintenance, maintaining desired behavior. These assumptions of the Stages of Change Theory are made for all problem behaviors, including those related to diet (Prochaska and Velicer, 1997a).

Table 4. Dimensions of the Stages of Change Model (Prochaska et al., 1992)

	***First dimension*: Stages of Change** (Core Structure of Behavior, Intention & Time)				
	Precontemplation	Contemplation	Preparation	Action	Maintenance
Behavior Outcome	-	-	-	+	+
Intention to change	No	Yes, maybe	Yes	Yes	Yes
Time		Within 6 mo[1]	Within 1 mo[1]	<6mo[2]	>6 mo[2]
Second dimension					
Processes of Change	Existential/Experiential Cognitive and Behavioral Processes ----------→! Consciousness raising---------->! Social-liberation---------->! Environmental reevaluation Dramatic relief-->! Self-reevalation>! Self-liberation---------->! Contingency management->! Counterconditioning------> Stimulus control------> Helping relationship---------->				
Third dimension					
Decisional Balance	High Cons ↘ Low Pros ↗			↙ High Pros ↖ Low Cons	
Self-Efficacy	Low	Low	Rising	High	High
Temptation	High	High	Decreasing	Low	Low

- : < 2 servings of fruit intake, < 3 servings of vegetable intake; + : ≥ 2 servings of fruit intake, ≥ 3 servings of vegetable intake

[1]: Time for the intention, [2]: Time for the behavior

Table 5. Types of processes of change (Prochaska et al, 1992)

Experiential	
Consciousness raising	Increasing information about self and problem
Self-reevaluation	Assessing how one feels and thinks about oneself with respect to a problem
Dramatic relief	Experiencing and expressing feeling about one's problems and solution
Environmental reevaluation	Assessing how one's problems affect personal and physical environment
Social-liberation	Increasing alternatives for non-problem behaviors available in society
Behavioral	
Self-liberation	Choosing and making a commitment to act or belief in ability to change
Counterconditioning	Substituting alternatives for anxiety-related behaviors
Stimulus control	Avoiding or countering stimuli that elicit problem behaviors
Contingency management	Rewarding one's self or being rewarded by others for making changes
Helping relationships	Being open and trusting about problems with someone who cares
Interpersonal control	Avoiding people or social situations that encourage problem behavior; seeking people or situation that encourage healthier behavior; restructuring social relationships
Medication	Use of prescribed or nonprescribed substances directed at appetite, metabolism or emotion

Most people do not maintain their desired behavioral change on the first attempt. Successful self-changers averaged three to four action attempts before attaining maintenance to smoking cessation (Shachter, 1982). These findings led to the proposed spiral pattern of change for behaviors.

The spiral model suggests that most relapsers do not revolve endlessly in circles, nor do they regress all the way back to where they began. Instead, each time relapsers recycle through the stages, they potentially learn from their mistakes and try something different the next time around (DiClemente et al., 1991).

Several researchers have reported that it is possible for people to change behaviors without expert assistance (Cohen et al., 1989; Orford, 1985). The behavior of such self-changers, based on the Stages of Change Theory, are well documented (Prochaska et al., 1995). Researchers have found the amount of progress clients make following intervention tends to be a function of their pretreatment stage of change (Prochaska and DiClemente, 1992).

To measure the Stage of Change, there are two ways of assigning stage: an algorithm or a continuous measure. An algorithm is a short measure or series of questions to categorize a subject into a single, discrete stage based on stage definition. Several items (4-6) are used to assign every person to a stage using the algorithm. Nutritionists often use this method rather than the continuous measure because it is simple and relatively easy to assign clients into stages. A continuous measure, by contrast, gathers information on each stage of change for an individual using several questions for each stage with a Likert response format. Individuals are then classified into groups based on their stage of change profiles (Reed et al., 1997). The measure

usually has eight items for each stage, Precontemplation, Contemplation, Action and Maintenance. By this method, every person has a score for each stage and items can be clustered into stages based on those scores. This method was the original tool used for the Stages of Change Theory developed by psychologists. From it derives the algorithmic method. Glanz et al. 1994 adapted this algorithmic method for dietary behavior for fat and fiber intake (**Table 6**). Questions in the algorithm include self-rated fat and fiber intake, time period for those intakes, behavioral intention to change diet and reported eating habits changes such as attempts and success (Glanz et al., 1994).

Process of Change-2nd dimension

Processes of change, the second dimension of the Stages of Change Theory (**Table 4**) provide important guides for intervention programs. Processes are the covert and overt activities that people use to progress through the stages. The definitions of processes have been explained in **Table 5** (Bowen et al., 1994; Prochaska et al., 1992b).

The processes are selected by examining recommended change techniques across different psychologic theories, which explains, in part, the term 'Transtheoretical' (Prochaska, 1979; Prochaska et al., 1992a). **Table 4** shows what processes have been applied at each stage by successful changers. For example, psycho-analytic techniques, attributed to Freud, are used to bring the unconsciousness or subconscious to awareness or consciousness. These processes are useful strategies for those in the precontemplation and contemplation stages. Therefore, consciousness raising, dramatic relief and environmental reevaluation are applied for moving from precontemplation to contemplation stages. Some techniques such as reducing perceived barriers and increasing perceived benefits derive from elements of the Health Belief Model. Other

Table 6. Stages of dietary change: Algorithm and items (Glanz et al., 1994)

Stage[a]	Definition	Items used
Maintenance	Healthy diet[b] for >6 months	Self-rated diet
Action	Healthy diet for <6 months or tried to change with some success success in the last 6 months	Self-rated diet Reported changes: attempts, Success
Preparation	Tried to make healthy diet changes in last 6 months but not successful or definitely plan to change	Self-rated diet Reported changes: attempts, Success Behavioral intention to change diet
Contemplation	Maybe/probably plan to change Maybe/probably plan to change diet in the next 6 months; and no attempts to change in the last 6 months	Self-rated diet Reported changes: attempts success Behavioral intentions to change diet
Precontemplation	No plans to change diet in the next 6 months; and no attempts to change in the last 6 months	Self-rated diet Reported changes: attempts, success Behavioral intentions to change diet

[a]Assignment to stages was done sequentially, beginning with maintenance. Once an individual was assigned to a stage, the remaining response codes were not processed.

[b]Healthy diet=Low/very low fat, or high/very high fiber

techniques such as expectation, expectancies and reinforcement from the Social Learning Theory can be used for preparation and action stages. Social support techniques like helping relationships are used as processes in the maintenance stage. Self-reevaluation is used to progress from the contemplation to preparation stage. Self-liberation is used for the movement from preparation to action. Contingency management, Counterconditioning and Stimulus control, all from the Behavior Modification Theory, are emphasized in Action and Maintenance stages (Prochaska et al., 1997). Consciousness raising, Dramatic relief, Environmental reevaluation, Social liberation and Self-reevaluation are considered "Experiential processes" and Helping relationships, Stimulus control, Counter conditioning, Reinforcement management and Self-liberation are considered "Behavioral processes" (Prochaska et al., 1991).

The processes identified to date have been for behaviors other than eating fruits and vegetables, 10 processes for smoking cessation (Prochaska et al., 1988) and 12 processes for weight control (**Table 5**) (Prochaska et al., 1992b). However, use of processes of change has been reported differently in some cases. Use of process in pregnancy smoking cessation differed from the processes used in nonpregnancy smoking cessation (Stotts et al., 1996). In that study, the behavioral process use for pregnant women in the Action stage was similar to that of nonpregnant women in the Preparation stage of change.

There are few studies on the processes of change for dietary practices. Eight processes instead of 10 processes were found for eating a low-fat diet (Bowen et al., 1994). A study reported a significant difference in the use of 10 processes for low-fat eating between people in precontemplation and those in maintenance (Ôunpuu et al.,

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2000). No study has been published to date on the processes of change for fruit and vegetable intake. It is important to identify the processes of change matched to each stage to develop intervention techniques to increase fruit and vegetable intake.

To identify processes of change for eating behaviors, two factors must be considered. When processes of change for smoking cessation were identified, researchers found out that including relapsers in the analysis created an inconsistent pattern of processes. When the relapsers were removed for the analysis of processes, a clear pattern of processes appeared across the stages (Prochaska et al., 1984b). Another important factor identifying patterns of process use is to consider those people in habitual maintenance who practice the desired behavior unintentionally. In smoking studies, such people, e.g. those who never smoked, were not included in the analysis.

Decisional balance-Part of 3rd dimension

Decisional balance reflects the individual's relative weighing of the pros and cons for changing the target behavior. Therefore, it helps to understand the decision-making process. Originally, Janis and Mann's model of decision-making, which include four categories of pros and four categories of cons, was used (Janis and Mann, 1977). Four categories of pros were 'gains for self' and 'to others' and 'approval for self' and 'to others'. Four categories of cons were 'costs to self 'and 'to others' and 'disapproval from self' and 'from others'. Many studies with these eight factors have been conducted, but only two structures, pros and cons, were found in smoking cessation (Velicer et al., 1985).

Analysis of 12 problematic behaviors assessed on the basis of the original concept of decisional balance with 24 items demonstrated that progress from precontemplation to

action involved an increase of approximately one standard deviation (SD) in the score for pros of changing and 0.5 SD decrease in the score for cons of changing (Prochaska et al., 1994). In seven of 12 behaviors such as smoking, quitting cocaine, condom use, weight control, radon testing, safe sex and follow-up appointment with doctor, the crossover point between pros and cons of the behavior occurred during the contemplation stage. The crossover point for exercise was during the preparation stage (Prochaska et al., 1994). For sunscreen use, high-fat diets and mammography screening, the crossover point was during the action stage. A decisional balance study with stage of change for weight loss also showed that people could not differentiate eight constructs in pros and cons, but investigators recommended using eight constructs in items to include all possible considerations. However, it is not known if all eight constructs are equally salient for all possible behavioral decisions (O'Connell and Velicer, 1988).

Other multidimensional approaches to decisional balance tested the external validity of the Stages of Change Theory by comparing the pros and cons between stages of change for drinking alcohol using different constructs in four categories such as ability, emotion, interpersonal and practical (Migneault et al., 1997). Myers et al. reported that exercise in young adults using four multidimensional benefit factors (social, psychological, body image and health) and four barrier factors (time-effort, social, physical effects, and specific obstacles) explained stage of exercise adoption better than the model with a smaller number of factors (Myers and Roth, 1997).

To decide which constructs we will use, a study with factors affecting the food choices of young adults should be considered. One study using focus group interviews with 57 young adults from 10 states (Stewart et al., 1994) identified several factors. The

factors affecting food choice included: 1) convenience; 2) calorie content; 3) health; 4) price; 5) satiety (whether the food was filling); 6) friends; 7) advertising; 8) taste; 9) habit; 10) appearance; 11) eating out; 12) cooking skills; 13) avoiding monotony; 14) culture; and 15) cooking and storage facilities. Based on finding from these studies reviewed here, a decisional balance instrument used in this dissertation was developed by a 10-state regional research team (Betts et al., 2000).

Self-efficacy-Part of 3rd dimension

Self-efficacy is the situation-specific confidence people have that they can perform particular healthy behaviors in high risk situations without relapsing to their unhealthy behaviors. This concept came originally from Bandura's Self-Efficacy Theory for behavior change (Bandura, 1977). The self-efficacy construct has been used as an intermediate outcome of behavioral change to assess construct validity in studies with the Transtheoratical Model. Self-efficacy has been found to be low in the precontemplation and contemplation stages, but higher in action stages (De Vries and Backbier, 1995). There have been some arguments about whether self-efficacy is a unidimensional or a multidimensional construct. However, in general, the number of efficacy dimensions is reported to be determined by the nature of the problem area with situational determinants (Velicer et al., 1990). In smoking cessation, three dimensions, positive/social, negative/affective and habit/addictive, were found (Velicer et al., 1990). Negative emotions, availability, social pressure, physical discomfort and positive activities were found to be the five primary factors of efficacy for weight control (Clark et al., 1991). In a study to reduce dietary fat intake, a significant difference in self-efficacy for three constructs -- negative affective, positive social and difficult situations -- was found

among stages (Õunpuu et al., 1999). The self-efficacy instrument used in this study was developed by the 10-state regional research team (Betts et al., 2000).

Validity of Stage of Change assessment tool

Because this research is one primarily establishing the validity and reliability of psychometric instruments, these concepts are discussed next. In this section types of validity and reliability defined and related to issues in this study.

Types of validity

Common methods used to establish validity of an instrument include ***content validity, criterion validity and construct validity*** (Carmines and Zeller, 1974; Baranowski and Simons-Morton, 1991). *Content validity* explains how closely the measure relates to the state of knowledge concerning a specific area. For example, if an instrument is to measure the risk factors of heart disease, then questions should include all the risk factors for heart disease including smoking, alcohol, diet, exercise, family history, etc. *Criterion validity* compares the results of a measure or instrument to a criterion measure or 'gold standard'. For example, if subjects were asked how many fruits were consumed, the validity of their responses could be established by comparing the self-reported number of servings to the number from an objective, surreptitious observation for fruit intake to check whether those subjects in action and maintenance stages were eating more than 5 servings of fruits and vegetables a day. *Construct validity* is used with quantitative analysis, but lacks an identifiable and/or accepted criterion or standard. For this type of validation, we examine whether the results of the measure used agree with what others think measures the same thing (Patrick and Beery, 1991). For example, if placing people into stages is done correctly, then other associated psychosocial factors should be

appropriate for the stage in which people are, or a factor analysis will result in clusters appropriate to the hypothesized theory.

Criterion Validity issues for Stage of Change assessment tool and dietary behavior

For healthy people of normal weight, most health problems related to diet do not produce immediate or dramatic symptoms, and are not targets of social stigma as are drug abusive behaviors. Eating habits usually do not produce short-term physical reactions, involve guilt and seldom invoke social pressure to change. The exception here is 'obesity' for which over-eating can be one cause. Dietary behavior change for disease prevention does not require the cessation of the behavior, but modification. Not eating food is neither possible nor desirable, unlike drug abusive behaviors (Glanz et al., 1994).

Some researchers argue that stage status in the Stages of Change Theory is cognitive and self-perceived rather than overtly behavioral (Glanz et al., 1994). In this case, the validity of a staging algorithm depends largely on people's ability to accurately self-rate their behaviors, perceive their own intentions and perceive the timeframe of intentions to change a health behavior (Glanz et al., 1994). However, people's ability to self-rate their smoking or other drug abusive behavior likely differs from that of self-rated eating behavior. Identifying one's self-rated smoking or drug abuse behaviors is fairly easy, because people are clearly aware of their abstinence from a substance, but many might not be likewise aware of the quality of their diet. The ability to accurately self-rate one's own diet requires some awareness of the nutrient content of a current diet, depends upon knowledge of the nutritional composition of foods, and an ability to estimate portion size, as well as the concepts of a "healthy diet" (Glanz et al., 1994).

Therefore, criterion validity should be addressed for assessing eating behaviors, unlike other behaviors such as smoking or condom use.

So far research with the Stages of Change Theory for food habits has been conducted primarily using cross-sectional research designs to specify people's stage of change for fat and the associated psychosocial factors. The validity of the Stages of Change instrument for fat has been reported as "fair", because most research in the Stages of Change Theory with dietary intake has shown a successful linear trend along the stages. The degree of validity is questionable for actual fat intake, because linear trend analysis fails to show certain criterion intake differences for people between pre- and post-action stages (Glanz et al., 1994; Sporny and Contento, 1995; Brug et al., 1997). One pilot study showed the correlation coefficient between self-ratings of high-fat diets and independently measured fat intake was r=0.49 (Glanz et al., 1994). In that study, although dietary fat consumption decreased as the stage of change progressed and seemed to support the validity of staging algorithms, people in the action stage still ate 37% energy from fat and people in the maintenance stage ate 31.7% energy from fat. Another study showed those in the action stage consumed 34% energy from fat and 31.6% in the maintenance stage (Sporny and Contento, 1995). These findings support that people were trying to change behavior, but the average person in the action stage had still not reached the goal of 30% energy from fat. In a stage-matched intervention for reducing fat and increasing fruits and vegetables, fat intake was reduced to 35% of energy after tailored intervention based on stages for fat intake. At the baseline, however, people who ate 40% of energy from fat were considered as in the action stage when intervention was given (Campbell et al., 1994).

If significant improvement in dietary behaviors is desirable, then a small change is still something worth doing (Prochaska et al., 1995) and making these step-by-step changes towards a goal is an important part of the change process. However, the ultimate goal according to the Stages of Change Theory is full freedom from the problem. Cutting in half the number of cigarettes over six months does not move a person to the maintenance stage of smoking. Likewise, it is questionable that making some behavioral improvement in eating should be defined as action and maintenance stages if people are still eating more than 30% energy from fat even if they are eating better than before.

Other efforts to establish criterion validity in dietary behavior

To get behaviorally accurate Stages of Change, Green and colleagues tried another approach using the "avoid" algorithm combined with behavioral markers including 5 items for low-fat intake to assign people to each stage (Greene et al., 1994). In the study by Greene and colleagues, the people who were in action and maintenance stages showed an average 29.9% and 28.5% energy from fat calculated from the 46-item food frequency, respectively. Only 7% of the nonsmoking adults who consumed more than 30% energy from fat were assigned to post-action stages. However, 44% of the people who consumed less than 30% of energy from fat were assigned to pre-action stages. To overcome that kind of criteria problem with Stages of Change and increase the sensitivity and specificity of the tool, the same researchers developed a Stage of Change algorithm combined with the behavioral criterion which should be met -- less than 30% energy from fat for post-action stages (Greene et al., 1998). If a person reported eating less than 30% energy from fat at the baseline or for 6 months, but the person actually ate more than 30% energy from fat, she or he was assigned to an unclassified stage. Without using a

behavioral marker, about 55% of the subjects fell into the unclassified group. Those people in unclassified group were more likely than those classified to decrease fat intake and move to an advanced stage after getting feedback.

The next several studies discuss criterion validity for fruits and vegetables. Stage of Change based on self-reported fruit and vegetable intake from one study was validated with the score from a 24-hour recall Food Behavior Checklist which asked the frequency of intake 16 foods, four related to fruits and vegetables (Laforge et al., 1994). Stage of Change based on self-reported fruit and vegetable intake showed a linear relationship with the fruit and vegetable intake score and Stage of Change. However, the Stage of Change was not compared to the actual number of servings of fruits and vegetables consumed by subjects. In one EFNEP study, the correlation coefficient between fruit intake from a 2 day dietary record and self-reported frequency of fruit intake used in a Stages of Change questionnaire was $r=0.45$, $p<0.01$. For vegetables it was $r=0.21$, $p<0.05$ (Chung and Hoerr, 1998). Those correlation coefficients were significant with a slightly better estimation for fruits than for vegetables. Estimation by clients themselves can not generally be considered accurate. Only 58% of people who consumed less than 5 servings of fruits and vegetables perceived they ate less than 5 servings of fruits and vegetables, whereas, 82% of people who consumed more than 5 servings of fruits and vegetables reported they ate more than 5 servings of fruits and vegetables.

Therefore, to determine the Stage of Change for fruit and vegetable intakes in this study, the recommended number of servings of fruits and vegetables will be used as the a standard criterion to test criterion validity. Separation of adequate from inadequate fruit and vegetable intake is needed to place people to each stage for eating fruits and

vegetables. A recent study shows substantial numbers of subjects who were classified in action and maintenance stages by self-reported questions actually had fruit or vegetable intakes below the recommended levels (Brug et al., 1997). Brug and colleagues argued that such subjects might be better classified as precontemplators if they are unaware of their need to change (Brug et al., 1997). Another study of the Stages of Change Theory with fruit and vegetable intake also reported similar findings (Lechner et al., 1997). Investigators used the staging algorithm for self-rated fruit and vegetable intake comparing fruit and vegetable intake to an eight-item food frequency. They reported that " the lack of congruence between estimated objective and self-rated behavior appears to seriously lower the internal validity of the stage algorithm." These researchers concluded that a stage algorithm combining objective and subjective consumption with subjects' intention for eating would have better validity (Lechner et al., 1997).

Studies of construct validity

Most validation studies for the Stage of Change Theory have used construct validity using continuous measures of Stage of Change by McConnaughy et al. rather than categorized as earlier described (McConnaughy et al., 1983; Domel et al., 1996; Cardinal, 1997; Willoughby et al., 1996). Construct validation is likely the best test when a standard criterion is not accepted by researchers. Willoughby et al.'s study with alcohol use showed four components and some construct validity with anxiety and depression (Willoughby and Edens, 1996). This research group used the continuous Stages of Change instrument and found only two cluster stages -- precontemplation and contemplation/action stages. Participants in the precontemplation cluster reported being less worried about their alcohol use and less receptive to help. By way of contrast,

Cardinal used a categorical Stages of Change tool to test the construct validity by comparing differences between the stages in Body Mass Index (Kg/m^2), fitness, exercise behavior, barriers and self-efficacy. Significant between-stage differences were found for these variables (Cardinal, 1997), which he concluded demonstrated discrete Stages of Change.

There have been studies testing the construct validity of the Stages of Change Theory for fruit and vegetable intakes. Domel and colleagues used 32 items for a continuous Stage of Change questionnaire to get principal components and clusters based on the desired component (Domel et al., 1996). Against these identified components of stages, they then tested the construct validity by comparing actual fruit and vegetable intake, self-efficacy and outcome expectation for fruit and vegetable intake between the stages identified in the factor analysis. For children (age 8-9 years old) only two components -- precontemplation and beyond precontemplation -- could be identified. This two-stage (as opposed to 5-stage model) might have resulted from an inability to understand the questions by the children due to an immature level of cognitive development. However, self-efficacy and outcome expectations, but not actual fruit and vegetable intake, did increase with the advanced stages. Another study comparing stages of change to attitude, self-efficacy and actual fruit and vegetable intake showed similar results with Dutch adults (Brug et al., 1997). In that study, fruit and vegetable intakes were not significantly different among stages, but self-efficacy was.

Reliability of Stages of Change assessment tool

For reliability analysis, there are three types of tests used: ***split-half reliability; test-retest reliability***; and the calculation of ***Cronbach's alpha*** (Patrick and Beery, 1991).

Split-reliability tests are conducted by dividing in half the total number of items in a instrument and comparing the results obtained from each half using a correlation coefficient. *Test-retest* is when the same individuals are measured at two points in time and the results are compared by correlation. In this case, responses to a repetition of the testing tool might be affected by taking the initial test itself. This can result in so-called "learning effect"/and change results on the second test. *Cronbach's alpha* is used to test the internal consistency of items looking at how different items or questions fit together. It is also used to test consistency in a construct measured by several items.

Test-retest reliability within one week has been reported a study of the Stages of Change Theory for exercise using a categorical Stage of Change tool. Spearman's rho for the stage of exercise measure was very high, 0.96 (Cardial, 1997). In another study, test-retest reliability for fruit and vegetable intakes were r=0.54 for the "precontemplation" stage and r=0.70 for the "beyond precontemplation" stage over a 2-week period using a continuous Stages of Change tool with fourth- and fifth-grade school children (Domel et al., 1996). In the same study, Cronbach's alpha testing also was conducted to examine the internal consistency of questions within each stage construct, because continuous measures were used to assign stages in this study.

Another study on Stages of Change Theory using a longitudinal approach examined the stability of stages over time. More than half of the subjects in the precontemplation and contemplation stages for fat intake at baseline failed to progress at all over an 18-month period when given behavioral feedback. Subjects in the preparation stage were the most dynamic demonstrating in both forward and backward stage movement (Greene and Rossi, 1998). About a third of the subjects in the preparation

stage at 12 months regressed, primarily to contemplation at 18 months, and 29% progressed to action, when they were given feedback at 12 months. However, in the study by Greene and his colleagues, it was not clear whether some people in the preparation stage actually relapsed into the contemplation stage at 18 months or whether they were actually in the contemplation stage at 12 months, instead of in the preparation stage, because the survey period intervals were 6 months. In regards to the stability of stages, one could argue that when people in the preparation stage do not move toward the action stage within one month, then the Transtheoretical Model fails this definition for preparation stage (Pierce et al., 1996).

Direction for developing Stage of Change assessment tool for dietary behavior

A problem behavior can be considered solved once you attain the criteria that health professionals agree places you at zero or minimal risk for a particular behavior (Prochaska et al., 1995). The purpose of behavior change by Stage of Change is that people take action to solve the problem, not just improve it (Prochaska et al., 1995). To achieve this purpose, action criteria for problem behaviors must be set for each behavior. However, it is difficult to set criteria or to get accurate measures by self-assessment for some non-discrete behaviors like physical activity or eating. For fruit and vegetable intake, the consumption of the recommended number of servings of fruit and vegetable intake has been used as the action criteria. Therefore, eating at least two servings of fruits and three servings of vegetables can be used as the criterion to place people into post-action stages because those are the current goals for fruit and vegetable intake in the U.S. However, if people frequently estimate their fruit and vegetable intake inaccurately, by either over or under estimation or both, then people will not be assigned to their actual

Stage of Change. The effort of the self-changer or interventions by professionals using the Stage of Change Theory would then be ineffective and inefficient.

To adapt the Stage of Change Theory for eating fruits and eating vegetables from the Stage of Change Theory for problematic behaviors to assign people into appropriate stages, we need to keep in mind another factor as well. Most studies on the Stage of Change Theory with problematic behaviors have focused on only people who have problem behaviors to change because investigators assumed that people are able to recognize their problematic behaviors and used self-rated data. However, this dissertation study will test whether people can recognize their dietary behavior using adequate and inadequate fruit and vegetable intake.

In this dissertation study, the Stages of Change tool based on the algorithm, the method preferred by nutritionists, with short items will be used to assign people to each stage. Scientific observation will also compare stages by actual fruit and vegetable intake from a 3 day record to stages with three kinds of assessment method for fruit and vegetable intake -- self-rated, 24-hour recall and food frequency -- for criterion validity. Results of using these staging instruments with also be compared to subjects' process and decisional balance scores and self-efficacy to assess construct validity.

Few reliability studies have been reported with Stages of Change because of the natural dynamics of the Stages of Change Theory. People can change their behavior without assistance within a certain time period. However, the reliability for Stages of Change based on three assessment methods will be tested in this dissertation research because measuring reliability for an inconsistent behavior like eating may be worthwhile, although it confounds reliability results with learning and change.

Chapter Three

Validity of Stages of Change Instruments For Eating Fruits And Vegetables

A. ABSTRACT

Objective To establish outcome validity for "stage of change instruments" to assess eating the recommended number of servings of fruits and vegetables.

Participants A convenience sample of 294 college students were recruited from introductory nutrition classes for this study.

Design The servings of fruits and vegetables, separately, from three types of staging methods--self-rated intake, 24-hour recall and food frequency (FFQ)--were compared to the servings from a three-day food record. The outcome validity was assessed based on whether or not at least two servings of fruits and three servings of vegetables were reported.

Analysis 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 staging methods and a three-day food record.

Results For fruits, sensitivity was best using a 24-hour recall (K= 0.81). The recall also showed the best agreement with a three-day food record for servings consumed by people in pre-action or post-action stages. For vegetables, however, all three methods had low agreement with the results of a three-day food record. Self-rated intakes for vegetables had the best sensitivity (K = 0.66) and FFQ had the best specificity (K=0.73).

Application/conclusions Dietitians can use the 24-hour recall methods to identify people who consume inadequate servings of fruit. To detect adequate vegetable intake,

the FFQ was best of the three methods. Dietitians should probe for vegetables in mixed dishes and on sandwiches.

B. INTRODUCTION

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., 1992a; 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 changes but not reached a particular criterion). Likewise, people must be able to recognize the time period within which they are making current health changes in order for health practitioners to determine people who are in post-action stages. Post-action stages include action, actively changing behavior, and maintenance, maintaining desired behavior.

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), because the theory is relevant to all health behaviors (Prochaska et al., 1997b). What differs most noticeably from drug cessation in the use of the TTM with diet is the estimation of the target behavior. Unlike the change for drug abuse behaviors, dietary behavior change for disease prevention requires the

modification, not cessation, of the behavior. Dietary behavior is not an addictive behavior which must be avoided for health. Not eating is neither possible nor desirable, whereas cessation of drug abusive behaviors is the target (Glanz et al., 1994). Target dietary behaviors using the TTM are eating recommended amounts and types of specific foods. The fact that people do not know dietary recommendations is a problem for dietitians. Previous studies on the TTM, which relied only on people's "perceptions of their behavior," showed a linear relationship for fat intake and for fruit and vegetable intakes across the stages from precontemplation to maintenance (Greene et al., 1994; Sporny and Contento, 1995; Laforge et al., 1994; Hoerr et al., 1997). Stage assessment based on self-reported dietary intake has failed to show validity in terms of a behavioral criterion of achieving the dietary goal, likely because people were unaware of whether they were eating the recommended amount of food or nutrient (Brug et al., 1997; Glanz et al., 1994; Sporny and Contento, 1995).

To use the TTM to change dietary behavior, dietitians need other objective methods in addition to people's own generalized perceptions of adequate or inadequate intakes (in this study called "self-rated intake"). Such 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). Measurement of reliability based on the outcome of staging instruments for a behavior like eating, which typically varies from day to day, is important. The objectives of this study were to establish outcome validity and reliability for types of methods to classify the stage of change for eating adequate amounts of fruits or vegetables, separately.

C. METHODS

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, landgrant university. 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 including a three-day record. Subjects with incomplete dietary data (n=66) were excluded, including 44 subjects with incomplete sets of dietary records. Data were 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 11 days. Separate consent forms were signed for data collected at the baseline and for the retest.

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.

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)

(**Figures 1 and 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. Fruits included fruit juice. Vegetables included fried potatoes, vegetable juice and vegetables in mixed dishes.

Self-Rated Intake. The first method for classifying the stages of change (**Figure 1**) used the question for self-rated intake, "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. Subjects were classified into categories for action or maintenance stages, if self-rated intake met the outcome criteria. A further division between action and maintenance was determined with a question about the time period. Subjects who did not meet outcome criteria were assigned 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.

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 of vegetables.

Further classification was made using the same concepts described for the self-rated intake (**Figure 2**).

Food Frequency. For the third outcome assessment, separate food frequency questionnaires (FFQ) for fruits and for vegetables over the past week included 12 fruit items and 14 vegetable items (**Figure 2**). These short FFQs 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 (Betts et al., 2000).

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 all food they ate, and detailed instructions were provided to increase the accuracy of recalls and records.

Calculation of fruit and vegetable servings. For 24-hour recalls and a three-day record, the food servings database for the 1994-96 USDA Continuing Survey of Food Intakes by Individuals (CSFII) was used to count fruit and vegetable servings (U.S. Department of Agriculture, 1998). The Expanded Food and Nutrition Education Program (EFNEP) Evaluation/Reporting System (U.S. 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 for further statistical analysis. Because the ERS was designed prior to release of the CSFII Food Guide Pyramid servings database, some discrepancies were found between the servings in the CSFII and in the ERS. Therefore, the database of the ERS was revised for such foods by counting fruits and vegetables on the basis of the CSFII servings using the Microsoft Access program (version 7.0).

Analysis

The Statistical Package for Social Science (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. Differences in the average servings of fruits and of vegetables among the stages by all three methods were compared using ANOVA. 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). Outcome was examined by pre- versus post-action Stages of Change, because we were interested in which staging method best predicted eating at least two servings of fruits and 3 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, and specificity, the ability to detect who had at least two servings of fruits and three servings of vegetables, 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. A program was written for Microsoft Excel to test the significant difference between Kappa values for the three staging methods (Donner et al., 1996). Test-retest reliability of all three methods for stage classification was also compared using Kappa.

D. 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 FFQ and 3.1 ±1.9 from a three-day food record.

Approximately 65% and 66% of the subjects were assigned to the post-action stages of action and maintenance for eating at least two servings of fruits by staging the self-rated intake and the FFQ, respectively, whereas 42% were in post-action stages by the 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. For fruits, all staging methods demonstrated on average <2 servings in pre-action stages and ≥2 in 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.

Figure 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 (K=0.31) and FFQ (K=0.29). Sensitivity, the ability to detect people who ate less than two servings of fruits, was the highest for Recall (K=0.81)

compared to self-rated intake (K=0.49) and FFQ (K=0.47) (**Figure 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 (K= 0.85) and FFQ (K=0.84) than with the 24-hour recall (K=0.73). For vegetables, however, agreement between stages and vegetable servings from a three-day food record was low for all three methods: the self-rated intake had a Kappa of 0.17); the recall, 0.21; and the FFQ, 0.27. When sensitivity and specificity for vegetables were calculated, the self-rated intake showed the highest sensitivity (Kappa=0.66) and the FFQ showed highest specificity (Kappa=0.72).

Reliabilities or agreements between the stages at the baseline and the stages about 11 days later on average, were similar and acceptable for all three staging methods for fruits (**Figure 5**). For vegetables, the 24-hour recall had poor reliability compared to the self-rated intake and the FFQ.

E. DISCUSSION

When subjects were examined as a group, the average fruit and vegetable servings from all three outcome assessments could distinguished 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. Stage classification by the 24-hour recall had the best validity and acceptable reliability. All stage classifications failed to show good validity for individual vegetable intake using sensitivity to test validity. Both self-rated intake and the FFQ with 12 fruit items showed good ability to detect people with adequate fruit intakes. However, vegetable intake showed a different pattern. None of the three assessments demonstrated good agreement with vegetable

servings from a three-day food record, although FFQ was the best. Therefore, neither people's perceptions about their vegetable intake nor yesterday's intake was good for stage assessment using a behavioral outcome criterion.

All three methods, except the 24-hour recall for vegetables, showed good reliability for both fruits and 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 Prochaska et al., 1995). However, it may be worthwhile to measure the reliability of Stages of Change assessment for variable 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 on 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; Sporny and Contento, 1995; Brug et al, 1997), other staging methods were tried for fat, fruit and vegetable intakes. Those studies using behavioral criteria such as a food checklist or FFQ 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; Greene and Rossi, 1998, Laforge et al., 1994; Lechner et al., 1997; Lechner et al., 1998; Van Duyn et al., 1998). Food frequencies have shown good validity as a staging method for dietary fat (Greene et al., 1994; Greene and Rossi, 1998). Other investigators have shown, however, that FFQ 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., 1995c; Calvert et al., 1997). Our FFQ 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 to 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 FFQ for vegetables might lead to relatively high sensitivity for self-rated 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 limited uncome women (Chung and Hoerr, 1998). In the present study, FFQ was positioned 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 overestimated fruit and vegetable intakes compared to the simple, self-rated intake.

For eating vegetables, further studies on stage assessment are likely needed because all classification methods failed to show good agreement with vegetable servings in our population. Vegetable intake varied over time and estimation is more difficult than for fruit. Some of the difficulty with estimation of vegetable intake is likely due to a high consumption of mixed dishes such as pizza, tacos, spaghetti, etc.

One study 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 healthy and those who do not. The authors 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 healthy, 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 assessment 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 was measured, the distribution of stages 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 a general adult Dutch population (Brug et al., 1997). This difference might reflect cultural differences and 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 in the north central U.S. and were people with some interest in nutrition. 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. Further studies are needed to replicate our results using another, large 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 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.

F. APPLICATIONS

- Dietitians can quickly evaluate a person's usual fruit intake by 24-hr recall when they assess stages of readiness to eat fruits.
- For vegetables, all methods distinguished between adequate and inadequate intakes for groups, but none worked well for individuals. Dietitians must recognize that people are not educated well enough to recognize vegetables or portion sizes recommended for the Food Guide Pyramid and thus, they should probe for vegetables in sandwiches and mixed dishes.
- To distinguish simply between pre- and post-action stages for fruits and vegetables for groups of people, Dietitians can use any of the three staging methods.

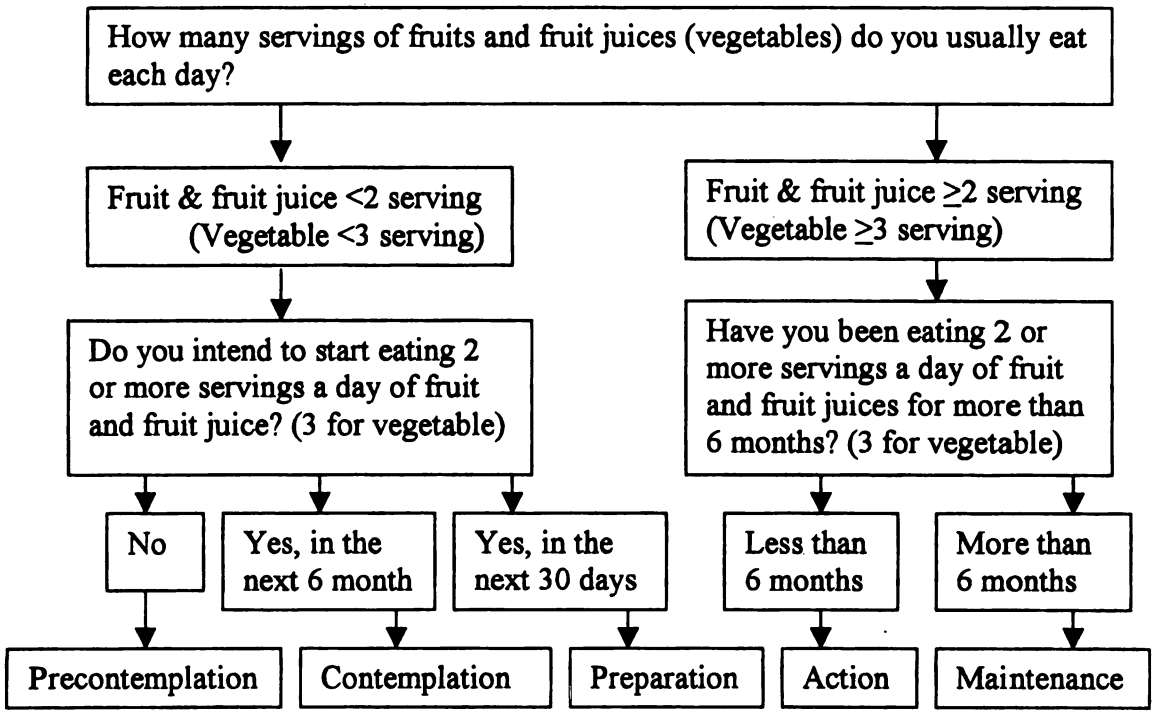


Figure 1. Method A (Self-rated intake) of classifying the stages of change

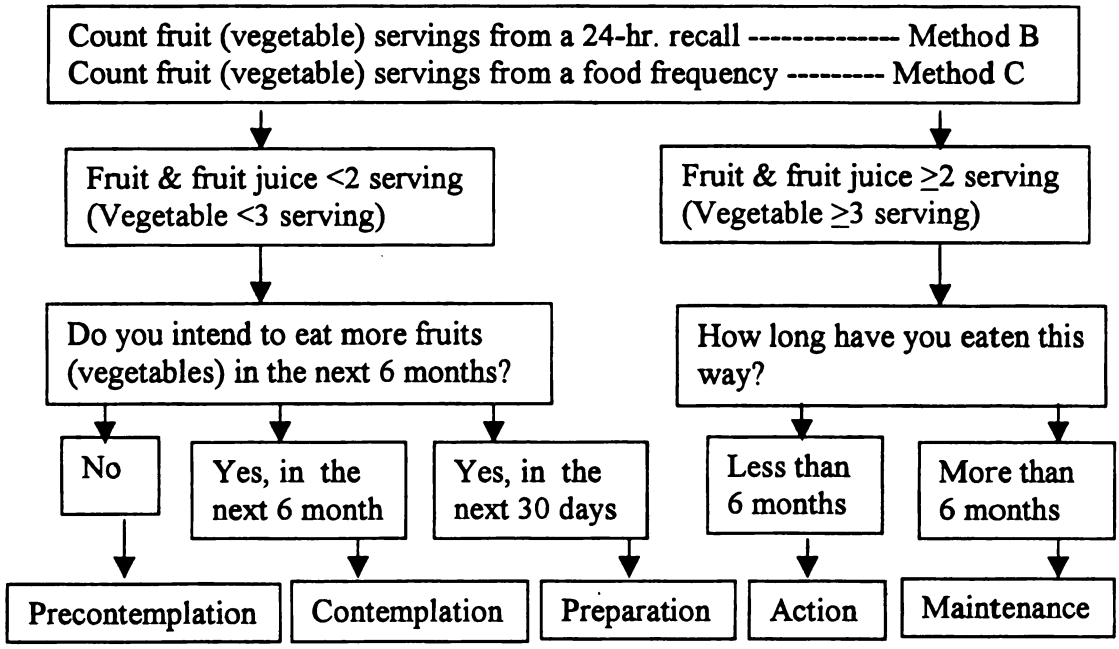


Figure 2. Method B (24-hr. recall) and Method C (FFQ) for classifying the stages of change

Table 1. Percentage of respondents by stages of change for eating fruits and vegetables using three staging methods and compared to servings of fruit and vegetable [Mean(SD)] from a three-day food record (n=294).

	Fruit						Vegetable					
Stage of Change	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)[a]	9.4	1.1(0.9)[a]	6.6	0.9(0.9)[a]	20.1	2.7(1.4)[a]	15.8	2.6(1.5)[a]	14.2	2.4(1.1)[a]
Contemplation	12.6	0.9(1.1)[a]	13.0	0.8(1.0)[a]	11.8	0.9(1.1)[a]	16.7	2.6(1.7)[a]	11.8	2.3(1.5)[a]	12.2	2.5(1.6)[a]
Preparation	15.3	1.5(1.1)[a]	35.4	1.3(1.0)[a]	15.6	1.3(1.4)[a]	21.8	2.7(1.7)[a]	23.2	2.7(1.7)[a]	16.3	2.3(1.5)[a]
Action	15.0	2.4(1.4)[b]	9.4	2.8(1.4)[b]	16.3	2.3(1.4)[b]	6.8	3.4(1.7)[ab]	13.2	3.5(1.5)[ab]	14.6	3.0(1.7)[ab]
Maintenance	50.3	2.5(1.9)[b]	32.9	3.3(1.9)[b]	49.7	2.4(1.9)[b]	34.7	3.8(2.3)[b]	36.0	3.8(2.3)[b]	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] Reclassified by algorithm using svg eaten from 24-hr recall, intention and time frame

[3] Reclassified by algorithm using svg eaten fromFFQ, intention, and time frame

[ab] Means not sharing the same superscripts are significantly different by Tukey's multi-comparison test ($p<0.05$)

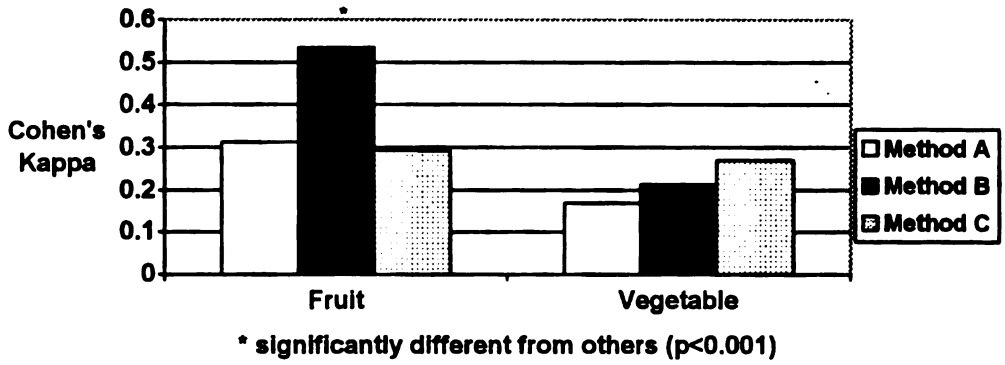


Figure 3. Agreement for detecting intake from three staging methods compared to 3-day food record using behavioral criteria

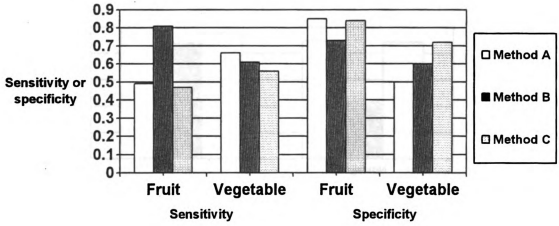


Figure 4. Ability of three staging methods to detect low and adequate fruit and vegetable intake, Sensitivity and Specificity, respectively (n=294)

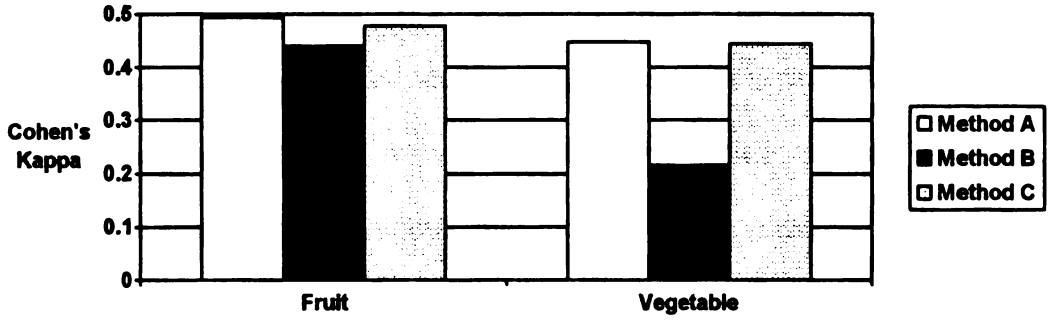


Figure 5. Test-Retest Reliability of Stage agreements by three staging methods (n=123)

Chapter Four

Developing an Instrument to Measure the Processes Young Adults Use for Eating Fruits and Vegetables

A. ABSTRACT

The purpose of this study on fruits and vegetables was to identify processes of change and to identify relationships between the processes and the stages of change. Items from the 11 process constructs were generated from other health behaviors; then focus group interviews were conducted to clarify wording and to find additional items. Eighty items were tested on a sample of 151 students in an introductory nutrition class. Using confirmatory factor analysis, 29 items resulted in 7 constructs: Health Concerns, Self Reevaluation, Social Liberation, Health Commitment/Action, Interpersonal Control, External Reinforcement and Helping Relationship. The coefficient alpha was calculated for each and the reliabilities, ranged from 0.69 to 0.85, i.e., acceptable for these 3 to 6-item scales. The relationship between use of processes and stages were examined with 294 collegiate young adults. Significant differences on self reevaluation and health commitment for fruit intake were found among stages. For vegetables, only health commitment differed between groups ($p<0.05$). However, when the relapser and maintenance groups were considered, health concern and self-reevaluation also differed among stages ($p<0.05$). For both fruits and vegetables, "Health Commitment" and "Self-reevaluation" were important behavioral strategies which differed between groups; "Health Concerns" was an additional strategy for vegetables.

Key Words: Fruits; Vegetables; Behavioral Theory; Transtheoretical Model; Instrument

B. INTRODUCTION

Many studies have shown the benefits of eating adequate fruits and vegetables to reduce risk for chronic diseases (Steinmetz and Potter, 1996; Ness and Powles, 1997). Because of the health benefits, the national objectives in the U.S. have been set at five or more servings of fruits and vegetables per day (USDA & USDHHS, 1992; USDA & USDHHS, 1990; National Research Council, 1980; U.S. Department of Health and Human Services, 2000). Nutrition educators remain frustrated in attempts to help people meet this objective, because most Americans fall short of these recommendations (Krebs-Smith et al., 1995a; Li et al., 2000). Several studies also revealed many young adults do not eat the recommended number of fruits and of vegetables, even though dietary habits of young adults relate to their current and later health (Song et al., 1996; Ma and Betts, 1999). Helping people achieve this national objective for fruits and vegetables has been a challenge for nutrition educators (Cullen et al., 1998; Ciliska et al., 2000).

Stage of Change Theory has been used as a successful behavioral model to change smoking and drug abuse behaviors. Such success has encouraged nutrition educators to become interested in applying Stage of Change to dietary behaviors as well. The Stage of Change Model can be depicted in three dimensions, which are: 1) the stages of change; 2) processes of change; and 3) decisional balance, self-efficacy and temptation. The first dimension of the model, has five stages: precontemplation, contemplation, preparation, action and maintenance assigned by the temporal, motivational and constancy aspect of change (DiClemente and Prochaska, 1985). The second dimension--processes of change-

-are the covert and overt activities that people use to progress through the stages. These processes provide important guides for intervention programs and have been selected from recommended techniques for change across various psychological and behavioral theories, which explains another term for this theory, "Transtheoretical" (Prochaska, 1979; Prochaska and DiClemente, 1992).

Ten to 12 processes of change have been identified for smoking cessation and weight control. These are consciousness raising, dramatic relief, self-reevaluation, environmental reevaluation, social liberation, self-liberation, stimulus control, counter-conditioning, contingency management and helping relationship in smoking cessation. Weight control has two additional processes of change, which are interpersonal control and medication (Prochaska et al., 1992b). Studies in smoking cessation have shown that people in contemplation stage rely more on consciousness raising and people in action emphasize other behavioral modification processes to move into advanced stages, and, finally change their behavior (Prochaska and DiClemente, 1983; Prochaska et al., 1991). For example, the psycho-analytic techniques attributed to Freud, are used to bring the unconsciousness or subconscious to awareness or consciousness. Such processes or techniques appear to be useful strategies for those in precontemplation and contemplation stages. Therefore, consciousness raising, dramatic relief and environmental reevaluation are processes educators can use to help people move from precontemplation to contemplation stages. Self-reevaluation is used to progress from contemplation to preparation stages. Self-liberation is used for the movement from preparation to action. Contingency management, counter-conditioning and stimulus control, all from Behavior Modification Theory, help those in action stage transition to the maintenance stage.

Social support techniques such as helping relationships are used as processes for those in the maintenance stage (Prochaska et al., 1992a; Prochaska and Velicer, 1997a). Such well-established interrelationships between stage of readiness to change and processes of change have helped health educators develop effective intervention programs for smoking cessation. However, before we apply this theory to dietary behavior, we must know if the same processes exist for eating fruits and eating vegetables as for smoking or drug abusive behavior. It is likely that each health behavior has some unique aspects.

Few studies have reported the applicability of the processes of change to dietary behavior. A study conducted on low fat dietary change found eight processes--environmental reevaluation, self reevaluation, dramatic relief, social support, consciousness raising, behavioral strategies and social liberation (Bowen et al., 1994). The relationship between the stages and a process like social support has been studied for eating fruits and vegetables (Sorensen et al., 1998). However, no studies that identify all the processes of eating fruits and eating vegetables for young adults have been published to date. Nutrition educators need such information on the processes used to change dietitians' behaviors to improve intervention efforts when targeted by stage of readiness to eat fruits and vegetables.

The main purpose of this study was to develop a reliable process of change questionnaire for eating adequate fruits and for eating adequate vegetables. A secondary purpose was to examine the relationship between people's stages of change and their concurrent use of processes of change. A convenience sample of collegiate young adults was used for these purposes, because young adults were the target population of interest for future studies.

C. METHODS

Three steps comprised the process of instrument development to assess processes of change for eating enough fruits and vegetables. We identified and refined the process items and then examined the relation between the process items and Stages of Change.

Step 1. To identify processes of change for eating enough fruits and vegetables.

The processes of change items for eating adequate fruits and vegetables from 11 categories were adapted first from other studies (Prochaska et al., 1988; Prochaska et al., 1992b; Bowen et al., 1994). Items were also developed from transcripts of interviews for another study with young adults about eating fruits and vegetables (Betts et al., 2000). Each fruit and vegetable process item had a 5-point Likert response scale from "never use" to "always use" for the question "How frequently do you usually eat...?"

Using the items drafted, processes of change items were sent to 12 outside experts for review. Procedures for this group of experts included two activities. First, the experts listed their own strategies or thoughts about eating fruits and vegetables and categorized these processes. Secondly, the experts reviewed the draft of processes adapted from earlier research and described in the preceding paragraph. Experts checked the items for wording, sentence clarity and goodness of fit in each category. Items were revised after evaluation of the experts' feedback. The major concerns expressed by expert reviewers were whether processes of change were for increasing fruit and vegetable intakes or for eating enough fruits and vegetables. We decided to focus on eating enough fruits and vegetables because the staging instrument was designed to discriminate people who ate at least the recommended number of servings of fruit and vegetable from those who did not.

Because 'enough' is a relative term, it was used with the definitions explicit on the instrument, i.e., eating at least 2 serving of fruits and at least 3 servings of vegetables.

Next, four focus group interviews (n=24) were conducted with collegiate adults aged 18-24 years to clarify the items and to elucidate additional process items. First, focus group interviewers were recruited from an undergraduate nutrition class. The four interviewers and focus groups were matched by race and gender--African American male, African American female, white male and white female. Interviewers attended a 1 hour training session on focus group techniques and were paid $100.00 for their total time. Focus group interviews were conducted following standard methods (Stewart and Shamdasani, 1990; Betts et al., 1996). The interviews, lasting from 60-90 minutes, were audio tape-recorded. Each interviewer had five focus group attendees and one note taker. Attendees were paid $10 each for participation.

Generally, most respondents in focus group interviews mentioned eating fruits and vegetables as a substitute for unhealthy foods, keeping fruits and vegetables readily available and their mothers' support for eating healthy foods like fruits and vegetables. Most participants also reported that social relationships with friends were not relevant to eating fruits and vegetables. Although our main purpose for focus group interviews was to elicit the processes collegiate young adults use to eat enough fruits and vegetables and to clarify items on the draft process instrument, most young adults told us the reasons why they did or did not eat fruits and vegetables. The major reasons reported for eating fruits were that they liked the taste and the convenience. Subjects living in residence halls answered they ate fruits and vegetables because they were available in the cafeteria. Most females responded they ate fruits and vegetables as substitutes for unhealthy food

and that they felt healthy when they ate fruits and vegetables. Cited frequently by students as important reasons for eating fruits and vegetables were mother's support for eating healthy foods and keeping fruits and vegetables available. Eighty process items resulted from analysis of the focus group results.

Step 2. To refine the process items.

Eighty items from 11 constructs (categories) were tested on a convenience sample of 151 students (82% female) in an introductory nutrition class at a large, midwestern university in the fall, 1999. The constructs at this step included consciousness raising, dramatic relief, self reevaluation, social liberation, environmental reevaluation, self liberation, counter conditioning, stimulus control, contingency management, interpersonal control and helping relationships. A $1.00 coupon for redemption at a local campus-run snack shop was given to students for returning questionnaires and consent forms. To refine the instrument, confirmatory factor analysis (CFA) was used, because we started with known constructs (Hunter and Hamilton, 1992). Cronbach's α coefficients for the final constructs were calculated for reliability.

Confirmatory factor analysis (CFA), which examines whether data are consistent with a theoretical model to be identified, was chosen because process of change items were adapted from 11 theoretical constructs (Prochaska et al., 1992b). CFA approach assumes that constructs are inter-correlated, which is more likely to be true (Maruyama, 1998). Using r=0.90 for inter-correlation between constructs as the cut point to combine constructs, an instrument was developed for processes of change with 29 items for seven constructs and this instrument tested in Step 3. Inter-correlations of final seven constructs ranged from 0.21 to 0.83 for fruits and from 0.27 to 0.87 for vegetables.

Step 3. To examine how processes of change relate to stages of change.

The relationship between stages of change and processes of change were examined using data from an introductory nutrition class in spring, 2000. Response rate was 51% among 700 students, who were given extra points toward their grade as an incentive. Final analyses were done with 294 subjects, after excluding those with incomplete data. Subjects were 80% female and 86% white, reflecting the demographic distribution of the course.

The differences in frequency of use of the seven processes of change by stage of readiness to eat fruits and vegetables were tested using ANOVA, followed by Tukey's multiple comparison tests. Processes of change scores from the seven constructs were standardized to T-scores to put them on a comparable metric (mean=50, standard deviation=10).

Stages for fruit intake and stages for vegetable intake were measured separately. Current fruit/vegetable consumption was assessed as a stage outcome to assign subjects "pre" versus "post" action stages using self-rated intake, "How many servings of fruits/vegetables do you eat a day?" Fruit intake included fruit and fruit juice and vegetable intake included fried potatoes and vegetable juice. Subjects were classified in post action stages of Action or Maintenance, if they answered eating $\geq$2 servings for fruits or $\geq$3 servings for vegetables. These outcome criteria were from the minimum recommended intake in Food Guide Pyramid. Then, intention and time period for eating enough fruits/vegetables were asked for further stage divisions (Glanz et al., 1994; Hoerr et al., 1997).

People who had eaten ≥2 fruits/≥3 vegetables more than six months were assigned as in maintenance stage and those for less than six months were assigned as in action stage. The subjects who did not meet the outcome criteria were assigned into a pre-action stage of precontemplation, contemplation or preparation. Respondents were classified into precontemplation when they had no intention to eat ≥2 for fruits or ≥3 for vegetables, into contemplation when they intended to eat these within 6 months, and into preparation, when they intended to eat these within 30 days (**Figure 1**).

Of the people in pre-action stages (n=99 fruit, n=170 vegetable) we further separated those who were there because of "relapsing", so we could examine if they used unique processes. For separating relapsers from others in pre-action stages, a question was asked if their past experience of increasing fruit and vegetable intake was successful. Those who answered "No" were assigned into the relapser group and the remainder in pre-action stages were classified as "pre-action – R". For those in maintenance, a question about whether people had ever tried to increase fruit and vegetable intakes was used to divide those in maintenance by changing their behavior change from those who were in maintenance just by habit (**Figure 1**). People in maintenance by habit have not been separated from maintenance when the TTM model was used in other dietary studies (Green et al., 1994; Brug et al., 1997). However, because people who had never smoked were excluded from the Stage of Change study for smoking cessation, we thought people who had eaten adequate fruit and vegetable habitually, but not by intentions, should be examined separately. It would be important to see, especially in this examination of processes of change, if there were differences in people who cognitively consumed enough fruits and vegetables versus those who did so by habit. The uses of processes of

change were compared between two groups, "relapsers" versus "pre-action – R" and "maintenance by change" versus "maintenance by habit" using student independent t-test.

D. RESULTS

Results of Step to identify the processes of change for fruits and vegetables were reported in the Methods but also here with Step 2 for the results of the factor analysis. Data relating to the second purpose are reported in Step 3.

Steps 1 & 2. Identifying and refining the processes of changes.

Table 1 shows the confirmatory factor loadings and the coefficient alphas of each construct, which ranged from 0.69 to 0.84, i.e. acceptable for these 3 to 6-item scales. The same process items were chosen for both fruits and for vegetables which had the highest reliabilities. The three original constructs "Consciousness Raising, Dramatic Relief and Environmental Reevaluation" were combined into one construct "Health Concerns" due to high correlation (>0.90) among constructs both for fruits and for vegetables. "Self Liberation, Stimulus Control and Counter Conditioning" were likewise combined into the construct "Health Commitment/Action". Several items with the concept of self rewards for behavior change, originally from contingency management, were moved into "Self Reevaluation". Process items related to rewards from others in contingency management were labeled as "External Reinforcement". Twenty-nine items for seven constructs resulted: "Health Concerns, Self Reevaluation, Social Liberation, Health Commitment/Action, Interpersonal Control, External Reinforcement and Helping Relationship". The Hunter and Hamilton software (1992) allows one to test the internal consistency of each of the seven scales associated with the seven constructs. For all constructs for fruits and of vegetables, except for health commitment/action for

vegetables, the value of Chi Square was not significant ($p>0.05$), indicating a good fit to the measurement model. Therefore, for this reason and to reduce respondent burden, the same items for the same constructs were kept for both fruits and vegetables.

Step 3. How processes of change relate to stages of change.

Using the original five stages, people in precontemplation used less "Self reevaluation" and "Health commitment/action" than those in post action stages of fruit intake ($p<0.001$). For vegetable intake, only people in pre-action used less "Health commitment/action" than those in maintenance stage (Data not shown).

Comparing the processes of "relapsers" versus "pre-action – R", there was no difference on any processes of change for fruit. However, for vegetable intake, a higher use of self-reevaluation processes, but lower use of health commitment process, resulted for "relapsers" compared to those in "pre-action – R" (**Figure 2**). When we examined processes of change between those in maintenance by change versus by habit, we found no difference for fruit, but did for vegetables. Those in maintenance by change who ate enough vegetables used more processes for health concerns, self-reevaluation and health commitment/action than those in maintenance by habit (**Figure 3**).

Table 2 shows T-scores on each process of change among stages of change further separating relapsers and maintenance by habit from those in the five original stages. People in precontemplation were least frequent users of processes of change compared to those in other stages.

E. DISCUSSION

This is the first study to examine comprehensively the process of change dimension from the TTM for fruits and vegetables. Findings for Steps 1 and 2 demonstrate that young adults have unique processes of change and that these differ for eating fruits and for eating vegetables. Young adults likely have fewer processes for eating fruits and eating vegetables than do older adults. Investigators who examined process of change for fat consumption found 10 processes with middle-age adults, whereas we found only seven for fruits and vegetables with young adults (Öunpuu et al., 2000). Findings for Step 3 suggested that the processes of self reevaluation and health commitment are appropriate targets both for fruits and for vegetables, and health concerns, only for vegetables.

Step 1 & 2. Identifying and refining processes.

The construct "Health concerns" combined consciousness raising, dramatic relief and environmental reevaluation processes, because young adults did not discriminate among those for eating enough fruits and vegetables. Prochaska and colleagues identified these three original processes as important ones for people to move from precontemplation to contemplation in smoking cessation (Prochaska et al., 1992a). Results from studies on low fat intake with middle age people did not combine those three constructs either (Bowen et la., 1994; Prochaska et al., 1988; Öunpuu et al., 2000). Therefore, another possible reason for failure to discriminate among the three is these young adults were less aware of the importance of eating fruits and vegetables compared to older adults.

Self liberation, stimulus control and counter-conditioning were also combined into one construct – "Health commitment/action" - in this study, due to high correlation

between constructs. This collapse of earlier constructs may be because eating fruits and eating vegetables are behaviors promoted or substituted, not avoided, like smoking. To make a health commitment, fruits and vegetables should be available in the near environment rather than removed from the environment as for smoking cessation.

There were few references to social support processes observed in our focus groups, when young adults were asked what they did to eat enough fruits and vegetables. Most responded that "social influences", except for their mothers' support, were not important to them for eating fruits and vegetables. However, in a previous study, young adults reported that the food they ate was affected by what their friends ate (Betts et la., 1997). It might be that at this age friends influence the consumption of some foods, but not especially that of fruits and vegetables. This can be true, even though young adults in college have been reported to have more healthful dietary habits than those who had never been to college (Georgiou et al., 1997).

Step 3. How process of change relate to stages of change.

Although items developed for processes of change were the same for eating fruit and for eating vegetables, several different aspects for each were found in relation to stage of change. One of the differences was that the relationship between stages and use of the process "health concerns", differed significantly among stages only for vegetables. Two processes common to both fruits and vegetables, which differed among stages, were self reevaluation and health commitment/action. These findings are in contrast to those from smoking cessation, where the use of all 10 processes, except social liberation, differed significantly among stages (DiClemente et al., 1991). In this young adult

population, only self reevaluation and health commitment/action for fruits and vegetables and only health concerns for vegetables differed significantly among stages.

The use of self reevaluation by those in precontemplation was lower than by those in post-actions stages for both fruit and vegetable intake. This finding is similar to those for smoking cessation, although our self reevaluation process included a self reward item, "I feel good about myself when I eat enough" (Prochaska and DiClemente., 1984b; Prochaska et al., 1992a). If supported by longitudinal studies, it might be possible to use self reevaluation to help people move from precontemplation to preparation and action for fruits and vegetables.

The pattern of use of health commitment processes differed between eating fruit and eating vegetables. For vegetables, health commitment differed only between "maintenance by change" and other stages, whereas, health commitment differed among several stages for fruit. Health concerns for vegetable intake had a significant relationship with stages, but not for fruit intake. Therefore, processes for eating enough fruit may not relate to health concerns for these young adults. A study on social support with fruit and vegetable intake combined reported that coworkers and household supports were significantly associated with stages of change in that population group (Sorensen et al., 1998). However, our findings did not support those results, because the processes related to social support--such as social liberation, interpersonal control, external reinforcement and helping relationship--did not differ significantly among stages for either fruits or vegetables.

When adapting Stage of Change Theory from use for smoking cessation to changing dietary practices, two important factors often have been overlooked. The first

is that people who had never smoked in the past were not included in the research on smoking cessation In fact, those people not smoking, because they never did, need no processes at all for not smoking. Therefore, if somebody had eaten adequately just as a habit without having tried to change their diet, that person might not need any special processes or methods to eat adequately. Most stage of change studies have not addressed this issue, but the study of process of change should. We want to identify the processes used by those who have cognitively changed their dietary habits. Glanz and collegues (1994) did consider past experience for changing dietary behavior, but only to assign people into pre-action stages.

Another important difference from smoking cessation in this study is how "relapser" is defined. People who have had an unsuccessful experience with changing a particular behavior likely think and behave differently from people currently trying to change. Studies for smoking cessation have reported a clear pattern of processes used by people across each of the five stages, when relapsers were removed (Prochaska et al., 1991; Prochaska et al., 1994). Our findings showed "relapsers" had higher use of self reevaluation and lower health commitment/action processes than did people in pre action stages. We interpret this to mean that relapsers think a lot about eating fruits or vegetables, but do not commit. If so, this has implications for nutrition educators in that we need to find ways to help relapsers commit to making small changes in their diets.

The "maintenance group by change" had higher scores than "maintenance by habit" for the process of health concerns, self reevaluation and health commitment/action for eating vegetables. This could mean that if people think they have eaten enough vegetables, without having had the experience of trying to do so, they do not need many

processes to change or maintain intake. Surprisingly, for eating fruit, no processes differed between maintenance by habit and maintenance by change. The reason for this is unknown, and perhaps, the processes for eating fruit might be more affected by other factors such as intention, perceived current intake and availability, rather than by past experience when compared to processes for eating vegetables. Another possibility is that we have not adequately captured important processes for eating enough fruit.

Strengths and limitations.

The findings in this study are likely generalizable to young adult college women. Because the use of processes of change can differ by health behavior and demographics, further work is necessary to explore processes of change for men and for limited income groups. These findings need to be repeated with a larger number of people, because a small number in certain stages can lead to loss of statistical power to detect differences where they exist. Furthermore, longitudinal studies are necessary to find the true changes in use of processes for changing behaviors and to identify more detailed information about people assigned to specific stages, including relapsers or people in maintenance.

One of the strengths of this study was the separation of eating fruits from eating vegetables for all instruments. Our data clearly support the different processes for eating enough fruits and eating enough vegetables.

F. IMPLICATIONS FOR RESEARCH AND PRACTICE

Nutrition educators should consider that young adults are much less aware of the health benefits of fruits and vegetables compared to older adults. Our findings suggest that for those in pre-action stages some strategies nutrition educators should try with

young adults include self-evaluation of their fruit and vegetable intake. Other processes to promote adequate fruit and vegetable intakes include use self rewards such as feeling healthy and keeping fruits and vegetable around to substitute for high fat foods. Health concerns would be a good strategy to promote adequate vegetable intakes, but not fruit intakes. People who are relapsers and those in maintenance by habit should be identified, so nutrition educators can develop and apply effective intervention techniques. It is important to identify the processes of change matched to each stage to develop effective intervention techniques to help people eat enough fruits and vegetables for good health.

Table 1. Factor correlation and reliability of each construct

	HC	SR	SL	HCA	IC	ER	HR
1. I think about information regarding future health problems from not eating enough ____	.70[a](.71)[b]						
2. I think about information I have seen about eating enough _____	.65(.66)						
3. I pay attention to information on how to eat enough ____	.60(.56)						
4. Warning about health problems of eating too few ____ cause me concern.	.54(.64)						
5. I think about how my social group could benefit health-wise, if members would eat enough __	.61(.57)						
6. I get upset when I remember research about illnesses associate with eating too few ___	.63(.64)						
7. I feel healthy when I eat enough ____ each day		.84(.82)					
8. I feel good about myself when I eat enough _____		.86(.85)					
9. I have recently evaluated whether I eat enough _____		.51(44)					
10. When I eat enough ____, I believe I am doing something nice for myself		.78(.82)					
11. I find society supportive of people eating enough _____			.55(.56)				
12. I find society changing in ways that make it easier to eat enough _____ in my diet			.66(.68)				
13. Many people I know are eating enough _____			.51(.58)				
14. I see eating enough ____ being promoted in my community			.58(.66)				
15. I make commitments to eat enough _____				.73(.73)			
16. Instead of eating "unhealthy" foods, I eat ____				.63(.66)			
17. I am decreasing my fat intake, so I am purposely eating enough _____				.76(.81)			

Table 1. Factor correlation and reliability of each construct (cont'd)

	HC	SR	SL	HCA	IC	ER	HR
18. I eat _____ instead of other foods to lose or maintain my weight				.74(.80)			
19. I try to keep ____ around my place, in case I feel like eating something				.73(.61)			
20. I have given up eating with people who mostly eat too few ___					83(.85)		
21. I associate with people who help me eat enough _____					.60(.59)		
22. I leave place where people are eating high fat foods instead of eating _____					.71(.66)		
23. Other people will be pleased if I eat enough _____						.60(.64)	
24. Other people in my life try to make me feel good when I eat enough _____						.93(.90)	
25. I can expect to be praised by others when I eat ____						.60(.56)	
26. Someone cares whether I get enough _____							.61(.58)
27. I have someone who listens when I need to talk about eating ____							.59(.61)
28. Others encourage me to eat enough _____							.63(.65)
29. I have someone I can rely on to support my decision to eat enough ___							.70(.67)
Reliability	.79(.80)	82(.81)	.69(.71)	84(.84)	75(.73)	74(.74)	73(.73)

HC: Health Concerns, SR: Self Reevaluation, SL: Social Liberation, HCA: Health Commitment/Action, IC: Interpersonal Control, ER: External Reinforcement, HR: Helping relationship

[a]Outside of parenthesis: correlation for fruit

[b]Inside of parenthesis: correlation for vegetable

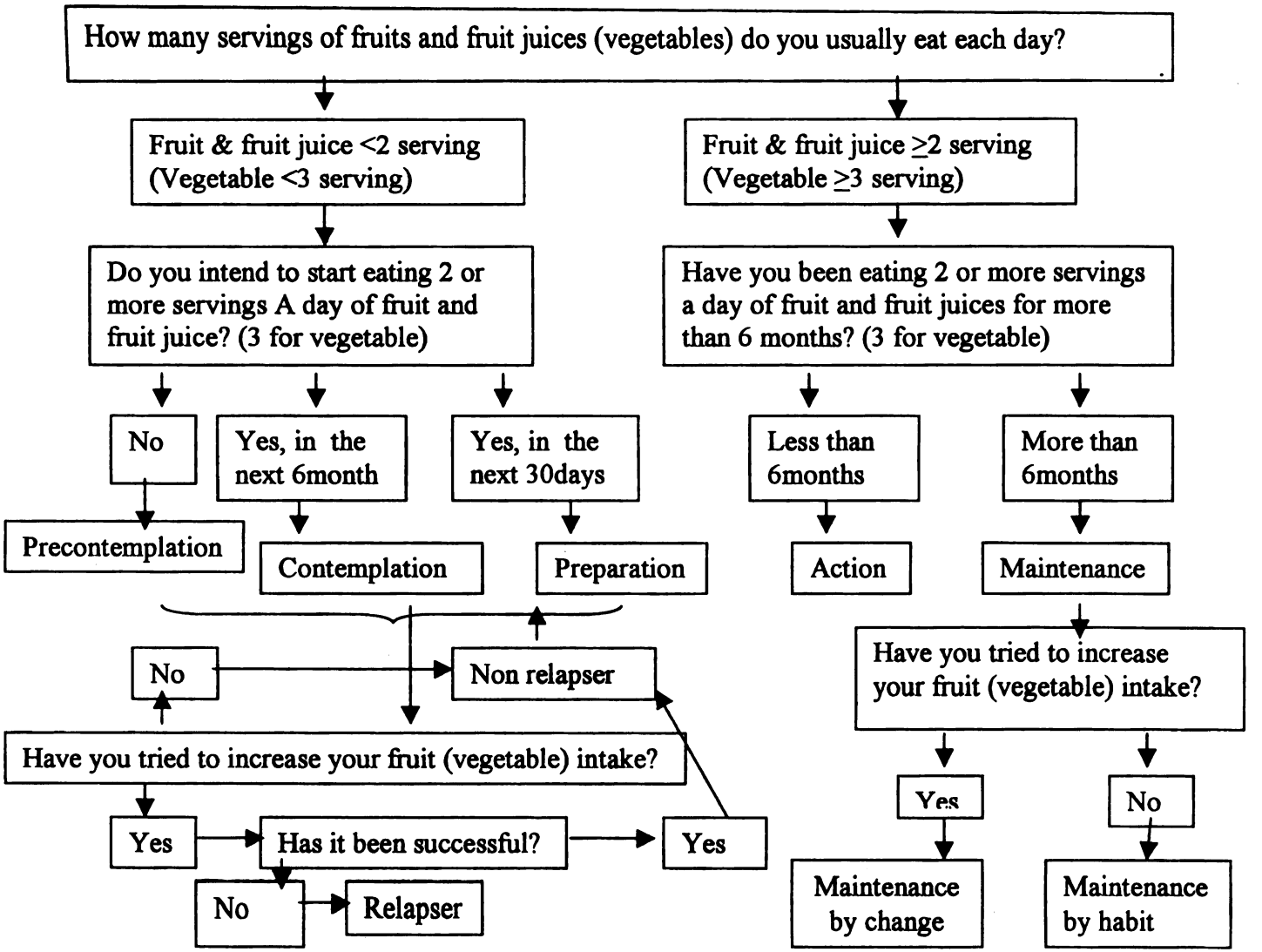


Figure 1. Stages of Change algorithm for eating fruits and vegetables.

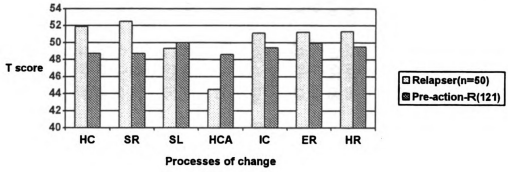


Figure 2. Comparison of processes of change (standardized T-scores) for eating vegetable – Relapser vs Pre-action -R

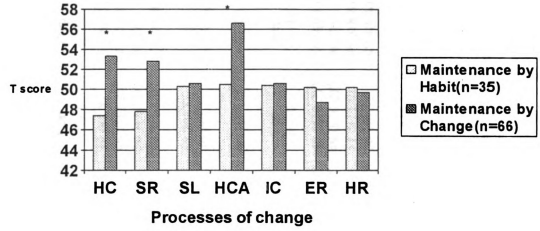


Figure 3. Comparison of processes of change (standardized T-scores) eating vegetable Maintenance by habit vs Maintenance by change

*Significant different between groups ($p<0.05$)

HC: Health concerns
SR: Self reevaluation
SL: Social liberation
HCA: Health commitment/action
IC: Interpersonal control
ER: External reinforcement
HR: Helping relationship

Table 2. Average T-scores (Standard Deviation) of the seven processes of change for stages of change by self-rated fruit and vegetable intake

Fruits	Stage of Change							
Processes of change	Relapser[1] n=43	Precon n=11	Con n=21	Prep n=24	Act n=45	Main(Change)[2] n=109	Main(Habit)[3] n=37	F value
Health Concerns	48.6(10.4)	46.6(11.4)	49.0(8.8)	50.0(9.5)	51.5(8.9)	51.3(10.5)	48.3(9.7)	1.06
Self-reevaluation	49.3(9.1)^{b}	39.2(8.4)^{a}	46.5(12.2)^{ab}	49.3(9.0)^{ab}	52.3(10.8)^{b}	51.6(10.1)^{b}	49.5(7.4)^{b}	3.69**
Social-liberation	47.6(9.7)	50.6(10.3)	50.1(11.5)	52.7(11.9)	51.5(10.1)	49.7(10.0)	50.2(7.9)	0.89
Health Commitment /Action	43.8(9.3)^{ab}	38.3(5.1)^{a}	43.5(10.6)^{ab}	49.2(7.6)^{bc}	50.4(10.2)^{c}	54.3(8.2)^{c}	52.6(9.7)^{c}	13.01***
Interpersonal Control	49.9(11.5)	44.6(6.1)	48.7(9.3)	52.2(13.2)	50.0(8.8)	50.2(9.9)	50.8(9.2)	0.83
External Reinforcement	50.4(9.4)	47.4(10.8)	49.0(9.7)	50.9(10.2)	48.6(11.0)	51.1(10.5)	49.0(8.1)	0.62
Helping relationship	49.8(9.7)	47.6(8.8)	49.1(10.5)	49.1(10.0)	49.8(11.1)	50.6(10.2)	50.6(9.2)	0.25
Vegetables	Stage of Change							
	Relapser[1] n=50	Precon n=50	Con n=30	Prep n=41	Act n=20	Main(Change)[2] n=66	Main(Habit)[3] n=35	F value
Health Concerns	51.9(9.8)^{ab}	46.4(10.6)^{a}	49.5(10.2)^{ab}	50.9(9.8)^{ab}	46.9(10.0)^{ab}	53.3(9.3)^{b}	47.4(8.6)^{ab}	3.46**
Self Reevaluation	52.5(9.0)^{ab}	47.0(10.7)^{a}	49.0(10.2)^{ab}	50.7(9.1)^{ab}	46.5(13.4)^{ab}	52.3(9.8)^{b}	47.8(7.5)^{ab}	3.00**
Social Liberation	49.3(8.9)	49.5(10.5)	51.8(11.0)	49.3(8.8)	48.3(10.8)	50.6(11.1)	50.3(9.0)	0.39
Health Commitment/Action	44.5(7.0)^{a}	47.0(10.3)^{a}	50.1(8.9)^{a}	49.4(9.8)^{a}	50.4(11.8)^{ab}	56.6(8.8)^{b}	50.5(9.3)^{a}	9.31***
Interpersonal Control	51.1(9.9)	47.2(8.1)	50.9(14.1)	51.1(10.7)	47.2(7.5)	50.6(10.2)	50.4(8.3)	1.17
External Reinforcement	51.2(9.0)	47.7(8.4)	50.8(10.7)	51.8(10.6)	50.5(11.4)	48.7(10.9)	50.2(9.3)	1.02
Helping relationship	51.3(9.2)	49.2(9.9)	48.6(10.5)	50.3(10.6)	50.7(11.5)	49.7(10.1)	50.4(10.0)	0.30

Different superscripts in the same row (a,b,c,d) indicate significant differences (<0.05) between groups.

1: People in pre-action stages with unsuccessful experience of increasing fruit or increasing vegetable

2: People in maintenance stage with past experience of increasing fruit or increasing vegetable

3: People in maintenance stage without past experience of increasing fruit or increasing vegetable

Chapter Five

Self-efficacy and health behaviors are associated with young adults' fruit and vegetable consumption

A. ABSTRACT

Background This study is to determine the self-efficacy, demographics, psychosocial factors and health behaviors associated with eating inadequate amounts of fruits and vegetables in young adults.

Method Demographics, psychosocial factors and fruit and vegetable intakes from a three-day food record were collected from 294 college students. Less than 2 servings of total fruits, or fruits excluding juice, and less than 3 servings of total vegetables, or vegetables excluding fried potatoes, were used as inadequate intakes to conduct multivariate logistic regressions controlling for gender, race, residency and energy intake.

Results. Fifty-eight and 82% of the respondents reported inadequate total fruits or fruits excluding juice, respectively. Fifty-three and 63% reported inadequate total vegetables or vegetables without fried potatoes. College students who were female, non-smokers, lived in a campus residence hall, ate breakfast more often, and exercised regularly, were less likely to eat inadequate amounts of fruits than those who were not. Successful experiences with increasing fruits and past experience with increasing vegetables, regardless of success, were positive predictors for fruit and for vegetable intakes, excluding fried potatoes. Self-efficacy was inversely associated with risk for inadequate consumption of both fruits and vegetables. Increasing discretionary fat consumption was associated with an increased risk for inadequate fruit intakes, but not vegetable intakes.

Conclusion Eating fruits is associated more with other healthy behaviors than is eating vegetables in young adults. Only self-efficacy was positively associated with both fruit and vegetable intakes.

Key Words: fruits; vegetables; healthy behaviors, self-efficacy, fat

B. INTRODUCTION

Due to the health benefits associated with fruits and vegetables (Steinmetz and Potter, 1996; Ness and Powles, 1997), eating two or more servings of fruits and three or more servings of vegetables a day has been a public health recommendation in the Food Guide Pyramid, the Dietary Guidelines, Healthy People 2010 and the Five-A-Day promotion (USDA & USDHHS, 1992; USDA & USDHHS, 1990; National Research Council, 1989; U.S. Department of Health and Human Services, 1991; Subar et al., 1995). Several studies, however, have reported that actual fruit and vegetable consumption in the United States is considerably less than that recommendation (Krebs-Smith et al., 1995a; Krebs-Smith et al., 1996). Dietary data from 8181 adults (>20 yr old) in the USDA's 1989-1991 Continuing Surveys of Food Intakes by Individuals (CSFII) over three days showed only 32% met the objective of five or more servings of fruits and vegetables per day (Krebs-Smith et al., 1995a). Assessments of the 3148 children and adolescents from the 1989-1991 CFSII data demonstrated only 20% ate more than five servings of fruits and vegetables (Krebs-Smith et al., 1996).

Early practice of sound dietary habits in young adulthood is associated with reduced risk for chronic disease later in life (Raitakari et al., 1994). Young adults in college are in a transitional period between living and eating at home and living on their

own and feeding themselves (Lau et al., 1990). Furthermore, young adults have the necessary mental processing equipment to consider future health risks while preadolescent children are less likely to do so (Domel et al., 1996). Therefore, efforts to establish well-founded health habits, including dietary behaviors, during this time of life should have positive long-term health consequences. Although the importance of developing healthy dietary habits at this time has been emphasized, young adults' intakes of fruits and vegetables remain low (Georgiou et al., 1997).

Knowing which factors are particularly associated with inadequate intakes of fruits and of vegetables in specific populations can be useful to target interventions to increase intakes of fruits and vegetables. Although several studies about dietary behaviors, including some on fruit and vegetable consumption, have been done with college populations (Betts et al., 1997; Keim et al., 1997), little has focused on factors associated with inadequate fruit and vegetable intakes.

There have been a few studies in several populations on determinants of psychosocial factors related to eating fruits and vegetables. A study of attitudes toward fruit and vegetable consumption in a population from the Special Supplemental Food Program for Women, Infants, and Children (WIC), for example, showed positive perceptions of fruits and vegetables were important to intakes (Treiman et al., 1996). Investigators also reported barriers to increasing consumption, such as a lack of availability, the time and effort to prepare fruits and vegetables, and preferences for other foods. In a study of randomly sampled Washington State residents, nutrition behavior scores largely depended on barriers to fruit and vegetable intakes. In the Washington study, elements of the Health Belief Model -- including benefits of and barriers to fruit

and vegetable intakes, and susceptibility to cancer and nutrition concerns -- explained 16% of the variance of fruit and vegetable intakes (Dittus et al., 1995). In another study with adolescents, inadequate fruit and vegetable intakes were associated with low socioeconomic status, low family connectedness, weight dissatisfaction and poor academic achievement (Neumark-Sztainer et al., 1996). In studies of Dutch adults, self-efficacy was significantly associated with consumption of cooked vegetables, salads or fruits (Brug et al., 1995; Lechner et al., 1997). Studies by Brug and Lechner separated vegetables into sub-categories, such as boiled vegetables and salads, because the researchers proposed different patterns of psychosocial factors associated with these sub-categories of vegetables. In fact, due to high fat content, fried potatoes have often been excluded from vegetable consumption in studies, including the 5-A-Day National research program (Calvert et al., 1997; Smith-Warner et al., 1997; Serdula et al., 1993; Thompson et al., 1999). Although fruit juice was included in the 5-A-Day studies, it can be viewed more as a beverage than a fruit by consumers and thus its intake might be associated more with different psychosocial factors than whole fruits.

In order to help plan effective interventions, the purpose of this study was to identify relationships between inadequate fruit and vegetable intakes and concomitant psychosocial factors in collegiate young adults. Furthermore, such possible associations were examined by separating fruit juice from fruits and fried potatoes from vegetables.

C. METHODS

Subjects

A convenience sample of subjects aged 18-24 years was recruited from two introductory nutrition classes at a large, north central land grant university during the winter. A total of 360 subjects (response rate=51%) completed the survey at the baseline. Subjects with incomplete dietary data (n=66) were excluded, as were 44 subjects with only two days of records. Data were usable from 294 people.

Procedure

After receiving approval from the University Committee on Research Involving Human Subjects, consent forms and a set of instruments about fruits and vegetables were distributed to interested participants. The instruments included demographics, psychosocial factors associated with fruit and vegetable intakes and 3 days of food records. Subjects reported three days of food intake for two weekdays and one weekend day. Detailed instructions for recording food intakes were provided to increase the accuracy of the records. Subjects were instructed to report all the food they ate. As an incentive, extra points toward class grades were given for complete questionnaires.

Instruments

Demographics

Respondents were asked to report their gender, place of residence, race/ethnicity, nutritional supplement use, smoking, drinking, physical activity, volunteer activities and employment. Subjects could choose from the following race/ethnic groups: White, Black, Hispanic, American Indian/Alaska Native, Asian/Pacific Islander and other. Supplement use, smoking, drinking, regular physical activity, volunteer activities and employment were dichotomous variables answered as yes or no.

Psychosocial factors

Weight satisfaction was measured using the five-point Likert scale from "very satisfied" to "very unsatisfied". "Very satisfied" and "satisfied" were coded as "satisfied" and "very unsatisfied" and "unsatisfied" were as "unsatisfied".

Instruments for decisional balance and self-efficacy developed by a ten-state research project team for use with young adults were used (Betts et al., 2000). Decisional balance consists of 18 items including 10 cons (perceived barriers) and 8 pros (perceived benefits) items. Items for decisional balance included external motivation/barriers, health concerns, weight control and other factors. A five-point Likert scale, ranging from "not at all important" to "very important" was used for decisional balance. In this study, Cronbach's α for pros was 0.73 for fruits and 0.72 for vegetables. For cons, 0.71 was for fruits and 0.72 was for vegetables.

Self-efficacy to eat the recommended serving number of fruits and vegetables was asked using 5 items with 5 point Likert responses from "not at all confident" to "very confident". Cronbach's α for self-efficacy items was 0.79 for fruits and 0.77 for vegetables.

To analyze the psychosocial factors, standardized T-scores were calculated for the pros (perceived benefits), the cons (perceived barriers) and self-efficacy (mean-50, SD-10). This transformation resulted in comparable scores correcting for different levels of dispersion among the variables.

Food Records - Fruit and vegetable servings

To assess past experience with changing fruit and vegetable consumption behaviors, subjects were asked, "Have you tried to increase your fruit/vegetable intake?" If subjects

answered "yes", they were asked if their efforts were successful. All questions were asked for fruits and vegetables separately.

From the three-day food records, average servings of food groups and discretionary fat were calculated based on the database from the 1994-96 USDA Continuing Survey of Food Intakes by Individuals (CSFII) (U.S. Department of Agriculture, 1998). The Expanded Food and Nutrition Education Program (EFNEP) Evaluation/Reporting System (ERS) (U.S. Department of Agriculture, 1994) was selected as the nutrition software. The first author supervised dietetic students who performed the dietary data entry and checking with the ERS software. This EFNEP software can calculate food group servings, energy intake and nutrients. The EFNEP Evaluation/Reporting System (ERS) has an accessible database for corrections and results can be exported easily for further statistical analysis. Because the ERS was developed prior to the release of the CSFII, some discrepancies were found between the servings in the CSFII and those in the ERS. Therefore, the database of the ERS for foods counting fruits and vegetables was revised using the Microsoft Access program using the CSFII servings as the standard. For the ERS revision, first the USDA food code for each food in the ERS was recorded using Codebook Search (CBSRCH) in the 1994-96 CSFII CD-Rom to match the food names between the ERS and the CSFII. Then, the CSFII food-serving database was searched by USDA food code. Food servings per unit of food were calculated, because the CSFII serving database used 100g of food. If the weight per unit of food in the ERS differed from the CSFII, the CSFII weight of food was selected. Some foods in the ERS could not be matched to foods in the CSFII. In that case, a CSFII food was matched to a food based on an equivalent or similar composition of ingredients.

Analysis

The Statistical Package for Social Science (version 7.5 for Windows) was used for data analysis. Logistic regressions for the odds ratio of fruit and vegetable intakes were run separately, coding fruit and vegetable consumption, the dependent variables, as "adequate" or " inadequate". Inadequate intake for fruits was less than two servings; for vegetables, three servings. Separate logistic regressions were conducted for two servings of fruits, excluding fruit juice, and three servings of vegetables, excluding fried potatoes. An odds ratio of 1.00 indicated no association, if the value 1.00 was included within the 95% confidence interval, i.e., the association was not significant ($p<0.05$). The magnitude of deviation from 1.00 in either direction shows the strength of the association, with the direction from 1.00 depending upon the reference group.

Energy intake was adjusted for all the demographic information due to significant relationships between fruit and vegetable servings and energy intake. Logistic regressions for psychosocial factors and food groups were conducted controlling for energy intake, gender, race and residency to exclude the effects of those factors. Odds ratios were calculated using a standardized score increment of 10 for the psychosocial factors, using 1 serving increments for each food group, and using increments of 10 grams of discretionary fat.

D. RESULTS

The characteristics of the participants are presented in **Table 1**. Eighty percent of the subjects were female and 86% were white. Sixty-seven percent of the females lived in campus residence halls. The percent of residency and weight satisfaction differed significantly between men and women by Chi-square test. Women were more likely to

live in residence halls and were not more likely to be satisfied with their own weight in this population. **Table 2** presents the mean scores and standard deviations of psychosocial factors before standardization, and of the food group intakes by gender. Reported intakes of all food groups, except total fruits and fruits without fruit juice, differed between male and female by independent t-test ($p<0.001$). Discretionary fat and energy intake was also higher in males. However, when energy intake was adjusted, significant differences by gender remained only for intakes of meat, total fruits and fruits excluding fruit juice.

Percentages of respondents reporting less than two servings of total fruit and of fruit excluding fruit juice consumption from a three-day food record were 58% and 82%, respectively. Likewise, 53% reported less than three servings of total vegetables and 63% reported less than three servings of vegetables excluding fried potatoes. **Table 3** represents the odds ratios for less than two servings of fruits with and without juice and for less than three servings of vegetables with and without fried potatoes when energy intake was adjusted. Race, drinking alcohol, vitamin/mineral supplement use and weight satisfaction were not associated with either fruit or vegetable consumption. Gender was associated with fruit consumption, with females at a lower risk for inadequate total fruit consumption (OR=0.30, $p<0.001$). Those living in residence halls were at a lower risk for less than two servings of fruit consumption either with or without juice (OR=0.36, OR=0.40, $p<0.001$). Because women were more likely to live in residence halls in this population, the odds ratio for gender was further adjusted by residency. Then, gender was still associated with inadequate total fruit intake, but not with inadequate fruit without juice intake (data not shown in Table 3). Smoking was negatively associated and

physical activity was positively associated with eating total fruits and fruits without juice. Eating breakfast one more day of the week was associated with an 18% lower risk for less than two servings of total fruits and of fruits without juice. Successful experience for increasing fruits had the lowest odds ratio for less than two servings of fruits with juice or without juice. For vegetables, only past experience for increasing vegetables was significantly associated with vegetables without fried potato consumption.

The odds ratios for the effects of psychosocial factors and intake of other food groups on fruits and vegetables are in **Table 4**. Only self-efficacy was positively associated with both fruit and vegetable intakes. Ten standardized score increments of perceived benefits (pros) and self-efficacy was significantly associated with a 38% and 45% lower risk for inadequate fruit consumption and a 37% and 59% lower risk for less than two servings of fruits without juice, respectively. Perceived barriers were negatively associated with fruit intake without juice. For vegetables, self-efficacy was associated with both total vegetables and vegetables without fried potatoes, and pros were associated with only vegetables without fried potatoes.

Increments of 10g discretionary fat were associated with an increased risk for eating less than two servings of fruits, either with or without juice. Eating more servings of fried potatoes showed an increased risk for inadequate fruit intakes, whether fruit juice was included or not. Drinking more juice also had an association with increased risk for inadequate vegetable intakes, but only when fried potatoes were separated. Although total fruit intake was not associated with vegetable intake without fried potatoes, and total vegetable intake was not associated with fruit intake, consuming more fruits without juice was associated with increased vegetable intake excluding fried potatoes.

E. DISCUSSION

These findings demonstrated that self-efficacy had the strongest positive association with both fruit and vegetable intakes, whether or not juice or fried potatoes were included, regardless of race, gender, energy intake and place of residence. The pros and cons from decisional balance were also associated with fruit and vegetable intakes, although not as strongly as self-efficacy. Several other investigators have reported similar associations of self-efficacy with fruit and vegetable intakes in different populations (Brug et al., 1995; Dittus et al., 1995; Havas et al., 1998; Baranowski et al., 1999), making self-efficacy for fruits and vegetables an important concept for health professionals to address with clients. Dittus and colleagues found perceived barriers from the Health Belief Model (HBM) to be the strongest predictor of fruit and vegetable intakes (Dittus et al., 1995). However, cons were associated only with fruits without juice in this study.

In the present study, perceived benefits (pros) were associated with fruit intake with or without juice, but only with vegetables when fried potatoes were excluded. This might support somewhat different patterns of psychosocial factors for certain sub-categories of fruits and vegetables, because fruit juice can also be considered as a beverage, and fried potatoes as a high fat food. The results of food group analysis also supported this different pattern of fruit juice and fried potatoes, which might reflect consumers' differing perceptions of them.

Another noticeable finding from this study was that the behavior of eating fruits was more associated with other healthy behaviors compared to the behavior of eating vegetables. Living in residence halls, not smoking, exercising regularly, and eating

breakfast and less discretionary fat were significantly associated with only fruit consumption, but not with vegetable consumption. Other studies with adolescents have found gender differences for inadequate intakes of fruit and vegetable, as we did, but without adjusting for total energy (Neumark-Sztainer et al., 1996; Story et al., 1998). Our data showed that living in campus residence halls might be beneficial for eating adequate fruits. Vegetable intake, however, was not affected by place of residence.

Smoking and regular exercise were related to only fruit consumption. Another study also demonstrated that exercisers more frequently met the Food Guide Pyramid recommended fruit intakes than non-exercisers (Georgiou et al., 1996). Similarly, Neumark-Sztainer and colleagues reported smoking and drinking alcohol were related to both inadequate fruit and vegetable consumption in adolescents (Neumark-Sztainer et al., 1996). In this present study with young adults, however, eating vegetables was not related to other healthy behaviors.

Eating breakfast has often been reported to relate to other healthy dietary behaviors such as low fat intake (Schlundt et al., 1992; Huang et al., 1997). Our findings supported an association of breakfast eating with adequate fruit consumption. One more day of eating breakfast was associated with decreasing the risk of eating less than two servings of fruits, with or without juice. Added discretionary fat was negatively associated only with fruit consumption. Billson and colleagues also showed a negative association between fruit and vegetable consumption and "other fat" using quintile groups of fruits and vegetables (Billson et al., 1999). The investigators did not indicate whether fruits or vegetables or both were related to "other fat", because they used combined fruit and vegetable consumption for analysis.

Past experience to increase vegetable intake and past successful experience to increase fruit intake were strong predictors for the consumption of vegetables and fruits. This result for vegetables was significant only when fried potatoes were excluded. Just trying to increase intakes of vegetables or fruits seems to be good indicators for eating the recommended number of servings. The importance of past success to dietary change has also been reported in a study about fat and fiber (Glanz et al., 1993).

A major strength of this study was the separation of fruits and vegetables in the examination of factors predicting their intake. Findings imply that different intervention strategies are needed to promote eating fruits or eating vegetables.

The use of three-day food record from which to estimate dietary intake was both a strength and limitation in this study. Three days of total intake, a large respondent burden, is a larger number of days than even national surveys are now using, but a smaller number than some report as necessary to capture usual intake of fruits and vegetables (Baranowski et al., 1997). Likewise, subject selection bias due to this high respondent burden might have also affected the results.

Due to using a convenience sampling from a nutrition class with mostly white women, we cannot generalize our results to all college students. Several studies for inadequate fruit and vegetable consumption have supported differences by ethnic group (Neumark-Sztainer et al, 1996; Havas et al., 1998). To verify these findings with other demographic groups, further studies are needed.

In conclusion, health behaviors such as not smoking, regular exercise and frequent breakfast eating were associated with fruit consumption. Less discretionary fat consumption was related to only fruit consumption. Future studies of fruit and vegetable

dietary behaviors should consider the sub-categories of fruit juice and fried potatoes separated from total fruits and vegetables.

Table 1. Percentage of participants by demographics and health behaviors

Variables	Men (n=58)	Women (n=236)
Race		
White	89.7	84.7
Non-white	10.3	15.3
Residency**		
Residence halls	48.3	66.9
Others	51.7	33.1
Smoking		
Yes	12.1	17.5
No	87.9	82.5
Alcohol drinking		
Yes	77.6	66.4
No	22.4	33.6
Exercising regularly		
Yes	65.5	65.0
No	34.5	35.0
Employment or volunteer activity		
Yes	55.2	63.6
No	44.8	36.4
Vitamin/mineral supplement use		
Yes	54.4	41.7
No	45.6	58.3
Weight satisfaction***		
Satisfied	69.4	37.9
Unsatisfied	30.6	62.1
Past experience to increase fruit		
Yes	74.1	75.7
Successful experience to increase fruit		
Yes	62.8	69.3
No	37.2	30.7
No	25.9	24.3
Past experience to increase vegetable		
Yes	58.6	64.0
Successful experience to increase vegetable		
Yes	60.6	68.4
No	39.4	31.6
No	41.4	36.0

** $p<0.01$, group difference by Chi-square
*** $p<0.001$, group difference by Chi-square

Table 2. Average of psychosocial factors, food group intakes and frequency of breakfast eating by gender (Mean ± Standard deviation)

Psychological variables[1]	Men (n=58)	Women (n=236)
Fruit		
Pros (perceived benefit)**	3.35±0.70	3.64±0.66
Cons (perceived barrier)	2.43±0.65	2.52±0.69
Self-efficacy	3.71±0.77	3.76±0.82
Vegetable		
Pros (perceived benefit)**	3.33±7.11	3.63±0.65
Cons (perceived barrier)	2.46±0.65	2.56±0.69
Self-efficacy	3.47±0.76	3.57±0.83
Food group (unit)[2]		
Meat (1 oz Meat Equivalent(ME))***	6.04±3.54	3.14±2.02
Dairy (serving)***	2.81±2.29	1.69±1.27
Bread (serving)***	8.36±3.30	6.00±2.31
Total fruit (serving)	1.91±2.02	1.97±1.63
Fruit without juice (serving)	0.86±1.33	1.11±1.12
Total vegetable (serving)***	3.93±2.63	2.90±1.66
Vegetable without fried potato (serving)***	3.19±2.63	2.53±1.50
Discretionary fat (gram)***	59.4±26.4	40.5±21.0
Energy intake (kcalorie)***	2393±855	1629±524
Frequency of eating breakfast/week[3]	3.6±2.3	3.4±2.3

1: Based on the average of 8 questions for pros, 11 questions for cons and 5 questions for self efficacy, each on a scale of 1 through 5. 1 - not at all important to 5 - very important to eat fruit/vegetable in pros and cons, 1 – not at all confidence to 5 – very confidence to eat at least 2 servings of fruit/ 3 servings of vegetable in self-efficacy.

2: Calculated from 3-day food records based on Continuing Survey of Food Intake for Individual (CSFII) food servings

3: 0-7 were answered as frequency of breakfast per week

** Significantly different between male and female at p value <0.01, t-test.

*** Significantly different between male and female at p value <0.001, t-test.

Table 3. Odds Ratio and 95% confidence intervals[1] for inadequate consumption of fruits and of vegetables by demographic and personal factors after adjusting energy intake

Variables	Reference	Fruit		Vegetable	
		Total fruit[2]	Fruit w/o juice[3]	Total vegetable[4]	Vegetable w/o fried potato[5]
		OR (CI)	OR(CI)	OR(CI)	OR(CI)
Race	White	1.40 (0.70-2.78)	2.34 (0.79-6.90)	0.86 (0.44-1.71)	0.83 (0.41-1.64)
Gender	Male	0.30 (0.14-0.62)***	0.41(0.16-1.04)	0.82 (0.41-1.63)	1.06 (0.54-2.07)
Residency	Others	0.36 (0.21-0.60)***	0.40 (0.20-0.81)**	0.92 (0.55-1.51)	1.07 (0.65-1.77)
Smoking	No	2.18 (1.09-4.35)*	2.07 (0.77-5.53)	0.86 (0.45-1.64)	0.91(0.47-1.76)
Alcohol drinking	No	1.62 (0.98-2.70)	1.12 (0.59-2.12)	0.68 (0.40-1.15)	0.65 (0.38-1.11)
Exercising regularly	No	0.79 (0.48-1.31)	0.37 (0.18-0.78)**	0.92 (0.56-1.53)	0.70 (0.41-1.17)
Vitamin/mineral supplement use	No	0.85 (0.53-1.36)	1.49 (0.81-2.76)	0.91(0.56-1.49)	0.95 (0.58-1.55)
Weight satisfaction	Satisfied	1.11(0.64-1.92)	1.48 (0.74-2.96)	0.99 (0.57-1.74)	1.06 (0.61-1.87)
Past experience to increase	No	0.64 (0.36-1.12)	0.56 (0.26-1.21)	0.80 (0.49-1.33)	0.48 (0.28-0.81)**
Successful experience to increase	No	0.19 (0.10-0.38)***	0.17 (0.06-0.49)***	0.56 (0.29-1.11)	0.59 (0.30-1.17)
Frequency of eating breakfast	1 time increase	0.82 (0.73-0.91)***	0.82 (0.72-0.94)**	1.14 (1.00-1.28)	1.07 (0.96-1.20)

*** <0.001, **<0.01, *<0.05

1: All odds ratios were adjusted by energy intake

2: Fruit & fruit juice (< 2 serving (n=170) versus ≥ 2 serving (n=124))

3: Fruit excluding fruit juice (< 2 serving (n=240) versus ≥ 2 serving (n=54))

4: Vegetable & fried potato (< 3 serving (n=155) versus ≥ 3 serving (n=139))

5: Vegetable excluding fried potato (< 3 serving (n=185) versus ≥ 3 serving (n=109))

Table 4. Odds Ratio and 95% confidence intervals[1] for inadequate consumption of fruits and of vegetables by psychosocial variables and other food groups

Variables	Fruit		Vegetable	
	Total fruit[2] OR (CI)	Fruit w/o juice[3] OR(CI)	Total vegetable[4] OR(CI)	Vegetable w/o fried potato[5] OR(CI)
Psychological factors	10 standardized T-score increment			
Pros	0.72 (0.56-0.94)*	0.63 (0.44-0.88)**	0.86 (0.67-1.10)	0.77 (0.60-0.99)*
Cons	1.16 (0.90-1.49)	1.42 (1.02-2.00)*	1.17 (0.91-1.50)	1.11 (0.87-1.43)
Self-efficacy	0.55 (0.42-0.73)***	0.41(0.28-0.60)***	0.60 (0.46-0.78)***	0.59 (0.45-0.77)***
Food groups	1 oz ME (meat group) or 1 serving increment (other food groups)			
Meat	1.07 (0.95-1.20)	0.97 (0.85-1.12)	0.91 (0.81-1.02)	0.87 (0.77-0.98)*
Bread	0.98 (0.86-1.10)	0.94 (0.81-1.09)	1.07 (0.95-1.21)	1.04 (0.92-1.17)
Dairy	1.20 (0.97-1.48)	1.20 (0.93-1.54)	1.15 (0.92-1.42)	1.19 (0.97-1.46)
Fried potato	1.72 (1.15-2.57)*	1.96 (1.13-3.40)*		
Fruit juice			1.29 (0.99-1.68)	1.31 (1.01-1.70)*
Vegetable w/o fried potato	0.93 (0.80-1.08)	0.76 (0.63-0.91)**		
Fruit w/o juice			0.85 (0.67-1.08)	0.75 (0.59-0.93)*
	10 gram increment			
Discretionary fat	1.78 (1.42-2.21)***	1.55 (1.22-1.97)**	0.88 (0.74-1.05)	1.01 (0.85-1.19)

*** <0.0001, **<0.01, *<0.05

1: Adjusted for Energy intake, Gender, Race, Residence

2: Fruit & fruit juice (< 2 serving (n=170) versus ≥ 2 serving (n=124))

3: Fruit excluding fruit juice (< 2 serving (n=240) versus ≥ 2 serving (n=54))

4: Vegetable & fried potato (< 3 serving (n=155) versus ≥ 3 serving (n=139))

5: Vegetable excluding fried potato (< 3 serving (n=185) versus ≥ 3 serving (n=109))

Chapter Six

Report of Construct Validity by Three Staging Methods

This chapter was written as a report, not a manuscript, because it has supplementary information about the validity of the Stages of Change Theory for eating fruits and vegetables. Some of the findings related to validity were in Chapter Three and some of the information related to processes of change was in Chapter Four.

The purpose of this report was to establish construct validity by comparing the results of psychometric constructs with three staging methods tested for outcome validity. The differences for decisional balance, self-efficacy and processes of change by the stages are reported by Method A (Self-rated intake), Method B (Recall) and Method C (Food frequency) from Chapter Three. The methods for assessing decisional balance and self-efficacy were described in Chapter Five and the methods for processes of change in Chapter Four.

A. Results

For fruit and vegetable intakes, **Table 1** shows decisional balance (pros and cons) and self-efficacy across the five main stages of change plus stages for relapsers and those in maintenance by habit. Self-efficacy differed among the stages for both eating fruits and eating vegetables by all three methods ($p<0.001$), except Method B (24-hour recall) for vegetables. As expected, people in precontemplation and relapser stages had the lowest self-efficacy scores and those in maintenance, either by change or by habit, had the highest self-efficacy scores for both fruits and vegetables. For fruits, stages did not differ by scores for pros and cons by any staging methods, except for pros by Method B.

For Method B which used a recall, the pros were higher for preparation, action and maintenance compared to other stages. Only the scores for cons by staging Method C (food frequency) showed significant differences among the stages for vegetables. Those in precontemplation and relapser stages had high scores for cons and those in maintenance by change and by habit had low scores.

When the use of processes by stages was compared among three staging methods, similar results for processes of change were found by all three staging methods for fruit intake. However, for vegetables, use of processes by stages using Method B (24 hour recall) showed different results from those using Method A (self-rated intake) and Method C (food frequency).

Among the seven processes, mean scores for only two -- self-reevaluation and health commitment/action -- differed significantly across the stages for fruits (**Table 2**). For vegetables, mean scores for health concerns, self-reevaluation and health commitment/action differed significantly between stages by staging Method A (self-rated intake) and Method C (food frequency). The uses of self reevaluation and health commitment/action by those in precontemplation were lower than by those in post-actions stages for both fruit and vegetable intake. By Method B (24-hour recall), only the uses of health concerns and health commitment/action differed significantly by the stages.

For both fruits and vegetables, people who were relapsers tended to have high self-reevaluation scores and maintenance by change had the highest health commitment/action scores by all staging methods. For vegetables, relapsers showed high scores for health concerns compared to those in other stages, but for fruits, they did not.

B. Discussion

These findings demonstrated that a certain amount of construct validity exists between stages of change and psychosocial factors using all three staging methods for fruits and vegetables, except for Method B (24 hour recall) for vegetables. For fruit, similar pattern of pros, cons, self-efficacy and processes of change across stages were shown using all three staging methods. Therefore, staging method using a 24-hour recall (Method B) for fruit, which had the highest criterion validity (see Chapter Four), could be used to place people into appropriate stages based on the results from criterion validity and construct validity. However, for vegetables, staging B (24 hour recall) showed different patterns from those by Method A (self-rated intake) and staging Method B (food frequency). Such findings mean that although stages for fruit by either perceived intake (self-rated or food frequency) or a recall show similar patterns of psychometrics, stages for vegetables only by self-rated and food frequency show similar patterns, but those by a recall do not.

The strong relationships between self-efficacy and Stages of Change for fruit and for vegetable intake in this study replicated the results shown in studies for smoking cessation (De Vries et al., 1995). One study of self-efficacy for eating low-fat intake reported no difference in self-efficacy between the action and maintenance stages (Õupuus et al., 1999). Data from this present study also showed that the scores for self-efficacy between pre-action stages and post-action stages differed significantly, but did not differ within pre-action stages or within post-action stages. That is, the change in self-efficacy for fruits and vegetables occurs between the three pre- and two post-action stages.

Significant differences of pros and cons for eating low-fat were reported between precontemplation and maintenance stages (Ôupuus et al., 2000). Our data, however, did not show such results for either fruits or for vegetables, except for pros by Method B for fruits and for cons by Method C for vegetables. From the results, pros tended to increase and cons tended to decrease in advanced stages, which agrees with the results from other behaviors (Prochaska et al., 1994). This result support the hypothese that people in advanced stages consider pros more and cons less when they decide to eat fruits and vegetables.

Comparison of the three staging methods by mean scores for the processes of change among the stages of change showed similar relationships between stages and psychometric scales by all three methods for eating fruits. However, for eating vegetables, staging Method B (24-hour recall) did not show similar results to other staging methods.

These findings need to be repeated with a larger number of people, because a small number in certain stages can lead to loss of statistical power to detect differences where they exist. Furthermore, longitudinal studies are necessary to find the true changes in pros, cons, self-efficacy and use of processes for changing behaviors and to identify more detailed information about people assigned to specific stages, including relapsers or people in maintenance.

In Chapter Three, validity was established only based on a behavioral criterion. However, a behavioral criterion is not the only factor to assign people into appropriate stages, because Stages of Change has several dimensions to be determined (Prochaska and DiClemente, 1984b). Therefore, in this chapter, other psychosocial factors, e.g.,

other dimensions of Stages of Change, were considered to establish construct validity between stages and psychosocial factors by all three staging methods. From those considerations, staging Method B (24 hour recall) for fruit might be an appropriate staging instrument satisfying both criterion and construct validity. For vegetables, Method A (self-rated intake) and Method C (food frequency) had similar results for both criterion and construct validity. Method B for vegetables does not seem to be an appropriate staging method by any test of validity.

Table 1. Average T-scores [Mean (SD)] of decisional balance and self-efficacy by stages of staging Methods A,B & C

Fruit	Stages of change by method A (Self-rated intake)							
	Relapser[1] n=43	Precontemp n=11	Contemp n=21	Prep n=24	Act n=45	Main(change)[2] n=109	Main(habit)[3] n=37	F value
Self-efficacy	45.4(9.6)[a]	41.4(12.1)[a]	45.5(9.6)[a]	49.2(9.6)[ab]	49.9(9.7)[ab]	52.4(9.7)	54.8(7.1)[b]	6.71***
Decisional balance								
Pros	48.5(9.0)	48.6(9.5)	47.2(11.9)	53.8(10.5)	51.4(10.6)	50.9(10.2)	47.5(7.3)	1.76
Cons	50.9(9.8)	49.3(8.9)	51.7(9.7)	53.2(14.1)	50.1(10.3)	49.5(9.1)	47.7(9.5)	0.96
Fruit	Stages of change by method B (24 hour recall)							
	Relapser[1] n=51	Precontemp n=16	Contemp n=21	Prep n=68	Act n=27	Main(change)[2] n=70	Main(habit)[3] n=20	F value
Self-efficacy	43.9(9.0)[a]	44.5(14.9)[ab]	46.8(10.6)[ab]	51.8(9.0)[bc]	50.4(8.8)[abc]	53.8(8.9)[c]	53.1(9.0)[bc]	7.48***
Decisional balance								
Pros	47.1(10.0)	46.8(10.2)	48.4(10.2)	52.0(8.9)	51.5(10.2)	51.6(10.4)	48.1(10.0)	2.14*
Cons	50.0(8.5)	49.7(9.7)	51.0(9.6)	51.7(10.2)	50.1(12.0)	58.4(9.3)	50.3(13.2)	0.69
Fruit	Stages of change by method C (Food frequency)							
	Relapser[1] N=24	Precontemp N=15	Contemp N=26	Prep N=33	Act N=47	Main(change)[2] N=104	Main(habit)[3] N=38	F value
Self-efficacy	44.0(11.1)[a]	42.1(13.1)[a]	46.5(10.4)[ab]	48.3(8.0)[abc]	49.9(8.7)[abc]	53.1(9.6)[c]	52.5(8.0)[bc]	6.37***
Decisional balance								
Pros	48.2(10.4)	48.7(9.6)	47.1(11.3)	50.3(11.0)	51.4(9.7)	51.9(9.6)	47.3(8.2)	1.83
Cons	51.0(9.7)	51.4(9.7)	50.0(9.1)	49.5(11.1)	50.3(11.1)	50.0(9.4)	49.7(11.2)	0.10

Table 1. (cont'd) Average T-scores [Mean (SD)] of decisional balance and self-efficacy by stages of staging Methods A,B & C

Vegetable	Stages of change by method A (Self-rated intake)							
	Relapser[1] n=50	Precontemp N=50	Contemp n=30	Prep n=41	Act n=20	Main(change)[2] n=66	Main(habit)[3] n=35	F value
Self-efficacy	45.8(8.4)[a]	47.1(10.8)[ab]	49.4(9.4)[abc]	50.9(10.0)[abc]	50.6(9.2)[abc]	54.0(9.3)[c]	52.5(10.0)[bc]	4.70***
Decisional balance								
Pros	51.5(10.2)	48.5(9.4)	49.4(10.4)	51.3(9.9)	48.2(12.5)	52.1(9.4)	46.6(8.8)	1.83
Cons	52.0(9.3)	51.6(10.0)	50.8(10.1)	51.6(11.6)	48.7(9.1)	48.2(9.0)	46.2(10.5)	2.02
Vegetable	Stages of change by method B (24 hour recall)							
	Relapser[1] n=38	Precontemp N=35	Contemp n=20	Prep n=44	Act n=36	Main(change)[2] n=66	Main(habit)[3] n=32	F value
Self-efficacy	47.1(8.9)	47.4(11.3)	48.6(9.2)	51.3(9.4)	49.0(9.1)	52.4(10.5)	52.4(10.1)	2.13
Decisional balance								
Pros	52.0(10.6)	46.9(10.2)	50.0(11.4)	50.5(10.7)	50.2(9.9)	51.2(9.4)	47.7(9.0)	1.26
Cons	51.8(9.9)	51.9(10.8)	52.9(11.4)	51.2(10.7)	51.0(9.7)	47.4(8.3)	47.3(9.6)	2.03
Vegetable	Stages of change by method C (Food frequency)							
	Relapser[1] n=38	Precontemp n=36	Contemp n=20	Prep n=29	Act n=42	Main(change)[2] n=80	Main(habit)[3] n=43	F value
Self-efficacy	46.3(10.7)[ab]	44.7(12.2)[a]	48.4(9.7)[abc]	50.0(8.2)[abc]	50.0(8.8)[abc]	53.2(9.3)[c]	52.6(10.8)[bc]	4.88***
Decisional balance								
Pros	53.5(8.2)	49.0(10.2)	50.7(10.3)	47.9(12.5)	49.6(9.8)	50.6(10.6)	47.6(7.9)	1.57
Cons	52.4(9.5)[ab]	53.4(10.4)[a]	51.3(12.0)[ab]	51.5(12.2)[ab]	51.0(9.6)[ab]	47.6(7.9)[ab]	46.7(9.7)[b]	2.96*

Different superscripts in the same row(a,b,c,d) indicate significant differences (<0.05) between groups.

1: People in pre-action stages with unsuccessful experience of increasing fruit or increasing vegetable

2: People in maintenance stage with past experience of increasing fruit or increasing vegetable

3: People in maintenance stage without past experience of increasing fruit or increasing vegetable

Higher self-efficacy scores mean more confidence to eat recommended number of fruits and vegetables and higher pros or cons scores mean more important to eat fruits and vegetables

Table 2. Average T-scores [(Mean (SD)] of the seven processes of change by stages of staging Methods A, B & C

Fruit	Stage of Change by Method A (Self-rated intake)							
Processes of change	Relapser[1] n=43	Precon n=11	Con n=21	Prep n=24	Act n=45	Main(Change)[2] n=109	Main(Habit)[3] n=37	F value
Health Concerns	48.6(10.4)	46.6(11.4)	49.0(8.8)	50.0(9.5)	51.5(8.9)	51.3(10.5)	48.3(9.7)	1.06
Self-reevaluation	49.3(9.1)^{b}	39.2(8.4)^{a}	46.5(12.2)^{ab}	49.3(9.0)^{ab}	52.3(10.8)^{b}	51.6(10.1)^{b}	49.5(7.4)^{b}	3.69**
Social-liberation	47.6(9.7)	50.6(10.3)	50.1(11.5)	52.7(11.9)	51.5(10.1)	49.7(10.0)	50.2(7.9)	0.89
Health Commitment /Action	43.8(9.3)^{ab}	38.3(5.1)^{a}	43.5(10.6)^{ab}	49.2(7.6)^{bc}	50.4(10.2)^{c}	54.3(8.2)^{c}	52.6(9.7)^{c}	13.01***
Interpersonal Control	49.9(11.5)	44.6(6.1)	48.7(9.3)	52.2(13.2)	50.0(8.8)	50.2(9.9)	50.8(9.2)	0.83
External Reinforcement	50.4(9.4)	47.4(10.8)	49.0(9.7)	50.9(10.2)	48.6(11.0)	51.1(10.5)	49.0(8.1)	0.62
Helping relationship	49.8(9.7)	47.6(8.8)	49.1(10.5)	49.1(10.0)	49.8(11.1)	50.6(10.2)	50.6(9.2)	0.25
Fruit	Stage of Change by Method B (24 hour recall)							
	Relapser[1] n=51	Precon n=16	Con n=21	Prep n=68	Act n=27	Main(Change)[2] n=70	Main(Habit)[3] n=20	F value
Health Concerns	48.8(9.8)	47.1(11.2)	48.6(9.0)	51.7(9.8)	50.0(8.2)	51.6(10.9)	48.4(10.9)	1.07
Self Reevaluation	48.1(9.5)^{ab}	40.9(12.3)^{a}	46.6(11.9)^{ab}	51.1(9.3)^{b}	52.8(9.1)^{b}	52.4(10.5)^{b}	51.1(4.4)^{b}	4.26***
Social Liberation	47.8(9.6)	48.4(11.4)	49.8(11.6)	51.3(10.5)	50.7(10.0)	51.6(10.0)	48.4(7.1)	0.94
Health Commitment/Action	43.6(9.5)^{a}	41.3(9.7)^{a}	43.9(10.6)^{a}	52.6(8.2)^{b}	51.0(9.7)^{b}	54.9(7.9)^{b}	52.4(8.5)^{b}	3.58***
Interpersonal Control	50.5(10.2)	47.7(8.1)	47.6(8.0)	51.2(10.9)	47.9(8.5)	51.2(11.0)	51.0(10.1)	0.85
External Reinforcement	50.2(8.8)	47.6(10.1)	48.5(9.7)	49.8(10.9)	47.3(10.4)	52.8(10.6)	52.0(7.7)	1.25
Helping relationship	50.1(9.3)	48.0(9.1)	47.8(10.6)	49.8(10.6)	48.9(11.4)	52.2(9.8)	51.9(9.5)	0.97

Table 2. (cont'd) Average T-scores [(Mean (SD)] of the seven processes of change by stages of staging Methods A, B & C

Fruit	Stage of Change by Method C (Food frequency)							
Processes of change	Relapser[1] n=24	Precon n=15	Con n=26	Prep n=33	Act n=47	Main(Change)[2] n=104	Main(Habit)[3] n=38	F value
Health Concerns	47.8(10.1)	50.2(12.6)	48.7(9.0)	50.1(10.5)	51.2(8.9)	51.7(10.4)	47.2(8.8)	1.38
Self-reevaluation	50.4(8.3)^{ab}	41.7(11.8)^{a}	47.0(12.2)^{ab}	50.6(10.0)^{b}	51.4(9.5)^{b}	51.8(9.9)^{b}	48.1(8.0)^{ab}	3.18**
Social-liberation	46.4(10.4)	49.1(11.8)	49.0(10.8)	49.4(12.5)	51.9(8.8)	50.4(9.9)	50.8(7.6)	0.98
Health Commitment /Action	44.2(8.4)^{ab}	41.0(12.2)^{a}	44.1(10.5)^{ab}	47.5(8.9)^{abc}	49.9(9.5)^{bcd}	54.5(8.3)^{d}	52.1(9.2)^{cd}	10.75***
Interpersonal Control	49.9(10.9)	48.3(8.1)	48.2(8.6)	49.9(12.0)	48.7(8.1)	50.8(10.6)	52.1(10.1)	0.72
External Reinforcement	50.2(9.4)	48.9(10.9)	48.8(10.4)	49.7(11.0)	47.9(9.4)	51.7(10.5)	50.1(8.3)	0.91
Helping relationship	50.3(9.3)	48.5(9.8)	48.6(10.9)	47.4(11.7)	50.1(9.8)	50.9(10.0)	51.6(8.6)	0.81
Vegetable	Stage of Change by Method A (Self-rated intake)							
	Relapser[1] n=50	Precon n=50	Con n=30	Prep n=41	Act n=20	Main(Change)[2] n=66	Main(Habit)[3] n=35	F value
Health Concerns	51.9(9.8)^{ab}	46.4(10.6)^{a}	49.5(10.2)^{ab}	50.9(9.8)^{ab}	46.9(10.0)^{ab}	53.3(9.3)^{b}	47.4(8.6)^{ab}	3.46**
Self Reevaluation	52.5(9.0)^{ab}	47.0(10.7)^{a}	49.0(10.2)^{ab}	50.7(9.1)^{ab}	46.5(13.4)^{ab}	52.3(9.8)^{b}	47.8(7.5)^{ab}	3.00**
Social Liberation	49.3(8.9)	49.5(10.5)	51.8(11.0)	49.3(8.8)	48.3(10.8)	50.6(11.1)	50.3(9.0)	0.39
Health Commitment/Action	44.5(7.0)^{a}	47.0(10.3)^{a}	50.1(8.9)^{a}	49.4(9.8)^{a}	50.4(11.8)^{ab}	56.6(8.8)^{b}	50.5(9.3)^{a}	9.31***
Interpersonal Control	51.1(9.9)	47.2(8.1)	50.9(14.1)	51.1(10.7)	47.2(7.5)	50.6(10.2)	50.4(8.3)	1.17
External Reinforcement	51.2(9.0)	47.7(8.4)	50.8(10.7)	51.8(10.6)	50.5(11.4)	48.7(10.9)	50.2(9.3)	1.02
Helping relationship	51.3(9.2)	49.2(9.9)	48.6(10.5)	50.3(10.6)	50.7(11.5)	49.7(10.1)	50.4(10.0)	0.30

Table 2. (cont'd) Average T-scores [(Mean (SD)] of the seven processes of change by stages of staging Methods A, B & C

Vegetable	Stage of Change by Method B (24 hour recall)							
Processes of change	Relapser[1] n=38	Precon n=35	Con n=20	Prep n=44	Act n=36	Main(Change)[2] n=66	Main(Habit)[3] n=32	F value
Health Concerns	52.8(10.9)	46.5(10.2)	48.8(11.0)	49.1(10.0)	50.4(8.8)	52.0(10.3)	47.0(9.5)	2.23*
Self-reevaluation	54.2(8.3)	48.1(11.1)	48.7(11.0)	48.9(12.0)	49.6(11.3)	51.2(9.7)	47.1(6.7)	2.11
Social-liberation	46.8(8.0)	50.9(10.5)	50.7(11.2)	50.0(8.2)	51.6(10.3)	50.3(10.1)	51.2(11.4)	0.96
Health Commitment /Action	46.8(7.6)^{a}	48.8(11.1)^{ab}	49.2(10.2)^{ab}	48.8(10.5)^{ab}	49.4(10.3)^{ab}	54.1(10.1)^{b}	47.5(8.1)^{a}	3.14**
Interpersonal Control	51.3(10.7)	47.6(9.4)	50.1(13.8)	52.5(10.4)	50.7(11.0)	48.8(8.5)	48.8(9.9)	1.11
External Reinforcement	53.3(9.5)	48.8(8.2)	50.2(13.1)	51.2(9.5)	51.9(11.3)	48.4(9.6)	47.9(8.4)	1.67
Helping relationship	52.0(10.1)	50.5(10.6)	48.1(11.4)	49.6(9.3)	52.8(10.4)	49.1(9.5)	49.1(9.6)	1.00
Vegetable	Stage of Change by Method C (Food frequency)							
	Relapser[1] n=38	Precon n=36	Con n=20	Prep n=29	Act n=42	Main(Change)[2] n=80	Main(Habit)[3] n=43	F value
Health Concerns	53.0(10.1)^{ab}	46.3(10.9)^{a}	49.8(10.4)^{ab}	49.4(10.5)^{ab}	49.5(8.6)^{ab}	52.2(9.9)^{b}	47.2(9.1)^{ab}	2.73**
Self Reevaluation	54.3(7.3)^{b}	46.9(12.0)^{a}	48.2(10.6)^{ab}	46.7(11.0)^{a}	48.3(11.5)^{ab}	52.3(9.6)^{ab}	48.5(6.4)^{ab}	3.46**
Social Liberation	49.0(9.2)	49.2(11.0)	49.5(11.2)	48.7(9.7)	49.8(8.7)	50.7(10.6)	50.6(9.7)	0.28
Health Commitment/Action	45.4(7.1)^{a}	46.3(11.0)^{a}	48.7(9.5)^{ab}	46.3(9.2)^{a}	49.7(10.0)^{a}	55.3(9.5)^{b}	50.1(9.2)^{ab}	7.43***
Interpersonal Control	50.2(10.5)	46.8(8.5)	47.4(11.5)	50.5(10.2)	53.0(11.4)	49.9(8.9)	50.9(10.0)	1.54
External Reinforcement	51.3(9.6)	49.5(9.8)	49.0(11.6)	49.6(10.5)	50.8(9.7)	49.7(10.2)	49.2(9.2)	0.26
Helping relationship	52.5(9.9)	50.5(10.0)	46.6(10.5)	50.3(10.5)	49.6(9.8)	49.9(9.9)	50.0(10.1)	0.78

Different superscripts in the same row(a,b,c,d) indicate significant differences (<0.05) between groups.

1: People in pre-action stages with unsuccessful experience of increasing fruit or increasing vegetable

2: People in maintenance stage with past experience of increasing fruit or increasing vegetable

3: People in maintenance stage without past experience of increasing fruit or increasing vegetable

Chapter Seven

CONCLUSIONS AND RECOMMENDATIONS

This chapter includes conclusions, strengths and limitations of this study. Recommendations for future research are made based on those findings.

For college young adults, this study: 1) established outcome validity and reliability for methods used to assign stage of readiness to eat adequate fruits and adequate vegetables; 2) identified the processes of change for eating enough fruits and vegetables; and 3) reported some lifestyle factors associated with inadequate fruit and vegetable intakes.

Because use of self-rated intake to establish stage of change often failed to show outcome validity for average fruit and average vegetable servings (Campbell et al., 1994; Brug et al., 1997), other staging methods using different outcome assessments were examined to establish outcome validity and reliability in this study. All three methods for evaluation intake of fruits and vegetables--self-rated intake, a 24-hour recall and a food frequency (FFQ) for the past week--distinguished people in pre-action stages from those in post action for fruits and vegetables as validated by the average fruit and vegetable servings from a three-day food record. Using the criteria of at least 2 servings for fruits and 3 servings for vegetables, the 24 hour recall method showed the highest agreement and ability to detect individuals with inadequate fruit intakes compared to the self-rated intake and FFQ. The 24-hour recall method also showed good reliability (Cohen's $\kappa>0.4$). Therefore, a 24-hour recall as the outcome assessment for staging readiness to eat fruits was valid. For eating vegetables, further studies are needed to improve staging

methods, because in this study all methods failed to show good agreement with vegetable servings from a three-day food record. This finding was due in part to daily variation in vegetable intake and vegetables disguised or overlooked in mixed dishes. In addition, this finding is likely due to cognitive differences between consumers and nutrition education researchers in regard to what is considered to be a vegetable. This is especially true for fried potatoes. To assess people's vegetable intakes more accurately, we need to investigate how consumers conceptualize the vegetables they eat, e.g., cooked vegetables, potatoes, side salads, condiments on sandwiches, etc.

The processes of change for eating enough fruits and vegetables were identified and examined in relation to the stage of change of each subject. Compared to other behaviors such as smoking cessation, fewer change processes for eating fruits or vegetables were found. We speculate that this college population is less aware of the importance of eating fruits and vegetables compared to that of other health behaviors. Another reason for finding fewer processes in this study is that eating fruits and vegetables is a desirable behavior, not an avoidance behavior. The different uses of self-reevaluation and health commitment/action processes by those in different stages suggest that these processes are important for young adults to change stages both for fruits and for vegetables. Therefore, "feeling healthy" and "keeping fruits and vegetables around to substitute for high fat foods" should be good strategies to promote adequate fruit and vegetable intakes. However, health concerns were important only for vegetable intakes, but not for fruit intakes.

In the original smoking cessation research on TTM, investigators examined "relapsers" in a study on processes of change, but this group was not examined in the

dietary studies on processes (Bowen et al., 1994; Öupuus et al., 2000). The group "maintenance by habit" used in this study was simply excluded in smoking cessation studies as irrelevant (Prochaska et al., 1979). Findings from this study on processes of change support that "relapsers" and "maintenance by habit" are important groups for nutrition educators to identify, especially for eating vegetables. Self-reevaluation was used more frequently by relapsers, and health commitment/action was less frequently used compared to others in pre-action stages. Health concerns, self-reevaluation and health commitment/action were less frequently used by people in maintenance by habit compared to those in maintenance by change. These are important differences relevant to nutrition educators for targeting their efforts.

For this study "inadequate" fruit and vegetable intakes were defined as less than 2 servings of fruits or fruits without juice and less than 3 servings of vegetables or vegetables without fried potatoes reported in a three-day food record. To help develop and target effective interventions, lifestyle factors associated with "inadequate" fruit and vegetable intakes can be identified. College young adults who ate "inadequate" amounts of fruits were less likely to live in residence halls and to practice health behaviors such as not smoking, regular exercising and eating breakfast. "Inadequate" fruit intake was positively associated with higher discretionary fat consumption, however, "inadequate" vegetable intake was not related to any of these behaviors.

Strengths and Limitations

As expected, self-efficacy was inversely associated with both inadequate fruit and vegetable intakes. Different associations of pros and cons for fruit and vegetable intakes were found when fruit juice and fried potatoes were excluded. The interpretation of

psychosocial factors in this study is limited because psychosocial factors were originally measured for total fruit intake, including juice, and total vegetables, including fried potatoes. Therefore, to examine the differences of psychosocial factors for juice intake and fried potatoes, separate questions would be necessary in the future and this is recommended. When fruit juice and fried potatoes were excluded, fruit and vegetable intakes were positively associated with each other.

In this study, the data clearly showed different patterns for eating fruits than for eating vegetables. Differences between eating fruits and eating vegetables include several psychosocial and demographic factors, stage distribution, perceptions of eating fruits and vegetables and the change processes used for eating enough fruits and vegetables. Therefore, future nutrition education research must continue to separate fruits and vegetables, even though the 5-A-Day message for the public has combined the two into one slogan. Because exclusion of fruit juice and fried potatoes from total intakes showed different results with psychosocial factors and intakes of other food groups, future research should consider fruit juice and fried potatoes separately from total fruits and total vegetables when lifestyle factors associated with fruit intakes and vegetable intakes are identified.

A three-day food record was the "gold standard" to evaluate the outcome validity of the staging methods for eating fruits and vegetables and to examine factors associated with inadequate fruit and vegetable intakes. However, because a longer period of intake is desired for "usual intake" and because food intakes during seasons other than winter might yield different results (Smith-Warner et al., 1997), a study using more days of intakes over a longer period would be useful to confirm our results.

A sample representative of young men not interested in nutrition would be necessary to generalize these findings to all college students. Furthermore, other samples from varied geographic regions are desirable, because results might differ somewhat in each area. Finally, this study should be repeated with a larger number of people, because the small number of people in certain stages, such as precontemplation and contemplation, could have led to a loss of statistical power to detect differences where they exist.

Recommendations for future studies

Based on the findings from this study, the following recommendations are made for research on fruit and vegetable intakes.

1. This study was conducted with college students who were predominantly Caucasian women, therefore, additional study is needed with different subpopulations at risk for low intakes of fruits and vegetables, such as limited income and men.
2. Examples of vegetable consumption, not always perceived as vegetables, included fried potatoes, side salads, spaghetti, pizza and vegetables on sandwiches. It is necessary to develop appropriate assessment instruments to detect vegetable intakes in the ways that people eat and conceptualize vegetables.
3. The association of psychosocial factors with intakes differed fro fruits and fro vegetables and differed when juices and fried potatoes were excluded. Future studies on dietary behaviors should continue to separate fruit and vegetable behaviors and consider the sub-categories of fruit juice and fried potatoes.

4. This study established cross-sectional relationships between uses of processes of change and stages of change for eating enough fruits and vegetables. However, longitudinal studies are necessary to identify true changes in processes for changing behaviors. Longitudinal studies would also help identify detailed information about people assigned to specific stages, including relapsers or people in maintenance, while interventions are conducted.

APPENDICES

APPENDIX A

UCRIHS APPROVAL

MICHIGAN STATE
UNIVERSITY

January 28, 1999

TO: Dr. Sharon L HOERR
204 GM Trout Building

APPROVAL DATE: January 28, 1999

RE: **IRB # 98814** CATEGORY: 1-C

TITLE: STAGE OF READINESS TO EAT DAILY FIVE OR MORE SERVINGS OF FRUITS AND VEGETABLES: VALIDITY, RELIABILITY AND PROCESSES OF CHANGE

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete and I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the **UCRIHS approved this project.**

RENEWALS: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Projects continuing beyond one year must be renewed with the green renewal form. A maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for a complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB# and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/CHANGES: Should either of the following arise during the course of the work, notify UCRIHS promptly: 1) problems (unexpected side effects, complaints, etc.) involving human subjects or 2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of further assistance, please contact us at 517 355-2180 or via email: UCRIHS@pilot.msu.edu. Please note that all UCRIHS forms and instruction are located

Sincerely,

David E. Wright

David E. Wright, Ph.D.
UCRIHS Chair

DEW: db

APPENDIX B

INFORMED CONSENT

Informed consent-Focus group interview, Step 1

Thank you for your willingness to participant in this study. You were selected to study how we can increase intake of fruits and vegetables. Please plan to discuss honestly your opinions about fruits and vegetables.

Consent:
I understand that all data including audio tapes will be kept confidential and reported in group form only.

I volunteer to participate in this study to discuss factors affecting my food intake.

I will participant in a small group discussion with the researchers.

I understand I will receive $10.00 in cash upon completion of the interview.

I can request information regarding the project at any time from Sharon L. Hoerr at 355-7701, Department of Food Science and Human Nutrition.

I am free to refuse this request without penalty.

I can refuse to answer particular questions.

I can withdraw at any time.

I am willing to participate in this study as indicated by my signature below.

Name(Print) : _____

(Signature): _____Date: _____

Phone : _____

E-mail: _____

Investigators: Sharon L. Hoerr, RD, PhD Professor, Department Food Science and Human Nutrition at Michigan State University, College of Human Ecology, Phone 517/355-7701, hoerrs@pilot.msu.edu

---

I received $10.00 for my participation in What Young Adults Think About Fruits and Vegetables.

_____ _____ _____

Signature *Social Security No.* *Date*

How Young Adults Think about Fruits and Vegetables
Informed Consent –Step 2

Thank you for your willingness to participant in this study about how young adults think about fruits and vegetables. By signing the consent from below, you indicate your permission for your responses to be used for this study.

All data will be anonymous and reported in group form only. Your name will not be attached to your responses.

You are free to refuse this request without penalty, refuse to answer particular questions or withdraw at any time.

You will receive a coupon for a single ice cream cone at MSU Dairy Store upon completion and return of the questionnaire and for agreeing to participate in this study.

You can request information regarding the project at any time from Dr. Hoerr at 355-7701, Department of Food Science and Human Nutrition.

Name (Print) : _____ (Signature): _____ Date: _____

We greatly appreciate your contribution. If you decide to participate, return this form outside the classroom 30 minutes before class on Nov 18, 23 or 30. Ms. Mook will report results back to the class in group form only. Thank you for your participation with this research project!

Investigator: Sharon L. Hoerr, RD, PhD, Professor, Department Food Science and Human Nutrition at Michigan State University, College of Human Ecology, Phone 517/355-7701, hoerrs@msu.edu

Food Habits of Young Adults

Step 3 - Baseline

Thank you for your willingness to participant in this study. Your class was selected to help study fruit and vegetable intakes of young adults.

By signing below, you indicate your understanding that participation includes the following, these things, as well as, your permission for your responses to be used for this study.

1) Recording food intake for three days. A one day's food intake includes all the foods and beverages consumed during a 24 hr period.
2) Answering 5 pages of questions on demographics, fruits and vegetables.
3) Completing a short frequency of fruits and vegetables and a 24 hr food recall (3 pages).

You understand:

All data will be kept confidential and reported in group form only.

You are free to refuse this request without penalty, refuse to answer particular questions or to withdraw at any time.

You will receive **extra points in HNF 150** when you complete these instruments at baseline, regardless of whether you permit us to use your responses for this study.

Name (Print) : _____

(Signature): _____Date: _____

You can request information regarding the project at any time from Dr. Sharon Hoerr at 355-7701, Department of Food Science and Human Nutrition, Michigan State University.

Investigators: Sharon L. Hoerr, RD, PhD Professor, Department Food Science and Human Nutrition at Michigan State University, College of Human Ecology, Phone 517/355-7701, hoerrs@msu.edu; Sang-Jin Chung, Graduate student, chungsa2@pilot.msu.edu

Food Habits of Young Adults

Step 3 - One-Two Week Later than Baseline

Thank you for your willingness to participant in this study. Your class was selected to help study fruit and vegetable intakes of young adults.

By signing below, you indicate that participation includes completion of a short frequency of fruits and vegetables and a 24 hr food recall. Your signature also indicates your permission for your responses to be used in this study.

You understand:

All data will be kept confidential and reported in group form only.

You are free to refuse this request without penalty, refuse to answer particular questions or to withdraw at any time.

You will receive a coupon for single ice cream for repeating the short frequency of fruits and vegetables and a 24 hr food recall. The coupon is redeemable at the MSU Dairy Store.

Name (Print) : _____

(Signature): _____Date: _____

You can request information regarding the project at any time from Dr. Sharon Hoerr at 355-7701, Department of Food Science and Human Nutrition, Michigan State University.

Investigators: Sharon L. Hoerr, RD, PhD Professor, Department Food Science and Human Nutrition at Michigan State University, College of Human Ecology, Phone 517/355-7701, hoerrs@msu.edu; Sang-Jin Chung, Graduate student, chungsa2@pilot.msu.edu

APPENDIX C

FOCUS GROUP INTERVIEW PROTOCAL & INSTRUMENT (STEP 1)

Processes of Change Focus Group Interview Protocol – for interviewers

8/20/99-9/20/99 Conduct interview

Interview complete chart

#	Female-Col (18-24yr)	Male-Col (18-24yr)

I. Interviewer Training

Training will include:

1) describe the purpose of the study
2) review the manual, script, and questionnaire
3) practice interviews

Objectives of the interview are to determine

- what processes subjects use to eat fruit and to eat vegetables-,
and – questions or clarification needed on items

will ask subjects to review the list of processes (attached) to see which one apply to themselves and to get their additional comments.

Interviewer

- should be someone close in age to the research participants.
- should be educated about the processes of change – to be able to respond when subjects have questions about them.
- will get information on strategies of how to increase fruit and vegetable intake during the interviews
- learn how to facilitate interview effectively.

II. Conducting the Interview

Supplies need:
- Tape player – tapes and extra batteries, extension cord(s)
- Copy of interview questions
- Consent forms

A. Interview Format and Questions

1. Greet each participants at the door with a smile.
2. Start the interview by making the participant feel comfortable, introduce yourself and thank the participant for his/her time.
3. Have the participant sign the consent form.
4. Ask participant, if the interview can be audio taped. Tell him/her it will only be used for research purposes, only first names will be used and all data will be destroyed after the data are merged into a group data file.
5. Indicate the interview will take between 1 – 11/2 hour to complete.
6. Start recording the session.
7. Tell the participant the purpose of the interview.
   " My purpose is not to evaluate your diet, so don't be afraid to be honest. I would like to understand one particular aspect of what you eat, so I will be asking you some questions only about the fruits/or vegetables you eat. First, we will start with your intentions for eating fruits/vegetables. Have you tried to eat adequate amounts of fruit/vegetable or to increase fruit/vegetable intake?"

B. Interview Questions

" - Think about what you or your friends have done and thought to eat adequate amounts of fruit/vegetable, to increase fruit/vegetable intake or to eat fruit/vegetable.
- Please write these actions and thought on the cards given. I'll collect the cards at the end of session. (5 min)

Discuss. Then, interviewer gives the participant a draft of questionnaires about processes of change and says,

- Read through this list of processes and instructions. These are items already developed by experts. For each section, answer the question. I will go through each sub-category with you.
- Start with consciousness raising part, check which processes apply to your fruit/vegetable intake. You can choose *never* to *always*. Do they make sense? Is wording clear? If not, please let us know.
- After that, think about whether you or your friends use different processes than those listed here. You can go back the items you wrote down at the beginning of this session. If there are, please write these down."

Interviewers check items in each category, "A. Consciousness raising" to "L. Helping relationship".
Then, ask an ending question. "Of all the things we discussed, what to you is the most important?"

III. Closing the interview

After finishing all items in the 11 categories, collect participants' questionnaires. When interviewers collect questionnaires and consent form (It is very important to get their signature and social security number), give $10.00 to each participant as an incentive.

Process of Change Focus Group Interview Instrument

Part V. This last part assesses ways that you think about fruits/vegetables and things that you and others might do relative to fruits/vegetables. *There are 11 subcategorizes.*[1]

"Adequate amounts mean fruit intake more than or equal to 2 servings and vegetable intake more than or equal to 3 servings"

Please indicate **how frequently** you currently do the following, when you eat Fruits and Vegetables. Circle the best response from:
1=Never 2=Seldom 3=Occasionally 4=Often 5=Always

*A. **Consciousness Raising**, e.g., "I have been increasing information about myself and the fruits and vegetable I eat."*	Never 1	2	3	4	Always 5
1. I think about why it is good for me to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
2. Others have made me think about the health benefits of eating adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I think about information regarding my health problems from not eating adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I pay attention to how my eating adequate amounts of _____ helps prevent disease and constipation.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I read and/or listen to information about the _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. I pay attention to ways I can eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I have been evaluating my feelings regarding the _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

8. I am willing to listen to advice to eat adequate amounts of _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
9. I realize that adding _____ to meals provides a variety of flavors.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

*B. **Dramatic Relief**, e.g., "I have been using feelings to motivate me to eat enough fruits and vegetables."*	Never				Always
	1	2	3	4	5
1. Warnings about the health problems of eating inadequate amounts of _____ cause me concern.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
2. A family history of chronic disease has caused me to consider the amount of _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I react emotionally to stories about health problems of people who did not eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. Watching a loved one die who had poor dietary habits, has made me think about the _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I eat adequate amounts of _____ so I do not get constipated.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. I am happy my family members stay healthy by eating adequate amounts of ____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I feel great because eating adequate amounts of _____ helps maintain or lose my weight.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
8. I've seen the consequences of a diet limited in _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
9. I think about how good my skin looks when I eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

*C. **Self Re-evaluation**, e.g., " I have been assessing how I feel and think about how many fruits and vegetables I eat."*	Never 1	2	3	4	Always 5
1. I take it as personal challenge to find ways to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I feel healthy and vitalized when I eat adequate amounts of _____ each day.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I see eating adequate amounts of _____ as part of my role to be a responsible and healthy person.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I feel good about myself when I eat adequate amounts of _____ .					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I feel frustrated when conforming to others' food preferences keeps me from using _____ in my menu plans.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. I have recently evaluated whether I eat adequate amounts of ____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I review what I have eaten over a few days, and that helps me eat adequate amounts of _____ .					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
8. I think _____ are taste good.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

*D. **Environmental Re-evaluation**, e.g., " I consider the influence of the fruits and vegetables I eat on the environment."*	Never 1	2	3	4	Always 5
1. I think about how my organization could benefit health-wise , if members would eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I think about health benefits to society, if everyone would eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I think about how everyone needs to understand the benefits to the environment of eating adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I think about how many people would benefit health-wise from having adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I think about how eating _____ is better for the environment than eating meat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. I'm concerned about environment (and how we treat animals), therefore I want to eat more _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I'm concerned about pesticide residues, and it influences the _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
8. My eating adequate amounts of _____ affects those with whom I live.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

9.	I feel uncomfortable when I think about being somewhere that won't have for me_____ to eat.					
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

*E. **Social Liberation**, e.g., " Society in general, and the places I go support eating adequate amounts of fruit and vegetable."*	Never 1	2	3	4	Always 5
1. When I go out, I can find _____ choices for snacks.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
2. I notice many choices for _____ when eating out.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
3. Where I shop there is a good selection of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. Others have made a dietary change which has influenced the _____ I eat.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I find society supportive of people eating adequate amounts of ____.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
6. Many people I know are eating adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
7. I see eating adequate amounts of _____ being promoted in my community.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
8. I notice ' 5 A Day' signs promoting eating adequate amounts of ___.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
9. I find people want _____ that they like to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
10. I find people like _____ at each meal, because they are typically served/available at dinner, lunch, breakfast or snack.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

*G. **Self Liberation**, e.g., "I recognize food choices and have made a commitment to eat adequate amounts of fruits and vegetables."*	Never 1	2	3	4	Always 5
1. I look for ways to include_____ in recipes and mixed dishes and on sandwiches.					
Fruits	1	2	3	4	5
Vegetable	1	2	3	4	5
2. I buy _____ to help me follow a good diet.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
3. Choosing adequate amounts of _____ gives me a feeling of control.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I plan ahead to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I make commitments to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. I imagine nutrients in the _____ I eat fighting disease in my body.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I know eating adequate amounts of _____ is easy.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
8. I made a New Year's resolution to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
9. I have told others that I want to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
10. I know that I can eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
11. I have set a goal (or am working on a plan) to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5

*H. **Counter-conditioning**, e.g., " I made substitutions that help me eat fruits and vegetable."*	Never				Always
	1	2	3	4	5
1. Instead of eating unhealthy foods, I eat _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I find that ordering _____ is good substitute for other foods in restaurants.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I eat ____ as snacks, when I have a craving for a high calorie food.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I substitute _____, when I want to eat high fat foods.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
5. Eating adequate amounts of _____ satisfies me physically, instead of eating other foods.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
6. When I crave a food, I think about eating ____ instead.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I am decreasing my fat, so I am purposely eating adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

*I. **Stimulus control**, e.g., " I have changed my environment to encourage eating adequate amounts of fruits and vegetables."*	Never				Always
	1	2	3	4	5
1. I try to keep _____ around my place, in case I feel like eating something.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I eat breakfast, which helps eat adequate amounts of _____ .					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I keep reminders to eat adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I remove foods around me that I used to choose instead of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I keep _____ on hand as lunch and/or snack, when I'm on-the-run.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
6. There are _____ visible in my house.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

*J. **Interpersonal control**, e.g., " I have avoided other people who act as barriers to eat fruits and vegetables."*	Never				Always
	1	2	3	4	5
1. I leave places where people are eating high fat foods instead of eating _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I change personal relationships which contribute to my inadequate _____ .					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I relate less often to people who contribute to my inadequate _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

*K. **Contingency management**, e.g., "I reward myself or am rewarded for eating adequate amounts of fruits and vegetables."*	Never				Always
	1	2	3	4	5
1. I praise myself when I eat _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
2. I expect to be rewarded by others when I eat _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
3. I feel better (or my clothes fit better) since I have eaten adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
4. I do something nice for myself, when I eat enough _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
5. When I eat adequate amounts of _____, I believe I am doing something nice for myself.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

*L. **Helping relationship**, e.g., " I have someone I can be open with regarding the fruits and vegetable I eat."*	Never				Always
	1	2	3	4	5
1. I discuss with my friends the benefits to health of eating adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
2. My parents or caregivers care about eating adequate amounts of _____, because they know the benefits for reducing chronic disease.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
4. Others encourage me to eat adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
5. I count on others to support my dietary changes for eating adequate amounts of _____.					
Fruits	1	2	3	4	5
Vegetables	1	2	3	4	5
6. My friends offer _____ with every meal.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
7. I discuss with friends, the health benefits of eating adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
8. Others in my life are also making dietary changes that have made it easier for me to eat adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
9. Friends/family admire me when I eat adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
10. Other people in my daily life try to make me feel good when I eat adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

11. I have someone who cares whether I get adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
12. I associate with people who help me eat adequate amounts of _____.					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5
13. Special people in my life accept me, whether or not I eat adequate amounts of _____ .					
Fruit	1	2	3	4	5
Vegetables	1	2	3	4	5

APPENDIX D

QUESTIONNAIRES FOR REFINING ITEMS OF PROCESSES OF CHANGE (STEP 2)

Major _____ Gender _____ Age _____ HNF 150 Project

These questions relate to how you think about fruits/vegetables. Please answer items for each fruit and for each vegetable.
" Enough" means fruit intake more than or equal to 2 servings, vegetable intake more than or equal to 3 servings

Part I. Process of Change -- Please indicate **how frequently** you currently do the following, when you eat Fruits and Vegetables. Circle the best response from:
1=Never 2=Seldom 3=Occasionally 4=Often 5=Always

		Never 1	2	3	4	Always 5
1. I think about why it is good for me to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
2. Warnings about the health problems of eating too few _____ cause me concern.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
3. I take it as a personal challenge to find ways to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
4. I think about how my social group could benefit health-wise, if members would eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
5. When I go out, I can find _____ choices for snacks.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
6. I look for ways to include_____ in mixed dishes or on sandwiches.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
7. Instead of eating "unhealthy" foods, I eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

8. I try to keep _____ around my place, in case I feel like eating something.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
9. I eat with people who may encourage me to eat enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
10. Someone cares whether I get enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
11. Others have made me think about the health benefits of eating enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
12. I react emotionally to stories about health problems of people who did not eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
13. I feel healthy when I eat enough _____ each day.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
14. I have someone who listens when I need to talk about eating _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
15. I think about how people could be healthier, if more would eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
16. I notice many choices for _____ when eating out.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
17. I buy _____ to help me follow a good diet.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
18. I find that ordering _____ is good substitute for other foods in restaurants.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

19. Eating breakfast helps me eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
20. Other people will be pleased if I eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
21. I think about information regarding future health problems from not eating enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
22. Watching a loved one get sick who had poor dietary habits, has made me think about the _____ I eat.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
23. I feel good about myself when I eat enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
24. Others in my life are also making dietary changes that have made it easier for me to eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
25. I'm concerned about the environment, therefore I want to eat more _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
26. Where I shop there is a good selection of _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
27. Choosing enough _____ gives me a feeling of control.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
28. I substitute _____, when I want to eat high fat foods.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

29. I keep reminders to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
30. I discuss with friends, the health benefits of eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
31. I pay attention to how my eating enough _____ helps prevent constipation.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
32. Eating _____ refreshes me.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
33. I have recently evaluated whether I eat enough ____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
34. I'm concerned about pesticide residues, and it influences the _____ I eat.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
35. Others have made dietary changes which have influenced the _____ I eat.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
36. I plan ahead to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
37. I am decreasing my fat intake, so I am purposely eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
38. I remove foods around me that I used to choose instead of _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
39. When I eat enough _____, I believe I am doing something nice for myself.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

40. Other people in my daily life try to make me feel good when I eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
41. I think about information I have seen about eating enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
42. My family's good health from healthy eating makes me happy to eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
43. I use my favorite _____ in recipes for improved taste.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
44. My eating enough _____ is affected by the cost.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
45. I find society supportive of people eating enough ____.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
46. I make commitments to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
47. I eat _____ instead of other foods to lose or maintain my weight.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
48. I keep _____ on hand as lunch and/or snack, when I'm on-the-run.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
49. I find society changing in ways that make it easier to eat enough ____ in my diet.						
	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5

50. I feel better (or my clothes fit better), when I have eaten enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
51. Others encourage me to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
52. I pay attention to information on how to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
53. I feel great because eating enough _____ helps me maintain or lose weight.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
54. I feel uncomfortable when I think about being somewhere that won't have _____ for me to eat.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
55. Many people I know are eating enough _____.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
56. I know eating enough _____ is easy.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
57. I add _____ to meals to provide a variety of flavors.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
58. I have given up eating with people who mostly eat too few _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
59. I associate with people who help me eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

60. I have been evaluating my feelings regarding the _____ I eat.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
61. I am concerned when I see the consequences of a diet limited in _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
62. I like the taste of _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
63. I see eating enough _____ being promoted in my community.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
64. I think our country's health care costs would be lower if people ate enough _____						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
65. I know I can eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
66. There are _____ visible in my house.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
67. I have someone I can rely on to support my decision to eat enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
68. I am willing to listen to advice to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
69. I think about how good my skin looks when I eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

70. I notice ' 5 A Day' signs promoting eating enough ___.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
71. I have set a goal (or am working on a plan) to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
72. I bring _____ into my place.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
73. I can expect to be praised by others when I eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
74. I get upset when I remember research about illnesses associate with eating too few _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
75. I leave places where people are eating high fat foods instead of eating _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
76. My parents or caregivers support my eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
77. I find people eat _____ at meals, in which these foods are typically served.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
78. I praise myself when I eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
79. I count on others to support my dietary changes for eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
80. I choose _____ because they are appealing.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

APPENDIX E

STAGING INSTRUMENT A (SELF-RATED F/V INTAKE), B (24HR RECALL) & C (F/V FOOD FREQUENCY), DEMOGRAPHICS, FINAL PROCESS OF CHANGE, DECISIONAL BALANCE, SELF-EFFICACY & 3 DAY FOOD RECORDS (STEP 3)

Part I. Staging instruments - The following pages ask about the fruits and vegetables you usually eat. As you answer these questions, think back over the past week. How often do you usually eat the foods listed?

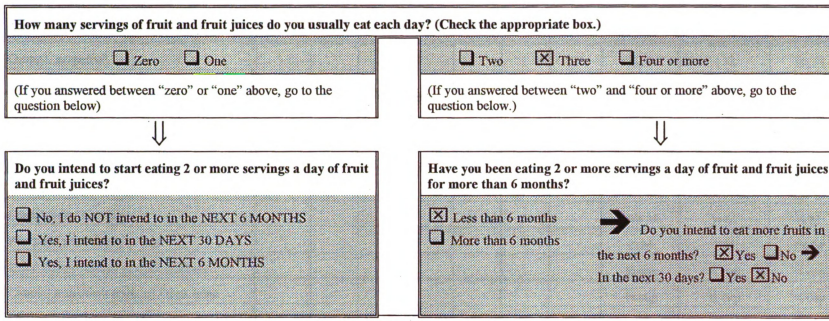
Step 1: Check (_) **HOW OFTEN?** on average, you eat each food.

EXAMPLE: If you eat an apple, on the average, once every day, check (_) the column under "1 time per day."

Step 2: Check circle **HOW MUCH?** you eat. Because people eat different amounts, we are asking you to tell us whether the usual amount of food you eat is small, medium or large. The definition of what is meant by small, medium and large are given for each food. Circle the one most appropriate to your usually serving. **EXAMPLE**: If you usually eat two apples, circle the "1½ medium" serving under "Large" to answer the question "HOW MUCH?" This shows the two apples you usually eat are at least 1½ times the medium amount for apple. **PLEASE DO NOT SKIP** any foods. Be sure to fill in **HOW OFTEN?** and **HOW MUCH?** for each food. Please **BE CAREFUL** into which column you put your answer. It will make a big difference if you say "Apple 1 time per day" when you mean "Apple 1 time per week." If you never eat a food, check (_) the column "Less than one per week."

EXAMPLE on this page: **Fruits**	Less than one per week	1 time a week	2 times a week	3-4 times a week	5-6 times a week	1 time a day	2 times a day or more	Your Serving Size: Small	Medium(M)	Large
Apple, applesauce						_		½ M	1 M	1½ M
Berries-strawberries, blueberries (in season)				_				¼ cup	½ cup	¾ cup
Peaches/ nectarines / plums.				_				½ M	1 M	1½ M
Canned fruits / fruit cocktail / fruit salad	_							¼ cup	½ cup	¾ cup
Orange juice						_		4 oz glass	6 oz glass	8 oz glass
Other 100% fruit juice--apple, grapefruit, cranberry. (DO NOT INCLUDE Juice Drinks / Koolaid / Lemonade / Snapple)							_	4 oz glass	6 oz glass	8 oz glass

Use your estimated DAILY INTAKE, as recorded above, to complete the questions below. (Example)



Fruits	Less than one per week	1 time a week	2 times a week	3-4 times a week	5-6 times a week	1 time a day	2 times a day or more	Your Serving Size		
								Small (S)	Medium (M)	Large (L)
Orange, grapefruit								½ M	1 M	1½ M
Apple, applesauce								½ M	1 M, ½C	1½ M
Banana								½ M	1 M	1½ M
Berries-strawberries, blueberries (in season)								¼ cup	½ cup	¾ cup
Other fresh fruits--grapes, pears, pineapple								¼ cup	½ cup	¾ cup
Watermelon (in season)								small slice	medium slice	Large slice
Cantaloupe / honeydew								1/8 M	¼ M	½ M
Peaches / nectarines / plums.								½ M	1 M	1½ M
Dried fruits--raisins, prunes, apricots								¼ cup	½ cup	¾ cup
Canned fruits/fruit cocktail / fruit salad								¼ cup	½ cup	¾ cup
Orange juice								4 oz glass	6 oz glass	8 oz glass
Other 100% fruit juice--apple, grapefruit, cranberry. (DO NOT INCLUDE Juice Drinks / Koolaid / Lemonade / Snapple)								4 oz glass	6 oz glass	8 oz glass

Use your estimated DAILY INTAKE, as recorded above, to complete the questions below.

How many servings of fruit and fruit juices do you usually eat each day? (Check the appropriate box.)

☐ Zero ☐ One

(If you answered between "zero" or "one" above, go to the question below)

⇩

Do you intend to start eating 2 or more servings a day of fruit and fruit juices?

☐ No, I do NOT intend to in the NEXT 6 MONTHS
☐ Yes, I intend to in the NEXT 30 DAYS
☐ Yes, I intend to in the NEXT 6 MONTHS

☐ Two ☐ Three ☐ Four or more

(If you answered between "two" and "four or more" above, go to the question below.)

⇩

Have you been eating 2 or more servings a day of fruit and fruit juices for more than 6 months?

☐ Less than 6 months
☐ More than 6 months → Do you intend to eat more fruits in the next 6 months? ☐Yes ☐No →
In the next 30 days? ☐Yes ☐No

Vegetables	Less than one per week	1 time a week	2 times a week	3-4 times a week	5-6 times a week	1 time a day	2 times a day or more	Your Serving Size		
								Small (S)	Medium (M)	Large (L)
French fries, fried potatoes, hash browns								¼ cup	½ cup	¾ cup
Other potatoes (baked, mashed) and Sweet								¼ cup	½ cup	¾ cup
Peas, Green beans, Lima Beans								¼ cup	½ cup	¾ cup
Refried beans, chili beans, etc.								¼ cup	½ cup	¾ cup
Carrots								¼ cup or 5 mini	½ cup or 10 mini	¾ cup or 15 mini
Broccoli, Cauliflower, Spinach, Greens								¼ cup	½ cup	¾ cup
Green salad, Lettuce								½ cup	1 cup	1½ cup
Pickles, onions, cucumber, celery, olives								¼ cup	½ cup	¾ cup
Tomatoes								½ M	1 M	1½ M
Tomato sauce / Spaghetti sauce / Barbecue sauce								¼ cup	½ cup	¾ cup
Catsup, Salsa								_ cup	¼ cup	½ cup
Vegetable Soup / Stew, Vegetable Drinks (V8)								½ cup	¾ cup	1 cup
Mixed veggies (frozen, canned, in mixed foods such as pizza, taco, stir fry)								¼ cup	½ cup	¾ cup
Other vegetables (corn, peppers, coleslaw)								¼ cup	½ cup	¾ cup

Use your estimated DAILY INTAKE, as recorded above, to complete the questions below.

How many servings of vegetables do you usually eat each day? (Check the appropriate box.)

☐ Zero ☐ One ☐ Two

(If you answered between "zero" or "two" above, go to the question below)

⇩

Do you intend to start eating 2 or more servings a day of vegetables.

☐ No, I do NOT intend to in the NEXT 6 MONTHS
☐ Yes, I intend to in the NEXT 30 DAYS
☐ Yes, I intend to in the NEXT 6 MONTHS

☐ Three ☐ Four ☐ Five or more

(If you answered between "three" and "five or more" above, go to the question below.)

⇩

Have you been eating 2 or more servings a day of vegetables for more than 6 months?

☐ Less than 6 months
☐ More than 6 months

→ Do you intend to eat more vegetables in the next 6 months? ☐Yes ☐No

→ In the next 30 days? ☐Yes ☐No

Next, we will get the information about your food intake during 24 hour period. Write down what you ate yesterday, including the time of day, the food you consumed and how much of each food you ate. Start with breakfast...

Please remember to include all ingredients for each food, so that the data can be analyzed with few errors. Below is a list of tips for filling out the forms easily and accurately.

- **The attached chart will assist you with you with accurately writing the foods you ate.**
- **Breakdown recipes into specific foods or breakdown the food into its components. For example, a peanut butter and jelly sandwich must be broken into certain amounts of peanut butter, jelly and bread. Do the same for salads and casseroles.**
- Don't forget snacks you had for a break, on the way to or from work, classes etc.
- Specify the type of food you ate. For example, if you had bread, what was the brand name and was it wheat or rye? If it was wheat bread, was it refined, whole wheat or cracked wheat?
- Accurate portion size is important for your dietary analysis. Please indicate how much you had of each food using standard measures—ounces, cups, teaspoons, tablespoons, slice etc.
- And last, don't forget condiments. Include on the form foods such as mayonnaise, catsup, sugar, creamer and salad dressings.

Food Item	Type	Preparation	Amount
Bread, Rolls, Tortillas,	White, Whole wheat, Rye, Brand name	Toasted French toast	Number of slices or parts there of
Cereals	Brand name	Cold or cooked	Estimate VOLUME in 8 oz cups or parts of cups of cereal. Measure milk and sugar separately.
Rice	White, brown, other type	Cooking method	Estimate VOLUME in cups or parts of cups of cooked rice
Pasta, Noodles	Dry, fresh, whole wheat, Ramen	Boil only, boil and bake, boil and sauté other	Estimate VOLUME in cups of cooked pasta/noodles alone. Measure sauce separately if possible. If necessary, estimate volume of mixture
Beans	Navy, Kidney, Refried	Boiled only, boiled and sautéed, etc.	Estimate VOLUME in cups or parts of cups of cooked beans
Fruits, Vegetables	Canned, frozen, fresh	Cooked or raw	Estimate VOLUME of cut-up fruit/veggies in cups of parts of cups or by the Each, i.e., one small plum
Salads	Tossed, Waldorf, etc.	Cooked or raw	Estimate VOLUME of each ingredient, i.e., 1 cup shredded iceberg lettuce, 2 Tablespoons chopped green pepper. List dressing separately.
Yogurt	Brand name, container description, plain or flavored, with fruit, frozen yogurt (Brand). Specify if reduced fat, fat free or artificially sweetened	Usually none	Estimate VOLUME in cups or parts of cups.
Cheese	Type (e.g. Swiss, Cheddar, String). Specify if reduced fat or fat free	Usually none or as part of a recipe	Estimate WEIGHT in ounces from total package weight or VOLUME in cups, tablespoons or teaspoons if shredded.
Cream, Creamers	Sour cream, half and half, whipping cream, powdered coffee creamer, frozen coffee creamer, Brand name. Specify if reduced fat or fat free	Usually none	Estimate VOLUME in cups or tablespoons or teaspoons.

Meats	Chicken, pork, etc., Loin chop, shoulder roast, thigh with or without skin & fat in ground eat	Broiled, boiled fried, baked, etc. With or without added fat.	Estimated cooked weight in OUNCES. Cooked weight is usually about 3/4 of raw weight
Mixed meat dishes	Give name and list ingredients (Tuna casserole with noodles, mushrooms, soup, peas, and breadcrumbs)	Baked, fried, boiled, etc. With or without added fat.	Estimate VOLUME of the finished product you ate in cups or part cups
BEVERAGES			
Coffee/Tea	Brewed, instant, decaf		Estimate VOLUME in cups or part cups. List sugar.
Juices	Canned, frozen, fresh		Estimate VOLUME in cups or part cups.
Milk	Whole, 1%, 2%, skim, buttermilk, soy, other		Estimate VOLUME in cups or part cups.
Beer / Wine / Spirits	Rose wine, lite beer, brandy, bourbon, etc. or Whisky sour		Estimate VOLUME in cups or part cups of ingredients or whole drink volume.
Soda / other sweet drinks	Brand and type. Diet or regular		Estimate VOLUME in cups or part cups or cans.
SNACKS			
Crackers	Brand name, specify if reduced fat or fat free		Number
Chips	Type - Brand name. Specify if reduced fat or fat free		Estimate VOLUME in cups or part cups.
Nuts	Type (peanuts, walnuts cashew)		Estimate VOLUME in cups or part cups or NUMBER of nuts
Candy	Brand name or type		WEIGHT from package, number of pieces or Each if whole candy bar.

DESSERTS			
Cookies	Brand name or type. Specify if reduced fat or fat free, or artificially sweetened	Homemade or purchased	Number and size estimate in INCHES across.
Cake, pie	Type, with or without icing.	Homemade or purchased	Measurements of piece (2" X 2" X 4") with icing, or 1/6 pie.
Ice Cream	Brand name, flavor, specify if reduced fat or artificially sweetened		Estimate VOLUME in cups or part cups or tablespoons.
Pudding	Brand name, type. Specify if reduced fat or fat free or artificially sweetened	Homemade or purchased. Specify kind of milk used, if any.	Estimate VOLUME in cups or part cups or tablespoons.
OTHER			
Margarine, Butter, Lard, Oil	Brand and type, Liquid or solid. Specify if reduced fat or fat free		Estimate VOLUME in tablespoons, teaspoons, cups or parts of any of these.
Salad dressings, mayonnaise	Brand and type. Specify if reduced fat or fat free	Ingredients if homemade	Estimate VOLUME in tablespoons, teaspoons, cups or parts of any of these.
Jam, Relish, Mustard, Salsa	Brand and type. Flavor	Ingredients if homemade	Estimate VOLUME in tablespoons, teaspoons, cups or parts of any of these.

24 HOUR FOOD RECALL

Day of week _____

Time	Food Item	Description and Preparation	Amount

1. Did you take a vitamin, mineral, herbal or other supplement today? Yes ___ No___
   If yes, Name and Brand and amount. _____
2. Was this your usual intake for fruits and vegetables? Yes_____
   No_____
   If not, what and how much more or less do you usually eat?

3. How long have you eaten this way?
   a. Less than 6 months
   b. More than 6 months

Pa

1.

2.

3.

4.

5.

6.

7.

8.

9.

1

1

1

1

Part II. Demographics

1. Current height? ____ ft ____ in

2. Current weight? ____ lb

3. How satisfied are you with your current weight? ___very satisfied ___satisfied ___neutral ___unsatisfied ___very unsatisfied

4. How old are you? ___years

5. Do you live in a ___residence hall ___apartment or house?

6. What is your gender? ____ male ____female.
   If female, are you pregnant? ___No ___Yes; are you breast feeding? ___No ___Yes

7. What is your major? _____

8. Total number in your household or living space including yourself ___.

9. Are you living with parents? _____No ____Yes

10. Are you living with friends? _____No ____Yes

11. Are you married/living with a partner? ___No ___Yes.

12. Are there any children in your household? ___No ___Yes. If yes, how many children ___?

13. Do you currently have jobs or volunteer activities? _____No _____Yes

    If yes, How many hours are you involved in them per week? _____

14. What is your race or ethnic group?

___ White (not of Hispanic origin)
___ Black (not of Hispanic origin)
___ Hispanic/Latino
___ American Indian/Alaska Native
___ Asian/Pacific Islander
___ Other

15. Times a week you eat breakfast? ____

16. Times a week do you eat a meal or snack at a fast food restaurant? ____

17. Do you smoke cigarettes? ___No ___Yes. If yes, how many a day ____?

18. Do you exercise regularly? ___No ___Yes, If yes, How many hours a week ____?

19. Do you drink alcoholic beverages? ___No ___Yes.

    If yes, how many drinks per week ____ (one drink = 12 oz beer, 5 oz wine, 1 shot liquor)?

20. Do you take vitamin or mineral supplements? ____No ____Yes, If yes, what kind _____(brand name or which nutrient)

    and how much _____?

Questions about fruit and vegetable

For Fruit

1. Is your current amount of fruit intake similar to intake you had in your childhood? _____No _____Yes,

2. Have you tried to increase your fruit intake? ____No ____Yes, If yes, has it been successful? ____No _____Yes

3. Have you participated in any intervention program to promote increasing fruit intake?

   ____No ____Yes

4. How many servings of fruit intake is enough to maintain your good health? _____
(One piece of fruit, ½ cup of fruit, ¾ cup of 100% fruit juice is a serving.)

For Vegetable

1. Is your current amount of vegetable intake similar to intake you had in your childhood? _____No _____Yes,

2. Have you tried to increase your vegetable intake? ____No ____Yes, If yes, has it been successful? ____No ____Yes

3. Have you participated in any intervention program to promote increasing vegetable intake? ____No ____Yes

4. How many servings of vegetable intake is enough to maintain your good health? _____
(1/2 cup of cooked vegetable, 1 cup of leafy vegetable is a serving.)

These questions relate to how you think about fruits/vegetables. Please answer items for each fruit and for each vegetable.
" **Enough"** means **fruit intake** more than or equal to 2 servings, **vegetable intake** more than or equal to 3 servings

Part III. Process of Change - Please indicate **how frequently** you currently do the following, when you eat Fruits and Vegetables. Circle the best response from:

1=Never 2=Seldom 3=Occasionally 4=Often 5=Always

		Never 1	2	3	4	Always 5
1. I think about how my social group could benefit health-wise, if members would eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
2. I try to keep _____ around my place, in case I feel like eating something.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
3. Someone cares whether I get enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
4. I feel healthy when I eat enough _____ each day.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
5. I have someone who listens when I need to talk about eating _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
6. I think about information I have seen about eating enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
7. I have given up eating with people who mostly eat too few _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

8. Warnings about the health problems of eating too few _____ cause me concern.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
9. Instead of eating "unhealthy" foods, I eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
10. Other people will be pleased if I eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
11. I have someone I can rely on to support my decision to eat enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
12. I feel good about myself when I eat enough _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
13. I am decreasing my fat intake, so I am purposely eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
14. Other people in my daily life try to make me feel good when I eat enough _____.						
	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
15. I find society supportive of people eating enough ____.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
16. I make commitments to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
17. I have recently evaluated whether I eat enough ____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

18. I find society changing in ways that make it easier to eat enough ____ in my diet.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
19. I eat _____ instead of other foods to lose or maintain my weight.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
20. Others encourage me to eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
21. I pay attention to information on how to eat enough ____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
22. I associate with people who help me eat enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
23. I see eating enough _____ being promoted in my community.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5
24. When I eat enough _____, I believe I am doing something nice for myself.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
25. I think about information regarding future health problems from not eating enough _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
26. I can expect to be praised by others when I eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
27. I get upset when I remember research about illnesses associate with eating too few _____. Fruits		1	2	3	4	5
	Vegetables	1	2	3	4	5

28. I leave places where people are eating high fat foods instead of eating _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
29. Many people I know are eating enough _____.	Fruits	1	2	3	4	5
	Vegetable	1	2	3	4	5

Part IV. Decisional Balance - Please indicate **how important** each of the following items is to you when you are **deciding whether or not to consume** Fruits and Vegetables. Circle the best response from:
1=not at all important 2=not too important 3=somewhat important 4=important 5=very important

		Importance				
		Not at all				Very
1. It would be inconvenient to eat _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
2. I would feel I am doing something good for my body if I ate more _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
3. It would be difficult to find _____that I like.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
4. Consuming more _____ would add variety to my diet.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
5. I would have time to shop at a store that sells _____ .	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
6. I would have limited equipment to prepare _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5
7. I would worry about the safety of chemicals used in _____.	Fruits	1	2	3	4	5
	Vegetables	1	2	3	4	5

8. Foods like ____ would help me maintain my weight.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
9. I would have limited ways to incorporate _____ in my meals.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
10. I would always be able to find new ways to fix _____.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
11. I would feel better if ate more _____.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
12. I would purchase _____ more often if priced low.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
13. I would not eat _____ often, if my friends and family didn't.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
14. Foods like _____ would help me lose weight when I need to.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
15. I would have to give up other foods to buy more_____	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
16. I would have limited storage space for fresh and/or frozen_____.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
17. I would eat more_____, if nutrition recommendations weren't so confusing.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5
18. Eating more _____ would keep me from getting sick.	Fruits Vegetables	1 1	2 2	3 3	4 4	5 5

Part V. Self-Efficacy - Please indicate **how confident** you feel about **being able to consume the recommended number of servings** for Fruits and Vegetables.

Circle the best response from:

1=not at all confident 2= not too confident 3=confident 4= somewhat confident 5=very confident

I feel:		Confidence Not at all Very 1 2 3 4 5
1. I can keep these foods at hand/readily available.	Fruits	1 2 3 4 5
	Vegetables	1 2 3 4 5
2. I can eat the recommended number of servings of _____ when I eat on my own.	Fruits	1 2 3 4 5
	Vegetables	1 2 3 4 5
3. I can shop for a variety of _____.	Fruits	1 2 3 4 5
	Vegetables	1 2 3 4 5
4. I can make time to eat _____.	Fruits	1 2 3 4 5
	Vegetables	1 2 3 4 5
5. When I eat at home, I can eat more _____.	Fruits	1 2 3 4 5
	Vegetables	1 2 3 4 5

Part VII. 3 day Food Records - Finally, we would like to get your three-day food records (three 24 hour periods). Please read instruction below carefully all foods eat.

Instruction for 3-day food record

< For two consecutive weekdays (excluding Friday) and either Saturday or Sunday, record everything YOU eat and drink, excluding water. Record the food you eat on the Food Record Analysis Forms. Use one form for each day.

< Record, for each day, only the amount of each food you ACTUALLY EAT -This will not necessarily be the same amount that was on your plate.

< Keep each day's food record by clock time of day, starting with the first thing you eat or drink after 5:00 AM and continuing until 5:00 AM the next day. If you eat or drink during the night,- record this on the previous day's record, not on the next day's. Group the items you eat and/or drink together next to a single clock time. (Time - This means clock time, for example 7:00 AM or 3:30 PM.)

< The attached chart in page 5-6 will also assist you with accurately recording the foods your have eaten.

(Chart attached next to a 24 hour recall form)

24 HOUR FOOD RECORD

Day ____ of 3

Subject Number _____
Day of Week _____
Date _____

Time	Food item	Description And Preparation	Amount

Did you take a vitamin or mineral supplement today? Yes_____ No_____

If yes, Name and Brand and Number

_____

24 HOUR FOOD RECORD

Day ____ of 3

Subject Number _____
Day of Week _____
Date _____

Time	Food item	Description And Preparation	Amount

Did you take a vitamin or mineral supplement today? Yes_____ No_____

If yes, Name and Brand and Number

_____

24 HOUR FOOD RECORD

Day ____ of 3

Subject Number _____
Day of Week _____
Date _____

Time	Food item	Description And Preparation	Amount

Did you take a vitamin or mineral supplement today? Yes_____ No_____

If yes, Name and Brand and Number

_____

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