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PREDICTORS ASSOCIATED WITH DIETARY MODIFICATION AFTER A WORKSITE NUTRITION PROGRAM

By

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ABSTRACT

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By

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Nutrition programs for employee health promotion have become common in the past 10 years. A better understanding of individual determinants of dietary behavior and behavioral changes is necessary for the development of effective nutrition programs. The purpose of this study was 1) to identify predictors for changes in dietary fat intake at the end and at 4-month follow-up of the worksite nutrition programs; 2) to compare those who dropped out vs. completed the programs; and 3) to characterize people at each stage of change for reducing fat intake and at each stage of change for increasing fiber intake by dietary intake, blood lipids, body mass index (BMI), and psychosocial factors surveyed at the time of enrollment. A total of 128 women was recruited from 10-week worksite nutrition programs between 1994 and 1996. Dietary fat intake (% kcal) and motivation at enrollment were significant predictors for reduction of fat intake immediately after the nutrition program whereas initial BMI, previous weight loss experiences and perceived benefits of a healthy diet at enrollment as well as dietary fat intake (% kcal) and motivation were the predictors at the 4-month follow-up. Dropouts (n=40) were more likely to eat > 30% of kcal from fat (69% vs. 50%) and to be overweight (67 % vs. 40%) than those who completed the programs. Blood lipids and psychosocial factors did not differ between the two groups. The majority of subjects were

already in Preparation and Action stages of change for fat and stages of change for fiber. Compared to other stages of change, Maintenance stage had 1) lower fat and higher fiber intake; 2) higher perceived benefits of a healthy diet and motivation; 3) lower perceived barriers to a healthy diet. Innovative strategies are also needed to retain those who drop out from the programs as well as to advance the majority of the participants who enrolled in the program from the Action stage to the Maintenance stage. Worksite nutrition programs designed to increase motivation, the perceived benefits of a healthy diet and the prevention of relapse from previous weight loss experiences are needed to help participants adopt more healthful diets.

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Chapter One

Introduction

Nutrition programs have been used to promote weight control, cholesterol reduction and cancer prevention (Glanz and Seewald-Klein 1986; Kris-Etherton et al. 1988). Worksites are considered as an important channel to deliver these health promotion programs because they provide access to over 60% of adults of varying ages and health status (U.S. Department of Labor 1992). The percent of worksites that offer nutrition programs increased sharply from 48% to 78% for large worksites (more than 750 employees), and from 9% to 22% for small worksites (50-100 employees) between 1985-1992 (USDHHS, 1992).

A growing number of studies have provided evidence that worksite nutrition programs can be effective (Pelletier 1993; Haus et al. 1994; Sorensen et al. 1992; Briley et al. 1992; Hunt et al. 1993; Gorbach et al. 1990; Masur-Levy et al. 1990). However, most nutrition program are short, less than 6 months in duration and have not addressed the challenge of how to support the maintenance of modified dietary behaviors. Phenomena such as weight cycling demonstrate the questionable effectiveness of intervention programs in achieving long-term modifications even though short-term effects are encouraging. Health and medical researchers interested in reducing dietary

risks for chronic diseases have attempted to the identify fundamental factors which influence modification of dietary behaviors. Once those factors are identified, effective program strategies can be developed to improve nutrition programs.

Another problem is that the majority of the findings on the efficacy of worksite nutrition are based solely on data of those who completed the programs in reference to either baseline data of the same group or of a control group. High dropout rates (12-35%) have been reported as one of the programmatic problems in worksite nutrition programs (Bruno et al. 1983; Lovibond et al. 1996; Carmody et al. 1980; Dishman 1988). Little is known, however, about the characteristics of those who were apparently motivated to enroll but discontinued participation in the program.

In order to improve the effectiveness of nutrition programs, many theories and models have been used to explain an individual's dietary behavior. The Stages of Change model has been successfully used in helping people quit smoking and has only recently been tested in relation to dietary change. The Stages of Change Model (Prochaska and DiClemente 1983) proposes that change occurs through a series of stages: Precontemplation (unaware or not thinking about changing), Contemplation (seriously thinking about making a change), Preparation (making definite plans to change), Action (actively modifying an unhealthy behavior) and Maintenance (maintaining the new behavior for some time). Currently, the majority of nutrition interventions are "action-oriented" and provide skills and strategies for people who are ready for action to change behavior. It appears, therefore, beneficial to know the stages of dietary change for people who participate in an nutrition program before an intervention is introduced. Previous studies (Glanz et al.1994; Greene et al. 1995) reported in

previous population-based studies that about 65% of people were in Action or Maintenance stages of dietary change for fat. It is not clear about the distribution of the stages of dietary change for people who were recruited into nutrition programs. In order to use the stages of change model effectively in developing nutrition interventions, it is also important to understand the characteristics of each stage of change.

Many studies have found that various psychosocial factors such as belief in diet-disease connection, self-efficacy, attitude, and nutrition knowledge are associated with healthful diet behaviors (Patterson et al. 1996; Shepherd and Stockley 1987; Smith et al. 1995; Glanz et al. 1993; Brug et al. 1994; Kristal et al. 1995; Laforge et al. 1994). Most of these studies are cross-sectional in design and as such they cannot establish if psychosocial factors are associated with dietary changes after intervention studies or further our understanding of how these occur. Predictors of weight change after an intervention have been reported (Haus et al. 1994; French et al. 1994), but predictors of maintenance of weight loss are not likely the same as those for dietary modifications. We know little about the predictors of dietary modifications after the completion of nutrition intervention programs. Additionally, high serum cholesterol and overweight are important risk factors for chronic diseases. We wanted to know whether these risk factors are related to dietary changes in worksite nutrition programs.

One approach to developing effective strategies for dietary changes is to identify the predictive factors associated with dietary change. Once we can identify the factors that most strongly influence people to select healthful diets, we can more rationally design worksite nutrition programs. Therefore, the objectives of this study were:

1. To examine whether various psychosocial factors, the stages of change for reducing fat intake, blood lipids (total cholesterol, LDL-C/HDL-C), dietary intake and BMI at the time of enrollment can predict the dietary changes at the end and at a 4-month follow-up of the worksite nutrition program. (Chapter Three)
2. To identify predictors which can differentiate participants who were more successful at changing fat intake than those who were not at the end and at a 4-month follow-up of the program. (Chapter Three)
3. To examine whether participants who dropped out from worksite nutrition programs differ from those who completed the programs with respect to dietary intake, blood lipid profile, BMI, stages of change for fat and fiber, and various psychosocial factors. (Chapter Four)
4. To identify the stages of change for reducing fat intake and the stages of change for increasing fiber intake of those who participate in worksite nutrition programs. (Chapter Five)
5. To examine the stages of change for reducing fat intake and the stages of change for increasing fiber intake in relation to dietary intake, blood lipid profiles, BMI, waist/hip ratio and various psychosocial characteristics. (Chapter Five)

Chapter Two

Review of Literature

A. Worksite nutrition Programs

Nutrition programs for employee health promotion have become common in the past 10 years. Programs have primarily addressed weight control and cholesterol reduction because of their link with obesity, hypertension, increased risk of cardiovascular disease (Glanz et al. 1986). Dietary intake, food selection, and dietary behavior are paramount in the prevention of these risk factors and related diseases. (Kris-Etherton et al. 1988). Worksites are an important channel to deliver these health promotion programs because they provide access to over 60% of adults of varying ages and health status (U.S. Department of Labor 1992). The workplace provides many opportunities for reinforcement and environmental support for health promotion behaviors.

The success of worksite nutrition programs has been measured by the improvement in blood lipid levels, dietary intakes, and weight control.
Previous studies indicated that the reduction of fat intake or an increase of fiber intake can be implemented in a free-living population after the nutrition programs (Barratt et al. 1994; Baer 1993; Hebert et al. 1993; Briley et al. 1992; Masur-Levy et al. 1990). Weight

loss along with a decreased dietary fat intake were reported by most of the weight control and cancer prevention programs (Fisher and fisher 1995; Haus et al. 1994; Johnston et al. 1994; Harris et al.1994; Shannon et al. 1987). A decreased total serum cholesterol level and LDL-C or improved ratio of total cholesterol to HDL-C were observed in the participants with elevated total serum cholesterol level in most of the cholesterol reduction programs (Perovich and Sandoval 1995; Byers et al. 1995; Fisher and Fisher 1995; Angotti and Levine 1994; Johnston et al. 1994; Baer 1993; Hebert et al. 1993; Briley et al. 1992; Shannon et al. 1987). However, most studies have focused on the short-term evaluation of interventions (6 to 12 weeks) and their results may not be valid or predictive for the long-term success of intervention. The health benefits are likely to be sustained only if positive dietary change is made and maintained for a long term. The few studies which included follow-up surveys have reported limited success in maintenance after interventions (Haus et al. 1994; Harris et al. 1994; Sorensen et al 1996). In fact, a high recidivism rate had been found in several weight maintenance studies (Foster et al. 1988; Hovell et al. 1988; Wooley et al. 1991; Haus et al. 1994).

Another problem is that average values for dietary fat, blood lipid levels and body weight were reported to show the impact of the dietary intervention (Table 1). From such aggregate data, we cannot tell whether everyone made the similar improvements on dietary intake after participating nutrition interventions. If not, who are those individuals with significant dietary change after intervention and how are they different from those who did not make significant dietary changes. The third problem for worksite nutrition programs is that the efficacy of programs is based solely on data of those who completed

Table 1. Summary of worksite nutrition programs reported in the literature

Author and Year	Sample	Intervention	Length of Intervention	Design and Measures	Results
Cholesterol reduction programs					
Angotti and Levine 1994	n=415	Combined dietary and exercise intervention	8 weeks	Pretest/post-test; Measures: Blood lipids	Improved total serum cholesterol/HDL-C ratio and lower LDL-C
Barratt et al. 1994	n=683 w/ total serum cholesterol > 5.2 mmol/L	Group A: received a self-help package "Food for a healthy heart"; Group B: received a nutrition course (5 one-hour sessions by dietitians)	5 weeks; 6-month follow-up	Pretest/post-test; Measures: Blood lipids Dietary intake - FFQ: 179 items	Decreased dietary fat intake in both groups at follow-up; No change in total serum cholesterol or HDL-C for both groups at follow-up.
Johnston et al. 1994	n=147; w/ total serum cholesterol > 5.2 mmol/L; total serum cholesterol/HDL-C >4.5	Group A: received group diet instruction; Group B: received a self-directed diet education program "self-care for a healthy heart".	12 weeks	Pretest/post-test; Measures: Blood lipids Body weight Dietary intake -24-hr diet recall	Significantly decreased total serum cholesterol and BMI in both groups.

FFQ: Food frequency questionnaire

Table 1. Summary of worksite nutrition programs reported in the literature (cont'd)

Author and Year	Sample	Intervention	Length of Intervention	Design and Measures	Results
Cholesterol reduction programs					
Hartman et al. 1993	n=84; w/total serum cholesterol >5.2 mmol/L	Eating-pattern messages were used to promote behavior change which focused on the skills needed to decrease total dietary fat.	8 weeks	Pretest/post-test; Measures: Blood lipids Eating pattern	Changes in eating behaviors were related to improvements in total serum cholesterol and LDL-C
Masur-Levy et al. 1990	n=216	Encouraged behaviors to reduce the risk of acquiring or promoting cardiovascular disease.	3 weeks	Pretest/post-test; Body weight Blood pressure Blood lipids Cardiovascular risk behaviors	No changes in total serum cholesterol; dietary fat, blood pressure decreased significantly.
Perovich and Sandoval 1995	n=956	Based on the guidelines from the National Cholesterol Education Program; included strategies for risk reduction of coronary heart disease	4 weeks	Pretest/post-test; Measures: Blood lipids Body weight	Significantly decreased total serum cholesterol in participants with total serum cholesterol >5.2 mmol/L, but not in participants with total serum cholesterol <5.2 mmol/L.

Table 1. Summary of worksite nutrition programs reported in the literature (cont'd)

Author and Year	Sample	Intervention	Length of Intervention	Design and Measures	Results
Cholesterol reduction programs					
Byers et al. 1995	n=2067	Participants were screened for blood cholesterol and received 5 minutes counseling; 2 hours nutrition education for dietary changes	4 weeks	Intervention vs. control; Measures: Blood lipids	Intervention group had a 6.5% drop in cholesterol levels vs. 3% in the control group.
Hebert et al. 1993	n=2000	Direct nutritional education and food demonstration		Intervention vs. control; Measures: Dietary intake -FFQ:67 items	Decreased in dietary fat intake; no difference in fiber intake. Increased vitamin A and carotene intake as well as vegetable consumption.
Greene and Strychar 1992	n=355	Video tape program "Heart healthy" Two 15-minute video tapes.	2 weeks; 4-month follow-up	Pretest/posttest	Improved nutrition knowledge and dietary behavior

Table 1. Summary of worksite nutrition programs reported in the literature (cont'd)

Author and Year	Sample	Intervention	Length of Intervention	Design and Measures	Results
Cholesterol reduction and weight control programs					
Baer 1993	n=33	Comprehensive nutrition education program with exercise prescription, individual dietary instruction and counseling, behavior self-management, group meetings, and phone follow-up	1 years	Intervention vs. control; Measurement: Dietary intakes Self efficacy Body weight Body fat Blood lipids	Decreased intake of calories and cholesterol and increased intake of carbohydrates and dietary fiber. Decreased total blood cholesterol, triglycerides, body weight, and body fat. Increased self-efficacy. No changes in control group.
Briley et al. 1992	n=28	During the first 6 months, subject and family attended five 2-hour seminars, individual counseling every 2 months.	1 year	Pretest/post-test; Measures: Dietary intakes Blood lipids Body weight	Dietary fat (% kcal from fat) decreased from 42% to 36%; Dietary cholesterol decreased from 405 mg to 295 mg; Total serum cholesterol and body weight decreased significantly after intervention

Table 1. Summary of worksite nutrition programs reported in the literature (cont'd)

Author and Year	Sample	Intervention	Length of Intervention	Design and Measures	Results
Weight control programs					
Shannon et al. 1987	n=75	Nutrition and weight control programs conducted by company nurses; 1 30-minute session/week	9 weeks	Intervention vs. control; Measures: Body weight Dietary intake - FFQ: 30 items	Mean weight loss was 8.5 lbs, compared to 0.7 lb for controls; Compared to the control group, the intervention group showed greater improvement in attitude toward the importance of nutrition eating behavior.
Haus et al. 1994	n=29	Weight control program	6 months; 6-24 month follow-up	Pretest/post-test; Measures: Body weight Waist/hip ratio Weight history Social support Physical activity Dietary intake -24-hr diet recall	One third of the participants maintained their weight losses with 2 kg at follow-up, although all had higher relative weight at follow-up than immediately after the program. High fat consumption correlated with increased relative weight at follow-up

Table 1. Summary of worksite nutrition programs reported in the literature (cont'd)

Author and	Sample	Intervention	Length of Intervention	Design and Measures	Results
Weight control programs					
Harris et al. 1994	n=157	Diet and exercise program	18 months	Pretest/ post-test; Measures: Body mass index Dietary intake	BMI change was inversely related to change in frequency of vegetable consumption; Changes in % kcal from fat predict BMI better than changes in total calories

the nutrition programs in reference to either baseline data of the same group or a control group (Table 1). The forth problem is that high dropout rates (12-35%) have been reported as one of the programmatic problem in worksite nutrition programs (Bruno et al. 1983; Livibond et al. 1996; Dishman 1988; Carmody 1980). However, there is a lack of research to characterize the people who joined these programs but dropped out during the programs. These problems have made it difficult to draw conclusions about the efficacy of worksite nutrition programs.

In order to understand more about the those problems such as predictors of dietary change and characteristics of dropouts from nutrition program, we reviewed the previous studies and summarized the variables which have been associated with dietary behaviors. (Chapter two: B. Relationship between psychosocial factors and dietary behaviors; C. Application of the stages of change model to dietary change; and D. High blood cholesterol and overweight)

B. Relationship between psychosocial factors and dietary behaviors

Nutrition programs to improve health through promotion of desirable eating patterns are more likely to be effective when based on an understanding of factors influencing dietary behaviors. A number of theoretical model such as Social Learning Theory (Bandura 1986), the Reasoned Action theory (Ajzen and Fishbein 1980), and the Health Belief Model (Rosenstock 1983) have been used to investigate the association between psychosocial factors and dietary behaviors. Previous research had addressed how each model relates to healthful eating (Dittus et al. 1995; Ferrini et al. 1994; Smith and Owen 1992). Several studies have also tested combinations of variables based on more than one model (Glanz et al. 1993; Kristal et al. 1995; Patterson et al. 1995; Contento and Murphy 1990). A summary of the association between various psychosocial factors and dietary behaviors is presented in Table 2.

Key elements of these theoretical models are belief about diet and health, perceived benefits, perceived barriers, self-efficacy, social support, nutrition knowledge, and perceived norms (Table 2). Overall, some consistency is found in the findings of this diverse research, in that belief in a strong relationship between diet and health and knowledge of diet recommendation are associated with healthful dietary behaviors (Patterson et al. 1995; Contento and Murphy 1990; Smith and Owen 1992; Glanz et al. 1993) . There is less consistency about social support and perceived norms influencing dietary habits (Glanz et al. 1993; Patterson et al. 1995; Shepherd and Stockley, 1987).

Most of these observations between psychosocial factors and dietary behaviors are, however, based on cross-sectional data. Therefore, it is not entirely clear whether

psychosocial factors are associated with dietary change after nutrition interventions. Attempts to identify indicators for predicting success in weight loss have been made (Haus et al. 1994; French et al. 1994; Klesges et al. 1992), but not for dietary modification. Demographic characteristics, dietary composition, social support, and weight cycling history had been found as important predictors for weight control after interventions (Haus et al. 1994; French et al. 1994; Klesges et al. 1992). Predictors of weight control, however, are not necessarily the same as those for dietary change. To our knowledge, no previous studies have reported on the predictors of dietary modification after completion of a nutrition program. Since dietary habits pose a health risk factor to many health conditions, identification of predictors of successful change in dietary habits is important.

Table 2. Previous studies reporting the association between various psychosocial factors and dietary behaviors

Authors and Year	Sample	Design and Measures	Results
Patterson et al. 1995	n=1,972	Cross-sectional design Psychosocial constructs: Belief Knowledge Norms Dietary assessment: Self-reported healthful diet changes over the previous 5 years	Belief and knowledge were significantly associated with a healthful diet intake. Perceived norms were strongly associated with reported diet changes.
Brug et al. 1994	n=1,507	Cross-sectional design Psychosocial constructs: Self-rated dietary fat intake Intention to change diet Dietary assessment: FFQ (25 items)	Self-rated dietary fat intake was a significant correlate of intention to reduce fat consumption among women. Underestimation of one's own dietary fat intake could be a major barrier in healthy diet promotion aimed at reducing fat consumption.
Dittus et al. 1995	n=1069	Cross-sectional design Psychosocial constructs: Benefits of fruit and vegetable intake Barriers to fruit and vegetable intake Susceptibility to cancer Dietary assessment: FFQ (76 items)	Barriers to fruit and vegetable consumption were associated with fruit and vegetable consumption behaviors.

FFQ: Food frequency questionnaire

Table 2. Previous studies reporting the association between various psychosocial factors and dietary behaviors (cont'd)

Authors and Year	Sample	Design and Measures	Results
Glanz et al. 1993	n=652 working men and women (M:55%)	Cross-sectional design Psychosocial factors: Belief in diet-disease connection Perceived benefits of healthy diet Perceived barriers to healthful diet Perceived norms for healthful diet Knowledge Social support Motivation, interest in changing diet Self-efficacy for changing diet Experience with weight loss attempts Dietary intake: FFQ (25 items)	Self-rated diet, experience with weight loss attempts and motivation to eat low-fat foods were strongly associated with dietary intake. Belief, barriers, norms, social support, and knowledge were weakly associated with dietary intake of fat and fiber
Smith and Owen 1992	n=874	Cross-sectional Psychosocial constructs: Belief: diet and health Expectations Dietary assessment: FFQ (172 items)	More positive beliefs: diet and health and expectations were associated with lower dietary fat and higher dietary fiber densities.

Table 2. Previous studies reporting the association of various psychosocial factors and dietary behaviors (cont'd.)

Authors and Year	Sample	Design and Measures	Results
Stafeleu et al. 1994	n=419	Cross-sectional design Psychosocial constructs: Attitudes towards high-fat foods and their low-fat alternatives	Attitude toward high-fat foods and their alternatives explained 25% of the variance for % kcal from fat
Shepherd and Stockley 1987	n=210	Cross-sectional design Psychosocial factors Nutrition knowledge Attitude Perceived norm	Knowledge of food composition was not associated with frequency of high fat food intakes Personal attitudes predicted consumption of high-fat foods more than perceived norms.
Contento and Murphy 1990	n=64	Cross-sectional design Psychosocial constructs: Perceived benefits Perceived susceptibility Perceived barriers Self-efficacy Belief in diet and health Motivation to comply Dietary assessment: Self-reported dietary change for the past five years	Perceived benefits, belief and personal susceptibility to diet-related diseases were the most important factors for dietary change. Self-efficacy was weakly associated with dietary change

C. Application of the stages of change model to dietary change

The stages of change model has been used successfully in predicting health-related behaviors such as smoking cessation and exercise adherence (Prochaska and DiClemente 1983; Marcus et al. 1992); the model has only recently been tested in relation to dietary change. The stages of change model proposes that behavior change occurs through a series of five stages: Precontemplation (unaware/not thinking about changing), Contemplation (seriously thinking about making a change), Preparation (making definite plans to change), Action (actively modifying an unhealthy behavior) and Maintenance (maintaining the new behavior for some time) (Prochaska and Diclemente 1983). While the stages are sequential, individuals do not necessarily progress through the stages in a linear fashion, but rather, may relapse and repeat stages (Prochaska et al. 1992).

Application of the stages of change model to dietary change poses methodological challenges especially in classifying people according to the stages. Dietary behaviors are changed rather than ceased as in the case of smoking. Furthermore, dietary references such as 30% of energy from fat present complex concepts while dietary behaviors change daily.

Currently, developing a method to identify an individual's stage of change is an area of much research. A summary of some published studies on developing the algorithm for dietary change is presented in Table 3. Greene et al (1995) developed an algorithm to assess stages of change for fat intake using the criterion for effective action of fat intake $\leq$ 30% kcal and tested in a mail survey with adults and university staff and

graduate students (n=184). The algorithm was based on subjects' behaviors related to the avoidance of high-fat foods. Curry et al. (1994) developed an algorithm based on Prochaska and DiClemente's series of mutually exclusive questions normally used for smoking cessation and tested in a random-digit dial telephone survey (n=1083). Both algorithms demonstrated that a liner decrease in % kcal as fat from Precontemplation to Maintenance stages and significant differences in fat intake were seen mainly between those in pre-action stages of change and those in the Action or Maintenance stages. The majority of people in these two studies were classified in the Action and Maintenance stages (60-62%). Consistent with the findings of Curry et al. (1994) and Greene et al. (1994), Glanz et al. (1994) tested an instrument designed to determine stage of change for fat and fiber consumption in a large study in United States (n=17,121) and reported little difference in % kcal from fat between the three pre-action stages. The largest difference was found between those classified in the pre-action and those in the Maintenance stage. Sixty-three percent of subjects were classified in Action or Maintenance stages for fat while only 51% of subjects were classified in Action or Maintenance stages for fiber. Little was known about the stages of change for reducing fiber intake (Loforge et al. 1994; Glanz et al. 1994). Loforge et al (1994), one of the few studies, tested an algorithm relating to stages of change for fruit and vegetables consumption (n=405). They found that only 15% of subjects were classified in the Action or Maintenance stages, whereas 67% were classified in either Precontemplation or Contemplation and 19% were classified in Preparation.

Age, education and gender were associated with stages of change in the previous

studies (Curry et al. 1992; Sporny and Contento 1995; Glanz et al. 1994). Those in Maintenance stage for either fat or fiber behaviors are more likely to be female, older, and highly educated. Sporny and Contento (1995) investigated psychosocial variables that have been used in other theory-driven studies of everyday food selection in relation to stages of dietary change. They found that reduction of perceived barriers, mostly in terms of taste and perceived difficulty of performing needed behaviors, and increased overall health concerns, social modeling, and self-efficacy were associated with taking action and maintaining the behavior change.

Table 3. Previous studies of stages of change model on dietary behaviors

Author and Year	Sample	Measures	Results
Glanz et al. 1994	n=17,121; Mail survey	Stage of change for reducing fat intake Stage of change for increasing fiber Dietary intake - FFQ (88 items)	Little difference in % kcal from fat between those in Precontemplation to Preparation stages, and the largest difference (6%) was between those in pre-action stage and those in Maintenance stage. 63% of subjects were in Action or Maintenance stages for fat while only 51% of subjects were in Action or Maintenance stages for fiber.
Curry et al. 1992	n=1,083; Telephone survey (random-digit)	Stage of change for reducing fat intake Dietary intake- Food frequency instrument, Kristal et al. (1990)	Little difference in % kcal from fat between those in Precontemplation through to Preparation stages. 62% of subjects were in Action or Maintenance stages of change for fat.
Greene et al. 1994	n=194; Mail survey	Stage of change for reducing fat intake Dietary intake-Food frequency instrument, Kristal et al .(1990)	Little difference in % kcal from fat between Precontemplation and Contemplation stages. Range from 39% kcal from fat in Precontemplation to 32% kcal from fat in Maintenance stage. 60% of subjects were in Action or Maintenance stages of change for fat.
Laforge et al. 1994	n=404; Telephone survey (random-digit)	Stage of change for fruit and vegetable intake Dietary intake- 24-hour diet recall	15% of subjects were classified in Action or Maintenance stages, whereas 67% were classified in either Precontemplation or Contemplation stages and 19% were classified in Preparation stages of change for fruit and vegetable intake.

D. High blood cholesterol and overweight

High blood cholesterol

High blood cholesterol is defined as a total cholesterol of 240 mg/dL or greater, however, a blood cholesterol above 200 mg/dL has been shown to increase the risk of developing heart and blood vessel disease (National Cholesterol Education Program 1993). Studies have documented an association between elevated level of blood cholesterol, development of atherosclerosis and heart disease risk, and risk increases directly as blood cholesterol level increases. Adults with high blood cholesterol are twice as likely to have heart disease as those with normal blood cholesterol levels (below 200 mg/dL).

Effective dietary interventions have been demonstrated to result in decreased total serum cholesterol level and LDL-C or improved ratio of total cholesterol to HDL-C in participants with elevated total serum cholesterol level in most of the cholesterol reduction programs (Perovich and Sandoval 1995; Byers et al. 1995; Fisher and Fisher 1995; Angotti and Levine 1994; Johnston et al. 1994; Baer 1993; Hebert et al. 1993; Briley et al. 1992; Shannon et al. 1987) while a lack of changes in total serum cholesterol levels was reported in some studies (Barratt et al. 1994; Masur-Levy et al. 1990). The conflict in the literature may due to the difference in content of the programs or the intervention protocol such as the length of intervention programs.

Perovich and Sandoval (1995) reported a significant interaction between the risk category and change in total serum cholesterol over time. People in high risk categories of serum cholesterol decrease their serum cholesterol more that those in moderate or low

risk categories after nutrition programs. Thus, we wanted to know whether individuals with high serum cholesterol at the time of enrollment in the program were more likely to make dietary changes in worksite nutrition programs.

Overweight

Being overweight is a significant contributor to risk for chronic disease (Berg 1992). The best current recommendation for reduction of chronic disease risk associated with obesity is to prevent becoming overweight. However, some research suggests that for those who are overweight even moderate weight loss (10% of body weight) does reduce health risks of obesity (Glodstein 1992). Increased risk of cardiovascular disease is generally recognized to be the primary relationship underlying the observed association between obesity and increase mortality (Hubert et al. 1983; Sorlie 1980). Obesity has also been associated with an increased prevalence of other conditions, such as osteoarthritis (Davis et al. 1988), gallbladder disease (Haffner et al. 1989), and some types of cancer (Doll and Peto 1981).

The BMI reference standards used to categorize weight status were based on the Second National Health And Nutrition Examination Survey 1976-1980 (NHANES II) sex-specific BMI distributions for person 20-29 years of age (Nation Center for Health Statistics 1987). The rationale for this choice was that people 20-29 years of age are relatively lean, i.e., closest to a population with a "healthy" body weight, and that weight gained after age 29 is predominantly fat (National Center for Health Statistics, 1983). The definition of overweight for men was a BMI of 27.8 kg/m^2 or greater; for women

overweight was defined as a BMI of 27.3 kg/m^2 or greater (greater or equal to the 85th percentile).

Changing dietary habits are consistently emphasized for weight control program. Weight loss along with a decreased dietary fat intake were reported by most of the weight control and cancer prevention programs (Fisher and fisher 1995; Haus et al. 1994; Johnston et al. 1994; Harris et al.1994; Shannon et al. 1987). On the other hand, a high recidivism rate had also been found in several weight maintenance studies (Foster, et al 1988; Haus et al. 1994) Haus et al. (1994) indicated people who regained the weight lost after nutrition intervention had higher BMI at the time of enrollment than those who maintained the weight loss. Thus, we wanted to know whether BMI at the time of enrollment is related to dietary change after the worksite nutrition programs.

Chapter Three

Change in fat intake of women after a worksite nutrition programs predicted by blood lipids, BMI, dietary intake, stages of change and various psychosocial factors

A. ABSTRACT

The objective of this study was to identify factors which predicted reduction in dietary fat intake of women at the end and at 4-month follow-up of 10-week worksite nutrition programs. Blood lipid, body mass index (BMI), dietary intake, stages of change and psychosocial factors assessed in 65 women (44±9 yrs) at enrollment were used to predict the change in dietary fat intake which was estimated from 3-day dietary records. Compared to the fat intakes at the time of enrollment, % kcal from fat at the end and at the follow-up of the program decreased on average 2.9±3.0% (mean±s.d.; $p<0.05$) and 1.5±1.9% (n.s.), respectively. Dietary fat intake (% kcal) and motivation at the time of enrollment predicted the reduction in fat intake after the nutrition program, explaining 37% of the variance. At the 4-month follow-up, dietary fat (% kcal), motivation, BMI, previous weight loss experiences and perceived benefits of a healthy diet at enrollment were significant predictors for reducing fat intake, explaining 50% of the variance. Blood lipids and stages of change did not predict changes in dietary fat. Risk factors for chronic diseases such as high fat intake or high BMI at the time of the enrollment were associated with dietary changes after the nutrition program.

B. INTRODUCTION

Dietary modification programs have been used to promote weight control, blood cholesterol reduction and cancer prevention (Glanz and Seewald-Klein 1986; Kris-Etherton et al. 1988) and a growing number of studies have provided evidence that such programs can be effective (Pelletier 1993; Haus et al. 1994; Sorensen et al. 1992; Briley et al. 1992; Hunt et al. 1993; Gorbach et al. 1990; Masur-Levy et al. 1990). However, most interventions are short, with less than 6 months duration, and do not address the challenge of how to support the maintenance of modified dietary behaviors. Phenomena such as weight cycling demonstrate the questionable effectiveness of intervention programs in achieving long-term dietary modification even though short-term effects are encouraging. Health and medical researchers interested in reducing dietary risks for chronic diseases have attempted to identify fundamental factors which influence modification of dietary behaviors. Once those factors are identified, effective program strategies can be developed to improve nutrition programs.

Many studies have found that various psychosocial factors such as belief in diet-disease connection, self-efficacy, attitude, and nutrition knowledge are associated with healthful diet behaviors (Patterson et al. 1996; Shepherd and Stockley 1987; Smith et al. 1995; Glanz et al. 1993; Brug et al. 1994; Kristal et al. 1995; Laforge et al. 1994). Most of these studies are cross-sectional in design and as such they cannot establish if psychosocial factors are associated with dietary changes in interventions studies. Previous studies have identified the predictive factors of weight change after the intervention (Haus et al. 1994; French et al. 1994), but predictors of weight change are

not likely the same as those for dietary change. We know little about the predictive factors of dietary change after completion of nutrition intervention programs designed to reduce dietary fat intake. Since certain dietary behaviors such as high fat and low fiber intakes pose significant disease risk, it is important to identify the predictive variables to successful dietary changes.

In order to improve the effectiveness of nutrition programs, many theories and models have been used to explain an individual's dietary behavior. The Stages of Change Model addresses the readiness to make behavioral changes (Prochaska and DiClemente 1983). The model has been successful in predicting smoking cessation, but only recently has been applied to dietary behaviors, such as fat consumption. Researchers have found an association between stages of change and dietary fat intake in cross-sectional studies (Glanz et al. 1994; Greene et al. 1994). However, this model has not yet been clearly tested in relation to dietary changes over time.

Additionally, high serum cholesterol and overweight are important risk factors for chronic diseases. We wanted to know whether or not these risk factors are related to dietary changes after the worksite nutrition programs.

The objectives of this study were: 1) to examine whether various psychosocial factors, stages of change for reducing fat intake, blood lipids (total cholesterol, LDL-C/HDL-C), dietary intake (fat and fiber) and BMI at the time of enrollment can predict the dietary changes at the end and at a 4-month follow-up of a worksite nutrition programs; and 2) to identify predictors which can differentiate participants who were more successful at changing fat intake than those who were not at the end and at a 4-

month follow-up of the program.

C. METHODS

Worksite nutrition programs

Ten-week nutrition programs have been offered since 1988 without charge as part of the health promotion program at a large midwestern university. Faculty and staff are informed of the nutrition program through brochures, flyers, and university newspapers. The program consisted of one-hour weekly meetings for ten weeks and the purpose was to promote healthy eating habits by lowering fat intake and increasing dietary fiber intake. The curriculum included recommendations for daily fat and dietary fiber intakes, modification of recipes, cooking techniques for low fat and high fiber foods, fat and fiber contents of foods, interpretation of food labels, suggestions for dining out, principles of weight control and exercise, and behavior modification strategies. Both knowledge and skills were provided for the participants to help them incorporate strategies for low fat and high fiber dietary behaviors into their individual dietary preferences and lifestyle. Two or three programs were offered each semester, averaging 12 participants in each program. The nutrition programs were taught by three leaders: one nutrition specialist with nutrition and exercise physiology degrees; and two well-trained senior dietetics students.

Data collection

A total of 151 participants enrolled in the worksite nutrition interventions

conducted between 1994-1996. The small number of men were excluded from this study (136 women; 15 men) to reduce the confounding effect of gender. Those who dropped out during the first four weeks of the program (n=40) or those who were unable to complete one of the measurements (n=31) were excluded from further analyses. Comparison of those who dropped out vs. completed the nutrition program have been presented elsewhere (Huang et al., 1995; Chapter Four). Data from the final sample of 65 women were used for data analyses in this study.

This study was approved by the University Committee on Research Involving Human Subjects (Michigan State University) and informed consent was obtained from all subjects. During the first week of the intervention program, the subjects were instructed to keep a 3-day diet record and to complete a questionnaire on psychosocial factors and stages of change. Blood lipids (total cholesterol, LDL-C, and HDL-C) and anthropometric measurements (weight and height) were conducted at the Nutrition Assessment Laboratory. Feedback on the dietary intake and blood lipids results were provided to each subject in the subsequent meeting. The same procedures were repeated at the end and at a 4-month follow-up of the program.

The number of participants who signed up for the nutrition programs did not differ among seasons (fall semester vs. spring semester). No significant differences were observed in the demographic characteristics, BMI (kg/m^2), or dietary intake at enrollment among subjects in the eight programs conducted during these two years. All data, therefore, were combined for subsequent analyses.

Variables and measurements

Dietary intake data for fat and fiber were obtained from a 3-day food record. The record required a detailed description of types and amounts of foods and beverages consumed for two non-consecutive weekdays and one weekend day. A detailed instruction for the food record was provided with an example of the types and amounts of food and beverages. Nutrient composition of the diet was analyzed using MSU NutriGuide diet analysis software (Song WO, Version 2.0, Michigan State University, East Lansing, MI). The nutrient composition database of the software was originated from Michigan State University's main-frame database, supplemented with USDA's Revised Agriculture Handbook 8 and data from food manufacturers. The nutrient database is 98% complete for fat and 99% for dietary fiber.

Psychosocial factors included belief in diet-disease connection, perceived benefits of a healthy diet, perceived barriers to a healthy diet, social support, perceived norms for healthy eating, motivation, self-efficacy for change, and weight loss experience. The instrument was a 24-item questionnaire which was developed and validated by Glanz et al.(1993) for the "Working Well Study". The questions were written in a Likert scale format with a five-category continuum from strongly negative=1 to strongly positive=5.

Stages of change for reducing fat intake and stages of change for increasing fiber intake were determined based on combinations of five items from the psychosocial factor questionnaire. Those five items were self-rated diet, how long a low-fat or high-fiber diet had been followed, behavioral intentions to change diet, attempts to make dietary changes, and the reported success of those change efforts. The five questions were

combined into an algorithm to classify the subject into one of five stages of changes for reducing fat intake or increasing fiber intake: Precontemplation, Contemplation, Preparation, Action, or Maintenance (Glanz et al. 1994).

Anthropometric measurements consisted of height and weight. The measurements were done following standard procedures (Lohman 1988), using a stadiometer and a calibrated balance beam scale (Holtain Portable stadiometers, Seritex Inc). Body mass index was calculated based on the formula: weight (kg) / height $(m)^2$. Subjects with BMI ≥ 27.3 kg/m^2 were considered overweight (National Institutes of Health, Consensus Development Panel 1995).

Blood lipids consisted of fasting plasma concentration of total cholesterol, HDL-C, and triglyceride from a blood sample collected by a finger prick (approximately 0.3 ml). Plasma was separated from whole blood which was collected into a tube containing lithium-heparin anticoagulant (Microcuvette LH CB 300, Sarstedt). Analytical procedures were performed using Kodak Ektachem DT60 Analyzer, DTE module. Total cholesterol, HDL-C, triglyceride were determined based on a colorimetric method. Plasma concentration of LDL-C was calculated by the formula: LDL-C (mmol/L) = total cholesterol- HDL-C-triglyceride/5. Cutoff points were used to classify subjects into different risk levels of total serum cholesterol: moderate risk (>5.20 and ≤ 6.24 mmol/L); high risk (>6.24 mmol/L) (National Cholesterol Education Program 1993).

Statistical analyses

Statistical Package for the Social Science (Windows version 6.1, 1996, SPSS Inc,

Chicago, IL) was used for statistical analyses. Multiple regression analyses were performed using the changes in dietary fat at the end of intervention and at the 4-month follow-up as the dependent variables. Changes in dietary fat were defined as the difference in dietary fat intakes (% kcal from fat) between the enrollment and at the end of the program; and between the enrollment and the 4-month follow-up. Dietary fat (% kcal) and fiber intakes (g/1000 Kcal), BMI ($\leq$ 27.3 kg/m^2; 27.3-36 kg/m^2; >36 kg/m^2), blood lipids ($\leq$ 5.20 mmol/L; 5.21-6.24 mmol/L; >6.24 mmol/L), various psychosocial factors (1-5 point scale), and stages of change (Precontemplation=1, Contemplation=2, Preparation=3, Action=4, Maintenance=5) at enrollment of the intervention were used as predictors (independent variables) for dietary changes. Initially, all variables described above were included in the model. A backward elimination precedure was used with the criterion for inclusion set at $p<0.10$. Variables not reaching this criterion were eliminated from the model.

Discriminate analyses were used to identify the differentiating predictors for those who were successful in changing fat intake (benefit group) vs. those who were not (no-benefit group) at the end and at the follow-up of the program. Participants were ranked and separated into tertiles based on the changes in fat intake (% kcal) at the end of the program. Those who were at the top and bottom tertiles in changing fat intake represented the benefit group and no-benefit group, respectively. Predictors (independent variables) described earlier were considered in a stepwise discriminate model to characterize the two groups. The same procedures were repeated to identify the predictors for the dietary changes at 4-month follow-up. Discriminate analysis provided maximal

discrimination between the members of two groups with the coefficients indicating the estimates of the relative importance of the variables to discriminate between the benefit and no-benefit groups.

D. RESULTS

Characteristics of subjects

A total of 65 women completed the measurements at enrollment and the end of the program. They were predominantly Caucasian (97%) and staff (98%) on campus with an average age of 44±9 years (mean ±s.d.): 27% between 25-39, 48% between 40-49, 22% between 50-59 and 3 % over 60 years of age. Descriptive statistics for dietary fat and fiber intakes, blood lipids, BMI, and various psychosocial factors at enrollment are summarized in Table 1. Mean % kcal from fat and fiber density were 30.8 ± 6.0 % (mean ± s.d.) and 9.5 ± 3.6 g /1000 kcal, respectively. Fifty-one and eighty-five percent of subjects at enrollment did not meet the dietary recommendations for fat (≤ 30% kcal from fat) and fiber (≥ 12.5 g/1000 kcal), respectively. About half of the subjects were at health risk with total serum cholesterol >5.20 mmol/L and/or BMI > 27.3 kg/m^2. According to the stages of change algorithm, the majority of the subjects were in Action stages (55%), followed by Preparation (23%) (Figure 1). The distributions of most of the psychosocial factors were highly skewed toward strong agreement. Ninety percent of subjects had prior weight loss experiences and 62% had previously lost the weight they wanted to lose but either had gained back all or some of the weight.

Changes of dietary fat, body weight, and blood lipids

The mean (±s.d.) dietary fat intake was 30.8±6.0, 27.9±6.8 and 29.1±7.4% kcal from fat at enrollment, at the end and at the 4-month follow-up of the program, respectively (Table 2). Compared to fat intake at enrollment, % kcal from fat at the end and at the follow-up of the programs decreased on average 2.9± 3.1% ($p<0.05$) and 1.5±1.9% (ns), respectively. Energy intakes had decreased by the end of program and at the 4-month follow-up ($p<0.05$). Body weight, serum cholesterol and HDL-C had not changed significantly at the end or at the follow-up (Table 2).

Predictors of change in dietary fat

Table 3 shows the regression coefficients and standard errors of the variables which are significantly associated with decreasing fat intakes at the end of program and at the 4-month follow-up. Dietary fat intake and motivation (i.e., how important to you is eating low-fat foods) at the time of enrollment predicted reduction in fat intake ($p< 0.05$) at the end of the nutrition programs, explaining 37% of the variance. The reduction of % kcal from fat was 4.7±6.0% (mean ±s.d.) and 0.3 ±1.5 % for those with >30% of kcal from fat and those with≤ 30% of kcal from fat at enrollment, respectively. Subjects who strongly agreed with the importance of eating low fat foods reduced their fat intakes more than those who strongly disagreed. Dietary fat intake and motivation at the time of enrollment also predicted the change at the 4-month follow-up. In addition, BMI, weight loss experience, and perceived benefits of a healthy diet at enrollment were significant predictors for reducing fat intake ($p<0.05$). These five predictors accounted for 50% of

the variance in reduction of fat intake at the follow-up. Subjects with higher BMI at enrollment were less likely to reduce their dietary fat intake than those with lower BMI. Those whose BMI $\leq$ 27.3 kg/m^2 reduced their fat intake from 31.1±5.4 % to 28.2±7.0% whereas those with BMI > 27.3 kg/m^2 increased their fat intake from 29.5± 5.9% to 31.1±7.0%. Blood lipids, stages of change, and some of the psychosocial factors (i.e., belief in diet-disease connection, social support) were not significantly associated with reduced fat intakes after the nutrition program or at the 4-month follow-up.

Differentiating predictors for benefit group vs. no-benefit group

At the end of the program, subjects categorized in the benefit group (top-tertile; n=22) reduced their dietary fat intakes from 33.4±4.5% to 23.5±5.2% (mean ± s.d.), while those who were in the no-benefit group (bottom- tertile; n=22) increased their dietary fat intakes from 27.4 ±5.2% to 31.8 ±5.4%. Those two groups could be discriminated by their enrollment data of dietary fat, BMI and motivation ($p<0.05$) (Table 4). Overall, subjects could be correctly classified into the benefit group or no-benefit group based on those three differentiating predictors, 76% of the time (probability). At the 4-month follow-up, subjects in the benefit group (n=19) changed their fat intake from 32.7±4.4% to 23.8 ±6.1%, while those who were in the no-benefit group (n=19) changed their fat intake from 26.5±4.4% to 35.4±6.1% (Table 4). Among all of the variables, dietary fat intake, BMI, and self-efficacy for change at enrollment were effective discriminators for two groups at the 4-month follow-up ($p<0.05$). Based on these three differentiating predictors, subjects could be correctly classified into the benefit group and no-benefit group at the follow-up, 83% of the time (probability).

E. DISCUSSION

This study identified the predictors related to reduction of fat intake after the worksite nutrition programs and but also at the 4-month follow-up. We found that dietary fat intake and motivation at the time of enrollment predicted the changes in fat intakes at the end and at the follow-up of the programs. In addition, BMI, perceived benefit of a healthy diet, and previous weight loss experience were also related to change in fat intake at the 4-month follow-up, although these associations were not found at the end of the program. Previous studies have attempted to identify psychosocial factors associated with dietary change but not related to the intervention programs (Smith et al. 1995; Smith et al. 1992; Patterson et al. 1996; Contento and Murphy 1990). Smith et al. (1995) found that diet-related beliefs and nutrition knowledge were predictive of dietary change in 249 volunteers three-months after a 1-hour one-to-one nutrition education program. Patterson et al. (1996) found in a population-based study that individuals who strongly believed in a diet-cancer connection and those with knowledge of fat and fiber recommendations decreased their percentage of energy from fat over 3 years. In this study, we examined blood lipids, BMI, and stages of change as predictive factors as well as psychosocial factors. Subjects who had a high risk for chronic diseases (i.e., BMI >27.3 kg/m^2), were less likely to reduce fat intake at the follow-up, although they needed most to modify and maintain their dietary intake. Identification of the underlying reasons for the difficulty in reducing fat intake for overweight people at follow-up is an important challenge for health promotion programs.

Previous studies reported that maintenance of changes in dietary behaviors is

difficult. We are not aware of any published research examining the predictors associated with reduction of dietary fat intake at the follow-up of worksite nutrition programs. However, several studies of weight management programs suggest that previous weight loss attempts and history of participants in a formal weight loss programs were related to increased body weight at 6-24 month follow-up (French et al. 1994; Haus et al. 1994). In this study, previous weight loss experience predicted the change in fat intake at the follow-up. These findings highlight the importance of prevention of relapse regarding weight loss experiences (i.e., loss but part or all of the weight regained) in nutrition interventions.

This is one of the few studies to show the association between stages of change and dietary change over time. Consistent with the study of Patterson et al. (1996), we found that the Stages of Change model was not a significant predictor of change in fat intake after a nutrition intervention program. One possible explanation is that 78% of the subejcts in our study were in the Preparation and Action stages of change for reducing fat intake, while a population-base study found only 55% of women to be in these two stages of readiness to reducing dietary fat (Glanz et al. 1994). The disproportionately smaller percentage of our subjects in different stages of change may have reduced the likelihood of finding associations with the dietary change even if such relations do exist. In this study, the majority of subjects in maintenance stage already consumed $\leq$ 30% kcal from fat at the time of the enrollment and kept their fat intake $\leq$ 30% kcal from fat at the end or at the 4-month follow-up of the program. Thus, there may have been a ceiling effect on possible fat reduction for those who already had fat intakes less than 30% of kcal. A

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study with EFNEP participants also suggested that participants with low dietary quality at enrollment make more dietary changes than those with high dietary quality (Koerner and Song 1997). In this study, we found that dietary fat consumption at enrollment in the program was associated with the stages of change (Contemplation: 33% kcal from fat; Preparation: 32% kcal from fat; Action: 31% kcal from fat; and Maintenance: 24% kcal from fat) and the trend was similar with findings in previous studies (Glanz, et al. 1994; Greenes, et al. 1994). This finding supports our confidence in the use of the algorithm developed by Glanz et al (1994) to classify participants into different stages of change for fat at enrollment.

In this study, motivation and perceived benefits of a healthy diet were important predictors for reducing fat intake in women. This result is consistent with the findings from a cross-sectional study by Kristal et al. (1995) in which similar psychosocial items were examined in 16,287 working men and women, and perceived benefits and motivation were found to be strong predictors of dietary intake and intention to change diet. In contrast to our findings, Patterson et al. (1996) and Smith and Owen (1992) reported that beliefs in diet-disease connection was related to dietary changes. Probably because belief in diet-disease connection was so skewed toward strong agreement (92% strong or very strong agree) at the time of enrollment, it may have resulted in no association with the reduction of dietary fat intake. Measurement of psychosocial factors did not vary enough initially to explain the change in fat intake after the worksite nutrition program.

Most of the nutrition intervention studies result in mixture of successful and

unsuccessful participants (Sorensen et al. 1992; Briley et al. 1992; Hunt et al. 1993; Gorbach et al. 1990; Masur-Levy et al. 1990). This study uniquely used both multiple regression and discriminate analyses to explain the outcome which are changes in dietary fat intake after intervention and at follow-up. Multiple regression models identified the variables that are significantly associated with the dietary changes. The discriminated analyses provided an insight between the two groups (those who were successful at reducing fat intake vs those who were not) regardless of how much dietary change was made. The predictors we found were similar for the two statistical approaches. We found that dietary fat intake and BMI at enrollment were most important in distinguishing these the two groups at the end and at the follow-up of the program. It appears that this nutrition program may not be suitable for all the participants, especially for those with high BMI and low fat intake at enrollment. Subjects who were less likely to reduce fat intake could be identified in the beginning of the program based on the predictors we found. Different strategies and program designs such as increased motivation, self-efficacy for dietary change and perceived benefits of a healthy diet can be provided to improve the effectiveness of nutrition programs such as the one described in this study.

Limitations of this study must be taken into account when interpreting the results. Although subjects included in the present study were a self-selected convenience sample, they may be representative of individuals likely to seek nutrition information in the United States. Since the subjects in the study were women and predominately Caucasian, results cannot be generalized to other populations. About 20% (17/88) of the participants who did not complete the measurements at the end and follow-up were not significantly

different in dietary intake, blood lipid, and BMI from those who were included in the analysis, therefore, the results were quite robust.

Table 1. Dietary intakes, blood lipids, BMI, and psychosocial factors of subjects (n=65) at enrollment of the worksite nutrition program

Variables	Mean ± *s.d.*	% of participants at risk
Age	43.7±8.9	
Dietary intakes		
% kcal from fat	30.8±6.0	51% (>30% kcal from fat)
Fiber density	9.5±3.6	85% (<12.5g/1000 kcal)
Blood lipids		
Total cholesterol(mmol/L)[c]	5.31±1.31	48% (>5.20 mmol/L)
LDL-C/HDL-C	2.2±0.9	
BMI (kg/m^2)	28.1±6.2	45% (>27.3 kg/m^2)
Psychosocial factors[a]		
Belief in diet-disease connection	4.5±0.7	
Perceived barriers to a healthy diet	2.5±0.9	
Perceived benefits of a healthy diet	3.8±0.7	
Perceived norms for healthy eating	2.9±0.9	
Social support	2.9±1.0	
Motivation	4.1±0.9	
Weight loss experience[b]	3.6±1.0	

[a]1-5 scale; 1= strongly negative, 5=strongly positive (Glanz et al. 1993)
[b]1-6 scale; 1= overweight; never try to lose to weight, 2=did not lose any weight; still on a diet now, 3= lost weight, but gained all of it back, 4= lost weight, but gained some of it back, 5= lost part of the weight I wanted to lose; kept it off, 6=lost all the weight I want to lose; kept it off (Glanz et al. 1993)
[c]To convert mmol/L cholesterol to mg/dL , multiply mmol/L by 38.7. Cholesterol of 5.20 mmol/L=200 mg/dL.

Table 2. Change in dietary intake, serum cholesterol levels, BMI of subjects at the end and at 4-month follow-up of the worksite nutrition programs

Variables	Enrollment (n=128)	End (n=65)	Follow-up (n=58)
Calories	1951±634[a]	1721±549*	1745±529*
Fat (g)	67.1±30.0	55.2±25.9*	57.6±28.9*
% kcal from fat	30.8±6.0	27.9±6.8*	29.1±7.4
> 30% kcal from fat[b]	*51%*	*41%*	*51%*
Dietary fiber (g)	17.5±6.2	16.1±5.9	16.9±6.9
Fiber density(g/1000 kcal)	9.6±3.6	9.9±3.4	10.1±4.3
<12.5g/1000 kcal[b]	*85%*	*77%*	*78%*
Serum cholesterol (mg/dL)	5.31±1.31	5.28±1.41	5.26±1.00
>5.20mmol/L[b]	*48%*	*46%*	*47%*
Body weight (lb)	174.3±40.3	173.5±40.7	173.6±41.4
BMI (kg/m^2)	28.8±6.2	28.7±6.1	28.7±5.9
>27.3 kg/m^2 [b]	*45%*	*44%*	*44%*

[a] Mean ± *s.d.*

[b] percentage of subjects

*$p<0.05$ by paired t-test compared to the enrollment

Table 3. Backward multiple regression models for reducing fat intakes at the end of the worksite nutrition programs and at the 4-month follow-up

Predictors	B	S E of B	Beta	p
	At the end of nutrition education program			
Dietary fat intake(%kcal from fat)	0.85	0.18	0.64	0.000**
Motivation[2]	2.97	1.08	0.35	0.005*
Weight loss experience	1.22	0.81	0.17	0.139
Dietary fiber density	0.34	0.27	0.17	0.220
Constant	- 43.19	8.70		0.000**
R^2 for the model	42%			
R^2 for dietary fat and motivation	37%			
R^2 for dietary fat alone	22%			
	At 4-month follow-up			
Dietary fat intake (% kcal from fat)	0.78	0.20	0.52	0.000**
BMI (kg/m^2)	- 4.20	1.65	- 0.36	0.016*
Perceived benefits of a health diet	4.82	2.03	0.34	0.024*
Motivation	3.71	1.71	0.32	0.037*
Weight loss experience	1.95	1.06	0.25	0.075
Constant	-25.64	11.43		0.032
R^2 for the model	50%			
R^2 for dietary fat and BMI	34%			
R^2 for dietary fat alone	24%			

* $p<0.05$; **$P< 0.001$

[1] Regression coefficient

[2] 1-5 scale; 1= strongly negative, 5=strongly positive

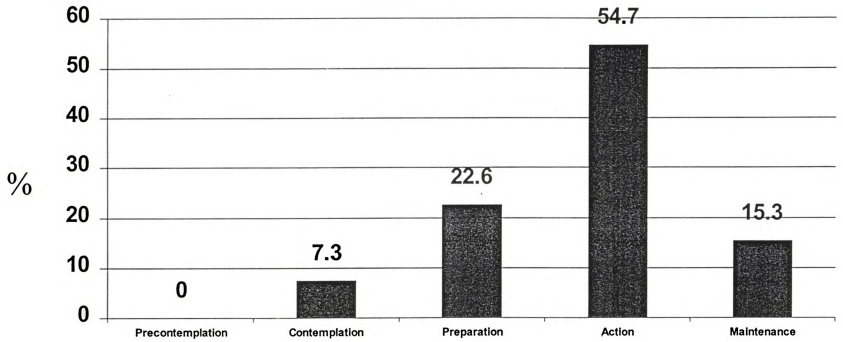
Table 4. Dietary intakes, blood lipids, BMI, and psychosocial factors (collected at the time of the enrollment) of benefit and no-benefit groups[a] based on their dietary changes at the end and at 4-month follow-up of the worksite nutrition program

	Classification at the end of program		Classification at the follow-up	
Independent variables at the enrollment	**Benefit group (n=22)**	**No-benefit group (n=22)**	**Benefit group (n=19)**	**No-benefit group (n=19)**
Age	42±9[b]	45±9	42±9	44±9
Dietary intakes				
% kcal from fat	33.4±4.7	27.4±5.2*	32.7±4.4	26.5±4.4*
Fiber density (g/1000 kcal)	8.6±2.8	10.8±4.2	8.3±2.1	11.3±4.4
Blood lipids				
Total cholesterol(mmol/L)	5.21±1.42	5.33±1.16	5.06±1.18	5.41±1.48
LDL/HDL ratio	2.0±0.9	2.1±0.9	1.8±0.4	2.0±1.3
BMI	26.8±5.6	29.6±5.6*	25.3±4.4	29.3±6.1*
Psychosocial factors[c]				
Belief in diet-disease connection	4.5±0.5	4.4±0.9	4.5±0.4	4.7±0.9
Perceived barriers to a healthy diet	2.6±0.9	2.3±0.9	2.3±0.9	2.4±0.9
Perceived benefits of a healthy diet	3.7±0.5	3.8±0.9	3.7±0.4	3.9±0.9*
Perceived norms for healthy eating	3.0±0.9	3.0±0.9	3.0±0.4	2.8±0.4
Social support	2.7±1.4	2.9±0.9	2.8±1.3	2.8±0.9
Self-efficacy for change	3.8±0.9	3.8±0.9	3.7±1.3	3.9±0.9
Motivation	4.1±0.9	3.8±0.9*	4.0±1.3	4.3±0.9
Weight loss experience[d]	3.8±0.9	3.3±0.9	4.0±1.3	3.3±0.9

Footnote for Table 4

[a] The benefit group and no-benefit group represent the top and bottom tertiles of change in fat intake
[b] Mean ± s.d.
[c] 1-5 point scale; 1= strongly negative, 5=strongly positive (Glanz et al. 1993)
[d] 1-6 point scale; 1= overweight; never try to lose to weight, 2=did not lose any weight; still on a diet now, 3= lost weight, but gained all of it back, 4= lost weight, but gained some of it back, 5= lost part of the weight I wanted to lose; kept it off, 6=lost all I want to lose; kept it off (Glanz et al. 1993)
* Differentiating predictors based on discriminate analyses

Figure 1
Distribution of Stages of Change for reducing fat intake of participants at the enrollment of the worksite nutrition program



Stages of change for reducing fat intake

Chapter Four

Dropouts from worksite nutrition programs differ from those who completed in dietary intake and BMI but not in blood lipids and psychosocial factors

A. ABSTRACT

The objective of this study was to compare the dietary intake, blood lipids, BMI, stages of change for reducing fat and increasing fiber intakes, and various psychosocial factors of participants who dropped out vs. those who completed worksite nutrition programs offered at a major university in the United States. Dietary intake (3-day diet record), blood lipids, BMI (kg/m^2), stages of change for reducing fat and increasing fiber intakes, and various psychosocial factors were surveyed during the first week of a nutrition program. A total of 128 women was recruited from 10-wk worksite nutrition programs between 1994 and 1996. Those who dropped out during the first four-weeks of the program were classified into the dropout group (n=40) and the rest into the completion group (n=88). T-tests and Chi-square analyses were used for continuous and categorical variables, respectively. Compared to the completion group, the dropout group was more likely to: 1) eat > 30% of kcal from fat (69% vs. 50%, $p<0.05$); 2) be overweight (67 % vs. 40%, $p<0.05$); 3) have a lower percentage of subjects at the Maintenance stage of change for reducing fat intake (6% vs. 18%, $p=0.07$) with no difference in other stages of change; and 4) have a higher percentage of subjects at the Action stage of change for

increasing fiber intake (49% vs. 32%, p=0.07) and a lower percentage of subjects in the Maintenance stage (8% vs. 21%, p=0.08). Innovative strategies are needed to retain those who are overweight or consume > 30% of kcal from fat in worksite nutrition programs as well as to advance the majority of the participants who enroll in such programs from the Action to the Maintenance stage.

B. INTRODUCTION

Nutrition programs have been used at worksites to promote weight control, cholesterol reduction and cancer prevention (Glanz and Seewald-Klein 1986; Kris-Etherton et al. 1988). Worksites are an important channel to deliver health promotion programs allowing access to over 60% of adults of varying ages and health status (U.S. Department of Labor 1992). Between 1985-1992, the percentage of worksites that offer nutrition programs increased sharply from 48% to 78% for large worksites (more than 750 employees), and from 9% to 22% for small worksites (50-100 employees)(USDHHS 1992).

Several studies have reported the efficacy of worksite nutrition programs (Pelletier 1993; Haus et al. 1994; Sorensen et al. 1992; Briley et al. 1992; Hunt et al. 1993). These findings are based solely on data of those who completed the programs in reference to either baseline data of the same group or of a control group. High dropout rates (12-35%) have been reported as one of the programmatic problems in worksite nutrition programs (Bruno et al. 1983; Lovibond et al. 1996; Carmody et al. 1980; Dishman 1988). Little is known, however, about the characteristics of those who were

apparently motivated to enroll, but discontinued participation in the programs. Therefore a better understanding of those individuals who drop out of worksite nutrition programs can help develop effective strategies, and also enhance efficacy of the programs.

Dietary behaviors have previously been associated with socioeconomic and psychological factors (Patterson et al. 1996; Smith et al. 1995; Winkleby et al. 1994; Glanz et al. 1993; Kristal et al. 1995; Brug et al. 1994; Laforge et al. 1994). The Stages of Change Model addresses the readiness to make health behavioral changes (Prochaska and Diclemente 1983). This model has been successfully used in predicting and modifying behavioral changes across a wide range of health problems (i.e., smoking cessation, exercise) and only recently has been applied to dietary behaviors. Whether the stage of change at the enrollment is related with the adherence to the nutrition program has not been tested clearly. Also it is important to evaluate whether or not the risk factors for chronic diseases such as high cholesterol and overweight are associated with the adherence to worksite nutrition programs.

The hypothesis of this study was that participants who dropped out from worksite nutrition programs differed from those who completed the programs in dietary intake, blood lipid profile, BMI, stages of change for reducing fat and increase fiber intakes, and various psychosocial factors.

C. METHODS

Worksite nutrition programs

Ten-week nutrition programs have been offered since 1988 without charge as part

of the health promotion program at a large midwestern university. Faculty and staff are informed of the nutrition program through brochures, flyers, and university newspapers. The program consisted of one-hour weekly meetings for ten weeks. The purpose of the program was to promote healthy eating habits by lowering fat intake and increasing dietary fiber intake. The curriculum included recommendations for daily fat and dietary fiber intakes, modification of recipes, cooking techniques for low fat and high fiber foods, fat and fiber contents of foods, interpretation of food labels, suggestions for dining out, principles of weight control and exercise, and behavior modification strategies. Both knowledge and skills were provided for the participants to incorporate strategies for low fat and high fiber dietary behaviors into their individual dietary preferences and lifestyle. Two or three programs were offered each semester, averaging 12 participants in each program. The nutrition programs were taught by three leaders: one nutrition specialist with nutrition and exercise physiology degrees; and two well-trained senior dietetics students.

Subjects and data collection

Between 1994-1996, 151 subjects enrolled in the worksite nutrition interventions. A small number of men (n=15) was excluded from the study to reduce the confounding effect of gender. Those who were unwilling or unable to complete any one of the measurements (n=8) were also excluded. Subjects who discontinued the program during the first four-weeks of the program were classified as the dropout group and the rest of subjects were classified as the completion group.

This study was approved by the University Committee on Research Involving Human Subjects and informed consent was obtained from all subjects. During the first week of the nutrition program, subjects were instructed to keep a 3-day diet record and to complete a questionnaire on psychosocial factors and stages of change. Blood lipid analyses (total serum cholesterol, LDL-C, and HDL-C) and anthropometric measurements (weight and height) were conducted at the Nutrition Assessment Laboratory by qualified technicians. Feedback on dietary intake and blood lipids data was provided to each subject at the subsequent meeting.

No significant differences were observed in demographic characteristics, BMI, or dietary intake of the subjects among eight programs conducted over two years. All data, therefore, were combined for subsequent analyses.

Variables and measurements

Dietary intake data for fat and fiber were obtained from a 3-day food record. The record required a detailed description of types and amounts of foods and beverages consumed for two non-consecutive weekdays and one weekend day. A detailed instruction for the food record was provided with an example of the types and amounts of food and beverages. Nutrient composition of the diet was analyzed using MSU NutriGuide diet analysis software (Song WO, Version 2.0, Michigan State University, East Lansing, MI). The nutrient composition database of the software was originated from Michigan State University's main-frame database, supplemented with USDA's Revised Agriculture Handbook 8 and data from food manufacturers. The nutrient

database is 98% complete for fat and 99% for dietary fiber.

Psychosocial factors included beliefs in diet-disease connection, perceived benefits of a healthy diet, perceived barriers to a healthy diet, social support, perceived norms for healthy eating, motivation, self-efficacy for change, and weight loss experience. The instrument was a 24-item questionnaire which was developed and validated by Glanz et al.(1993) for the "Working Well Study". The questions were written in a Likert scale format with a five-category continuum from strongly negative=1 to strongly positive=5.

Stages of change for reducing fat intake and stages of change for increasing fiber intake were determined based on combinations of five items from the psychosocial factor questionnaire. Those five items were self-rated diet, how long a low-fat or high-fiber diet had been followed, behavioral intentions to change diet, attempts to make dietary changes, and the reported success of those change efforts. The five questions were combined into an algorithm to classify the subject into one of five stages of changes for reducing fat intake or increasing fiber intake: Precontemplation, Contemplation, Preparation, Action, or Maintenance (Glanz et al. 1994).

Anthropometric measurements consisted of height and weight. The measurements were done following standard procedures (Lohman 1988), using a stadiometer and a calibrated balance beam scale (Holtain Portable stadiometers, Seritex Inc). Body mass index was calculated based on the formula: weight (kg) / height $(m)^2$. Subjects with BMI ≥ 27.3 kg/m^2 were considered overweight (National Institutes of Health, Consensus Development Panel 1995).

Blood lipids consisted of fasting plasma concentration of total cholesterol, HDL-C, and triglyceride from a blood sample collected by a finger prick (approximately 0.3 ml). Plasma was separated from whole blood which was collected into a tube containing lithium-heparin anticoagulant (Microcuvette LH CB 300, Sarstedt). Analytical procedures were performed using Kodak Ektachem DT60 Analyzer, DTE module. The plasma concentration of LDL-C was calculated by the formula: LDL-C (mg/dL)= total cholesterol- HDL-C-triglyceride/5. A cutpoint was used to classified subjects into different risk levels of total serum cholesterol: ≤ 200 mg/dL for low risk; > 200 mg/dL for high risk (National Cholesterol Education Program, 1993).

Statistical analyses

The dropout group was compared with the completion group using t-tests for continuous variables (i.e., dietary intake, blood lipids, and various psychosocial factors) and chi-square analyses for categorical variables (i.e., stages of change for reducing fat intake and percentage of overweight subjects). All statistical analyses were performed using Statistical Package for the Social Science (Windows version 6.1, 1996, SPSS Inc, Chicago, IL).

D. RESULTS

The majority of subjects who participated in this project (n=128) were Caucasian women (97%) and staff on campus (98%). The mean age was 44±9 years (s.d.): 28% between 24-39, 42% between 40-49, 28% between 50-59 and 3% over 60 years of age. Of these, 33% of the women (n=40) discontinued the program during the first four-weeks of the program (dropout group) and the rest 67% of the women (n=88) completed the program (completion group).

The dropout group had a higher average % kcal from fat (32.8±6.9%) in their diet at the time of enrollment than the completion group (30.3±6.6%; $p<0.05$); and a higher percentage of subjects not meeting dietary recommendation for fat i.e., > 30% of kcal (69% vs. 50%; $p<0.05$; Table 1). Calories and fiber intake did not differ significantly between the two groups. The majority of the subjects in both groups did not meet the dietary recommendation for fiber, i.e., ≥12.5 g/1000 kcal, (84% dropout group vs. 86% completion group; n.s.; Table 1). Although the average BMI did not differ statistically between the dropout group (30.9±7.5 kg/m^2) and the completion group (28.7±13.2 kg/m^2), the dropout group had significantly more overweight subjects (BMI ≥27.3 kg/m^2) than the completion group (68% vs. 47%; $p<0.05$; Table 1). About half of all subjects had total serum cholesterol concentrations >200 mg/dL with no differences between the dropout and completion groups (Table 1). Overall, the completion group seem to be healthier than the dropout group.

Various psychosocial factors did not differ significantly between the dropout and completion groups (Table 2). Belief in diet-disease connection was skewed toward strong

agreement in both groups with the mean equal to 4.4± 0.1(s.d.) on a 1-5 scale. About 90% of the subjects in both groups reported that they had tried to lose weight in the past. Forty-four percent of the dropout group and 32% of completion group reported that they had lost weight at least 10 pounds in the past, but gained back all of the weight(n.s.).

In terms of stages of change for reducing fat, the majority in both groups was in Action stage (58% in dropout group vs. 54% in completion group; n.s.) and no one was found in the Precontemplation stage (Figure 1). The distribution of subjects among Contemplation, Preparation, and Action stages did not differ between the two groups. The completion group had a higher percentage of subjects at the Maintenance stage (18%) than the dropout group did (6%; p=0.07).

Nearly half of the subjects in both groups were classified into the early stages of change for increasing fiber intake (Figure 2). Compared to the completion group, the dropout group had a higher percentage of subjects in the Action stage for increasing fiber intake (49% vs. 32%; p=0.07) and a lower percentage of subjects in the Maintenance stage (8% vs. 21%; p=0.08; Figure 2). When the distributions between stages of change for reducing fat and increasing fiber intakes were compared, a higher percentage of subjects was found in the early stages of change for fiber than stages of change for fat. About an equal percentage of subjects was in the Maintenance stage for fat and fiber.

E. DISCUSSION

We found that the dropout group had a higher percentage of subjects who were overweight or whose diets contained > 30% kcal from fat. The dropout group,

unfortunately, needed the nutrition programs more than the completion group did to modify their dietary intake.

Various psychosocial factors such as health beliefs, knowledge, motivation and self-efficacy have been related to dietary behaviors in other studies (Patterson et al. 1996; Kristal et al. 1995; Smith et al. 1995; Ferrine et al. 1994; Contento and Murphy 1990). However, dropout and completion groups in the present study did not differ in various psychosocial factors; they did differ slightly with respect to the stages of change for reducing fat intake or increasing fiber intake. The similar response to various psychosocial factors by the two groups may be explained by 1) homogeneity of overall subjects i.e., middle age, white, female staff; 2) strong agreement toward various psychosocial factors questions; 3) volunteer-enrollment in the program because subjects with similar response of psychosocial factors were likely to be recruited by the nutrition programs; and 4) the small sample size in four subgroups of the chi-square test for stage of change. Compared to the population-based studies (Glanz et al. 1994; Greene et al. 1994), a lower percentage of subjects in our study were found in the Precontemplation and Contemplation stages of change for reducing fat intake and increasing fiber intake for both the dropout and completion groups.

About half of the subjects in this study were overweight with BMI ≥ 27.3 kg/m^2. A campus-wide telephone survey conducted in 1993-1994 (Hembroff and Huang, 1995) revealed that 32.1% of staff on campus were overweight. These findings suggest that overweight individuals were likely to enroll in the worksite nutrition programs but also tended to drop out of the programs. Compared to women in the Third National Health

and Nutrition Examination Survey (McDowell et al., 1995), subjects in this study consumed slightly less % kcal from fat (31% vs. 36%). This comparison suggests that women consuming a high % kcal from fat were both less likely to be recruited into worksite nutrition programs and more likely to drop out if they did enroll.

This study was conducted in a university setting with predominantly Caucasian women. Thus the limitations of this study, such as participants' education levels and work environment, and limits of representation among diverse ethnic groups must be considered when interpreting the results. Furthermore, additional testing of this hypothesis is needed in different worksite settings and ethnic groups as well as in men.

Table 1. Dietary intake, blood lipids, and BMI of subjects in dropout vs. completion groups of worksite nutrition programs

Variables	Dropout group n=40	Completion group n=88	p[2]
Age	44.0±9.5 [1]	43.9±8.5	ns
Dietary intakes(day)			
Calories	1911 ± 625	1913 ± 601	ns
Fat (g)	71.5± 33.5	65.8 ± 30.1	ns
% kcal from fat	32.8±6.9	30.3 ± 6.6	p<0.05
> 30 % kcal from fat	69% [3]	50%	p<0.05
Dietary fiber(g)	15.1 ± 5.1	16.9 ± 5.6	ns
Dietary fiber density	8.5 ± 3.8	9.2 ± 3.2	ns
< 12.5 g/1000 kcal	84% [3]	86%	ns
Anthropometric measurement			
BMI (kg/m^2)	30.9 ±7.5	28.7 ± 13.2	ns
≥ 27.3 kg/m^2	67% [3]	47%	p<0.05
Blood lipids (mg/dL)			
Total serum cholesterol	208.8 ± 43.6	202.2 ± 40.4	ns
> 200 mg/dL	50% [3]	47%	ns
HDL-C	54.7 ± 16.4	58.4 ± 14.1	ns
LDL-C	119.9 ± 43.6	115.4 ± 33.8	ns
Triglyceride	165.2 ± 124.5	134.6 ± 70.5	ns

[1]Mean ± s.d.

[2] t-tests and chi-square analyses were used for continuous and categorical variables, respectively

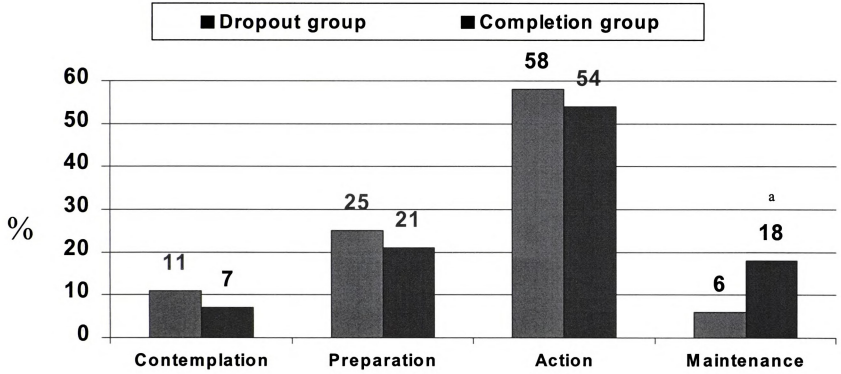
[3] percent of subjects with >30% kcal from fat, with fiber density <12.5 g/ 1000 kcal, BMI ≥27.3 kg/m^2, or total serum cholesterol >200 mg/dL

Table 2. Psychosocial factors of subjects in dropout vs completion groups of worksite nutrition programs

Variables	Dropout group n=40	Completion group n=88	p[2]
Belief in diet-disease connection [1]	4.4±0.6 [2]	4.4±0.9	ns
Perceived barriers to a healthy diet	2.8±1.3	2.5±0.9	ns
Perceive benefits of a healthy diet	3.7± 0.6	3.7±0.9	ns
Perceived norms for healthy eating	2.8±1.3	2.8±0.9	ns
Social support	2.9±1.3	2.9±0.9	ns
Self-efficacy for change	3.9±1.3	3.9± 0.9	ns
Motivation	4.1±0.6	4.1 ±0.9	ns

[1]Mean ± s.d.
[2] t-tests
[3] 1-5 Likert scale (1= strongly disagree, 5=strongly agree)

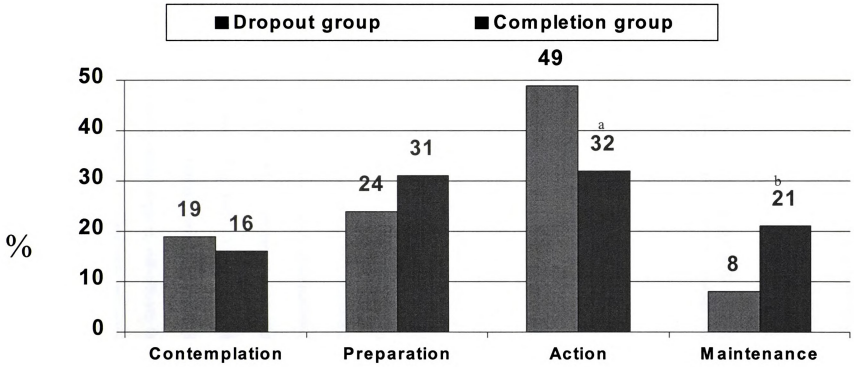
Figure 1
Distribution of stages of change for reducing fat intake :
those who dropped out vs. completed worksite nutrition programs



Stages of change for reducing fat intake

[a] p =0.07

Figure 2
Distribution of stages of change for increasing fiber intake :
those who dropped out vs. completed worksite nutrition programs



Stages of change for increasing fiber intake

[a] p =0.07 ; [b] p=0.08

Chapter Five

Stages of change are associated with dietary intake, BMI and various psychosocial factors but not with blood lipids among women in worksite nutrition program

A. ABSTRACT

Stages of change for reducing fat intake and stages of change for increasing fiber intake were assessed with dietary fat and fiber, body mass index (kg/m^2), blood lipids and various psychosocial factors among 128 women who enrolled in a worksite nutrition program. According to the algorithm for readiness to change, subjects were classified into five stages for reducing fat intake: Precontemplation (none), Contemplation (8%), Preparation (20%), Action (56%), Maintenance (15%); and five stages of change for increasing fiber intake: Precontemplation (none), Contemplation (16%), Preparation (29%), Action (37%), Maintenance (18%). Compared to the other stages of change for reducing fat intake, the Maintenance stage had 1) lower fat and higher fiber intake; 2) lower BMI and waist/hip ratio; and 3) higher perceived benefits of a healthy diet, perceived norms for healthy eating, social support, self-efficacy for change, and motivation; 3) lower perceived barriers to a healthy diet. Compared to the other stages of change for increasing fiber intake, the Maintenance stage had 1) lower fat and higher fiber intake; 2) higher perceived benefits of a healthy diet and motivation; and 3) lower

perceived barriers to a healthy diet. Blood lipids did not differ either among stages of change for reducing fat intake or stages for increasing fiber intake. Strategies are necessary to recruit those in early stages into worksite nutrition programs. It would be important to evaluate further whether people in Preparation or Action Stages can be moved into the Maintenance stage by influencing psychosocial variables differing among the stages.

B. INTRODUCTION

Health professionals have put a lot of effort in promoting healthy eating, such as decreasing fat and increasing fiber intakes, to reduce the dietary risk of chronic diseases. In an effort to improve the effectiveness of nutrition programs, many theoretical models have been used to explain an individual's dietary behavior and help one make dietary modifications. The Stages of Change model has been successfully used in helping people quit smoking and has only recently been tested in relation to dietary change. The Stages of Change Model (Prochaska and DiClemente 1983) proposes that change occurs through a series of stages: Precontemplation (unaware or not thinking about changing), Contemplation (seriously thinking about making a change), Preparation (making definite plans to change), Action (actively modifying an unhealthy behavior) and Maintenance (maintaining the new behavior for some time).

Currently, the majority of nutrition interventions are "action-oriented" and provide skills and strategies for people who are ready for action to change behavior. A study by Campbell et al. (1994) demonstrated that nutrition messages tailored to a

person's stage of change generated a significantly greater reduction in dietary fat intake than messages that were not so tailored. It appears, therefore, beneficial to know the stages of dietary change for people who participate in a nutrition program before an intervention is introduced. A few published studies have attempted to categorize the sample into stages of dietary change. Glanz et al. (1994) and Greene et al. (1995) reported in population-based studies that about 65% of people were in Action or Maintenance stages of dietary change for fat. Little is known about the stages of dietary change for people who are recruited into various nutrition programs.

In order to use the stages of change model effectively in developing nutrition interventions, it is important to understand the characteristics of each stage of change. Psychosocial factors from several theories have been used to explain dietary behaviors. Sporny and Contento (1995) reported that a reduction of perceived barriers and perceived difficulty and increased self-efficacy were associated with Action and Maintenance stages of change for reducing fat intake. Additionally, high serum cholesterol, overweight and high waist/hip ratio are important risk factors for chronic diseases. We wanted to know whether these risk factors are associated with stages of change for reducing fat and increasing fiber intake.

The purpose of this study was: 1) to identify the stages of change for fat and fiber of participants in a worksite nutrition program; and 2) to examine the stages of change for reducing fat intake and stages of change for increasing fiber intake in relation to dietary intake, blood lipid profiles, anthropometric measurements and psychosocial characteristics.

C. METHODS

Worksite nutrition programs

Ten-week nutrition programs have been offered since 1988 without charge as part of the health promotion program at a large midwestern university. Faculty and staff are informed of the nutrition program through brochures, flyers, and university newspapers. The program consisted of one-hour weekly meetings for ten weeks and the purpose was to promote healthy eating habits by lowering fat intake and increasing dietary fiber intake. The curriculum included recommendations for daily fat and dietary fiber intakes, modification of recipes, cooking techniques for low fat and high fiber foods, fat and fiber contents of foods, interpretation of food labels, suggestions for dining out, principles of weight control and exercise, and behavior modification strategies. Both knowledge and skills were provided for the participants to help them incorporate strategies for low fat and high fiber dietary behaviors into their individual dietary preferences and lifestyle. Two or three programs were offered each semester, averaging 12 participants in each program. The nutrition programs were taught by three leaders: one nutrition specialist with nutrition and exercise physiology degrees; and two well-trained senior dietetics students.

Subjects and data collection

Between 1994-1996, 151 subjects enrolled in the worksite nutrition interventions. A small number of men (n=15) was excluded from the study to reduce the confounding

effect of gender. Those who were unwilling or unable to complete any one of the measurements (n=8) were also excluded.

This study was approved by the University Committee on Research Involving Human Subjects and informed consent was obtained from all subjects. During the first week of the nutrition program, subjects were instructed to keep a 3-day diet record and to complete a questionnaire on psychosocial factors and stages of change. Blood lipids analyses (total cholesterol, LDL-C, and HDL-C) and anthropometric measurements (weight and height) were conducted at the Nutrition Assessment Laboratory by qualified technicians. Feedback on the dietary intake and blood lipids data were provided to each subject at the subsequent meeting.

No significant differences were observed in demographics, BMI, or dietary intake of the subjects among eight programs conducted over two years. All data, therefore, were combined for subsequent analyses.

Variables and measurements

Dietary intake data for fat and fiber were obtained from a 3-day food record. The record required a detailed description of types and amounts of foods and beverages consumed for two non-consecutive weekdays and one weekend day. A detailed instruction for the food record was provided with an example of the types and amounts of food and beverages. Nutrient composition of the diet was analyzed using MSU NutriGuide diet analysis software (Song WO, Version 2.0, Michigan State University, East Lansing, MI). The nutrient composition database of the software was originated

from Michigan State University's main-frame database, supplemented with USDA's Revised Agriculture Handbook 8 and data from food manufacturers. The nutrient database is 98% complete for fat and 99% for dietary fiber.

Psychosocial factors included beliefs in diet-disease connection, perceived benefits of a healthy diet, perceived barriers to a healthy diet, social support, perceived norms for healthy eating, motivation, self-efficacy for change, and weight loss experience. The instrument was a 24-item questionnaire which was developed and validated by Glanz et al. (1993) for the "Working Well Study". The questions were written in a Likert scale format with a five-category continuum from strongly negative=1 to strongly positive=5.

Stages of change for reducing fat intake and stages of change for increasing fiber intake were determined based on combinations of five items from the psychosocial factor questionnaire. Those five items were self-rated diet, how long a low-fat or high-fiber diet had been followed, behavioral intentions to change diet, attempts to make dietary changes, and the reported success of those change efforts. The five questions were combined into an algorithm to classify the subject into one of five stages of changes for reducing fat intake and stages of change for increasing fiber intake, respectively: Precontemplation, Contemplation, Preparation, Action, or Maintenance (Glanz et al. 1994).

Anthropometric measurements consisted of height, weight, waist/hip ratio and percentage of body fat. The measurements of height and weight were done following standard procedures (Lohman 1988), using a stadiometer and a calibrated balance beam

scale (Holtain Portable stadiometers, Seritex Inc) and fiberglass measuring tape. Body mass index (BMI) was calculated based on the formula: weight (kg) / height $(m)^2$. Subjects with BMI ≥ 27.3 kg/m^2 were considered overweight (National Institutes of Health, Consensus Development Panel 1995). The percentage of body fat was determined by bioelectrical impedance (BIA). BIA is based on the principle that resistance to a standard electric current is proportional to the volume of a conductors or body, the square of the length of a conductor path, the concentration of water and electrolytes, and the compartmental distribution of the water and electrolytes (Lukaski 1987; Segal 1988).

Blood lipids consisted of fasting plasma concentration of total cholesterol, HDL, and triglyceride from a blood sample collected by a finger prick (approximately 0.3 ml). Plasma was separated from whole blood which was collected into a tube containing lithium-heparin anticoagulant (Microcuvette LH CB 300, Sarstedt). Analytical procedures were performed using Kodak Ektachem DT60 Analyzer, DTE module. The plasma concentration of LDL-C was calculated by the formula: LDL-C (mg/dL)= total cholesterol- HDL-C-triglyceride/5. A cutpoint was used to classified subjects into different risk levels of total serum cholesterol: $\leq$ 200 mg/dL for low risk; > 200 mg/dL for high risk (National Cholesterol Education Program, 1993).

Statistical analyses

Subjects in Precontemplation, Contemplation, Preparation, Action and Maintenance stages of change were compared based on dietary intake, blood lipids, BMI, and various psychosocial factors. One-way analysis of variance (ANOVAs) were used to

determine the significance of group differences on these measures, and post-hoc contrasts (least-significant difference) were used to determine significant mean differences between specific groups. Chi-square analyses were used for categorical variables (i.e., % subjects with ≤ 30% kcal from fat). All statistical analyses were performed using Statistical Package for the Social Science (Windows version 6.1, 1996, SPSS Inc, Chicago, IL).

D. RESULTS

Characteristics of Subjects. The majority of subjects who participated in this project (128 women) were Caucasian (97%) and staff (98%) on campus. The mean age was 44±9 (s.d.) years: 28% between 24-39, 42% between 40-49, 28% between 50-59 and 3% over 60 years of age.

Stages of change for reducing fat intake. The percentage of subjects in Precontemplation, Contemplation, Preparation, Action and Maintenance stages for fat were 0%, 8%, 20% 57%, and 15%, respectively. There was a linear trend in group means for calories, % kcal from fat, and fiber density of four stages (Table 1). As indicated in Table 1, average intake of calories and % kcal from fat decreased and fiber density increased from Contemplation stage to Maintenance stage. The percentage of subjects who met dietary recommendations for fat (≤ 30% kcal) and fiber (≥12.5 g/1000 kcal) also increased with advanced stages. Subjects in the Maintenance stage had significantly lower % kcal from fat (24%) and higher fiber density (12.5 g/1000 kcal) than those in other stages. Average BMI decreased with advanced stages of change for reducing fat intake ($p<0.05$). Although percentage of body fat did not significantly differ among

stages of changes for reducing fat intake (Table 1), it was found to be highly correlated with BMI ($r=0.80$; $p<0.001$). This indicated that those with higher BMI did have higher percentage of body fat. Blood lipids did not differ significantly among stages of change for reducing fat intake (Table 1).

The result of the ANOVAs of psychosocial factors are presented in Table 2. Significant F-ratios and linear trends were obtained for five out of seven psychosocial factors: perceived barriers to a healthy diet, perceived benefits of a healthy diet, social support, self-efficacy for change and motivation (Table 2). Those in the Maintenance stage had significantly higher scores than those in Action stages for perceived benefits of a healthy diet. Those in Action stage had significantly higher scores than those in Preparation stage for social support. Those in Preparation stage had significant higher scores than those in Contemplation stage for self-efficacy for change and motivation (Table 2).

Stages of change for increasing fiber intake. The percentage subjects in Precontemplation, Contemplation, Preparation, Action and Maintenance stages for increasing fiber intake were 0%, 16%,29%, 37%, and 18%, respectively (Table 3). Subjects in Maintenance stage for fiber had higher fiber density and lower % kcal from fat than other stages. BMI, blood lipids, and calories did not differ significantly among stages of change for increasing fiber intake (Table 3).

Significant F-ratios and linear trends for group means were obtained for three out of seven psychosocial factors: perceived barriers to a healthy diet, perceived benefits of a healthy diet and motivation. Subjects in the Maintenance stage had reported a lower

perceived barriers to a healthy diet than those in Action stage. Subjects in the Preparation stage reported higher perceived benefits of a healthy diet and higher motivation than those in Contemplation stage. Subjects in Action stage did not differ significantly from Preparation stage on various psychosocial factors. About 55%, 62%, 55%, 62% of subjects in Contemplation, Preparation, Action and Maintenance stages of change for reducing fat intake, respectively, were also found in the same stages of change for increasing fiber intake.

E. DISCUSSION

Most of the subjects in our study were in Preparation or Action stages of change for reducing fat intake. A higher percentage of subjects in our study were in the Preparation stage and a lower percentage of subjects in Precontemplation and Contemplation stages for reducing fat intake compared to a population-based study where the similar algorithm was used for 5,334 women (Glanz et al. 1994). Similar differences were found in stages of change for increasing fiber intake between our study and the population-based study of Glanz et al. (1994). The differences between the two studies could be predicted, since those who volunteer for programs aiming for particular behavioral changes are more likely to be in advanced stages of change (Rossi 1996).

The distribution of stages for reducing fat intake and stages for increasing fiber intake differed. Compared to the stages of change for reducing fat intake, stages of change for increasing fiber intake had a lower percentage of subjects in Action stage (30% vs. 56%) and a higher percentage of subjects in the Precontemplation and

Contemplation stages for fiber than for fat (16% vs. 8%). This may reflect the trends in awareness of nutrition, specifically fat and fiber in the United States over the past decade (Schucker et al. 1991). Concern about dietary fat has grown steadily since about 1980 and dietary fat is now the leading nutrition concern (Schucker et al. 1991). Although there is widespread general diet-disease awareness of dietary fiber, specific knowledge of recommended intake and sources of fiber is still low (Fullmer et al. 1991; Ippolito and Mathios 1991). About 60% of our subjects in each stage of change for fat were at the same stages of change for fiber. These findings suggest that for the majority, but not all subjects, stages of change for fat indicated the individual's readiness to increase fiber intake as well as readiness to reduce fat intake.

In this study, average % kcal from fat decreased with advanced stages of change for reducing fat intake. The trend corroborates with the findings of Glanz et al. (1994) and Greene et al. (1995). Subjects in Action and Maintenance stages who have tried and believed that they had consumed a low-fat diet, indeed, had low % kcal from fat either met or close to dietary recommendations (Action: 31% kcal from fat; Maintenance: 23% kcal from fat). These findings support our confidence in the use of such an algorithm to classify participants into different stages of change for reducing fat intake. Consistent with findings of another study (Sporny and Contento 1995), dietary fiber density of our subjects also increased with advanced stages of change for reducing fat intake.

Although the dietary fiber density increased with advanced stages of change for fiber, the average fiber density in Action and Maintenance stages for fiber was still only 8.8 g/1000 kcal and 10.8 g/1000 kcal, respectively. Most of the subjects (73%-88%) in

these two stages did not meet the fiber recommendation of ≥ 12.5g / 1000 kcal. We do not know if our finding is due to inadequate knowledge and skills necessary to rate fiber intake of the subjects or truly inadequate fiber intake by the subjects. The algorithm used in this study was based on the individual's self-rated diet for classification in either early or later stages of change (i.e., how high in fiber is your overall diet?). The algorithm thus requires subjects to be knowledgeable on the fiber content of foods and fiber recommendations to correctly classify themselves.

In this study, the largest reduction of % kcal from fat and increase in fiber density were seen between Action and Maintenance stages. The most important psychosocial factors for distinguishing those in Maintenance from Action stages were perceived benefits of a healthy diet in the case of stages of change for fat and perceived barriers to a healthy diet in the case of stages of change for fiber. These findings suggest that different strategies are needed for fat and fiber to advance those in Action stages to Maintenance. Motivation was most important for both fat and fiber in distinguishing those in Preparation from Contemplation stages. These findings support the suggestion of Baranowski (1992) that motivations that lead to psychological state of readiness to take action would be most important in the early stages of the dietary change process. For both stages of change for fat and fiber, perceived barriers to a healthy diet were highest for those in Contemplation stage and then linearly decreased with advanced stages; perceived benefits of a health diet were lowest in Contemplation and then linearly increased with advanced stages. Thus, both a decrease in perceived barriers to a healthy diet and increase in perceived benefits of a healthy diet may help people move forward to

improve their diets relative to fat and fiber.

Previous studies found that older people were more likely to be in the Action or Maintenance stages for reducing fat intake than younger people (Curry et al. 1992; Sporny and Contento 1995; Glanz et al. 1994). In contrast, we found age was not associated with stage of change for either reducing fat or increasing fiber intake. This may be because the age of our sample (45% between 40-49 years) did not vary enough to detect a difference.

We found that subjects in Contemplation and Preparation stages of change for fat had higher BMI and waist/hip ratio than those in Action and Maintenance stages, but these relationship was not found in stages of change for fiber. The cross-sectional nature of this study does not permit us to see whether the lower BMI and low waist/hip ratio are due to the their low fat diet or whether those with low BMI and low waist/hip ratio are more likely to adopt low fat eating and maintain the change. However, the finding is interesting and deserves further study.

This study was conducted in a university setting with predominantly Caucasian women. Thus the limitation of this study such as participants' education levels and work environment, and limits of representation of diverse ethnic groups must be considered when interpreting the results. Furthermore, additional research is needed in different worksite settings and ethnic groups as well as in men.

Most of subjects who signed up for the worksite nutrition program in this study were in Preparation or Action stages. Such understanding can assist us in designing nutrition programs that can more appropriately be targeted by stage of change. Strategies

are necessary to recruit those in early stages to the worksite nutrition program. It would be important to evaluate further if people in Preparation or Action stages can be moved to Maintenance stage by influencing psychosocial variables differing among the stages.

F. IMPLICATIONS

The action-oriented activities of the worksite nutrition programs would appear to be appropriate for the majority of subjects in Preparation and Action stages, but not for those in Contemplation who had higher fat intakes, higher BMI and waist/hip ratio. Prochaska and DiClemente (1983) and Campell et al. (1994) suggest different strategies such as conscience raising, self-evaluation, and self-liberation should be developed to move those in the Contemplation stage into the Preparation stage. The complete absence of anyone in the Precontemplation stage in this worksite nutrition program reflects readiness of people who enroll in worksite nutrition programs. Targeting those in the Precontemplation stages with information messages about the health benefits for adopting healthy diet, along with the information about the health risk associated with high fat and low fiber diet, may be more effective in recruiting those in early stage of change into the nutrition programs.

Table 1. Dietary intake, blood lipids and anthropometrics of subjects at various stages of change for reducing fat intake

	Contemplation	Preparation	Action	Maintenance	F[2]	Linearity[4]
% (n)	8% (10)	20% (24)	57% (67)	15%(18)		
Age(yr)	41.7±8.9[1]	45.6±7.4	43.5±8.2	44.7±11.2	ns	ns
Dietary intake						
Calories (kcal/day)	2166±694	2102±602	1894±632	1723±628	ns	ns
Fat (g/day)	90.2±42.3[a]	79.3±30.8[ab]	66.5±28.7[b]	46.6±19.8[c]	p<0.001	p<0.001
% kcal from fat	36.3±5.8[a]	33.5±6.4[ab]	31.1±6.6[b]	24.0±5.6[c]	p<0.001	p<0.001
≤30% kcal from fat[5]	20%	30%	42%	83%	p<0.01[3]	
Fiber (g/day)	13.6±3.5[a]	16.5±6.4[a]	15.9±5.7[a]	19.6±5.2[b]	p<0.05	p<0.01
Fiber density(g/1000 kcal)	6.6±2.3[a]	8.2±2.9[ab]	8.7±3.3[b]	12.0±3.8[c]	p<0.001	p<0.001
≥12.5 g/1000 kcal[5]	10%	14%	12%	27%	p<0.05[3]	
Blood lipids						
Total cholesterol (mg/dL)	217±38	200±44	206±41	200±52	ns	ns
>200 mg/dL[5]	70%	46%	49%	44%	ns[3]	
LDL/HDL	2.1±1.3	2.1±1.5	2.3±0.8	2.2 ±0.9	ns	
Anthropometrics						
BMI (kg/m^2)	33.3±11.5[a]	30.7±6.4[ab]	28.8±6.6[bc]	26.4±3.0[c]	p<0.05	p<0.01
≥27.3 kg/m^2 [5]	60%	61%	50%	39%	ns[3]	
Percentage of body fat	37.4±11.5	35.0±8.3	34.6±9.0	34.1±7.8	ns	ns
Waist/Hip ratio	1.2±0.3[a]	1.1±0.5[ab]	1.0±0.8[bc]	1.0±0.4[c]	p<0.05	p<0.05

Footnote for Table 1

[1]Mean ± s.d.
[2]One-way analysis of variance among stages of change
[3]Chi-square analysis
[4] Linear trend in the group means of four stages
[5] percent of subjects who met the criteria
[abc] Means not sharing the same superscript are significantly different at $p<0.05$, using post-hoc contrasts.

Table 2. Psychosocial factors at various stages of change for reducing fat intake

	Contemplation	Preparation	Action	Maintenance	F	Linearity[4]
Belief in diet-disease connection [1]	4.3±0.6[2]	4.3±1.0	4.5±0.8	4.4±0.8	ns	ns
Perceived barriers to a healthy diet	3.0±1.2[a]	2.9±1.0[a]	2.5±0.8[ab]	2.2±0.8[b]	$p<0.05$	$p<0.001$
Perceived benefits of a healthy diet	3.3±0.6[a]	3.6±0.5[a]	3.6±0.8[a]	4.1±0.4[b]	$p<0.05$	$p<0.05$
Perceived norms for healthy eating	3.2±0.9	2.6±1.0	2.9±0.8	2.9±0.8	ns	ns
Social support	2.5±0.6[ab]	2.4±1.0[a]	3.1±0.8[b]	3.0±0.8[b]	$p<0.05$	$p<0.05$
Self-efficacy for change	3.2±0.9[a]	3.9±1.0[b]	4.0±0.8[b]	4.2±0.8[b]	$p<0.05$	$p<0.05$
Motivation	2.9±0.6[a]	4.0±1.0[bc]	4.3±0.8[bc]	4.6±0.4[b]	$p<0.001$	$p<0.001$

[1] 1-5 Likert scale (1=strongly disagree, 5=strongly agree)
[2] Mean ±s.d.
[3] One-way analysis of variance among stages
[4] Linear trend in the group means of four stages
[abc] Means not sharing the same superscript are significantly different at $p<0.05$, using post-hoc contrasts.

Table 3. Dietary intake, blood lipids and anthropometrics of subjects at various stages of change for increasing fiber intake

	Contemplation	Preparation	Action	Maintenance	F[2]	Linearity[4]
% (n)	16% (19)	29% (34)	37% (44)	18%(21)		
Age (yr)	42.4±6.1	42.1±6.9	44.1±9.8	46.4±8.2	ns	ns
Dietary intake						
Calories (kcal/day)	2083±410	1968±515	1902±705	1966±615	ns	ns
Fat (g/day)	73.1±21.7	70.1±25.5	68.5±33.7	63.3±36.6	ns	ns
% kcal from fat	31.2±4.5[b]	31.7±5.9[a]	31.9±6.6[a]	27.2±7.3[b]	p<0.05	ns
≤30% kcal from fat[5]	48%	58%	68%	32%	p<0.03	
Fiber (g/day)	15.4±4.5	16.4±5.4	16.2±7.4	19.6±5.2	ns	ns
Fiber density (g/1000 kcal)	7.5±1.9[a]	8.8±2.5[a]	8.8±3.3[a]	10.8±3.8[b]	p<0.01	p<0.01
≥12.5 g/1000 kcal[5]	10%	14%	12%	27%	ns	
Blood lipids						
Total cholesterol (mg/dL)	208±26	207±40	199±41	221±56	ns	ns
>200 mg/dL[5]	50%	50%	46%	59%	ns	
LDL/HDL	2.5±0.6	2.2±1.0	2.2±1.6	2.2±0.9	ns	ns
Anthropometrics						
BMI (kg/m^2)	30.1±5.1	29.7±5.4	28.6±7.4	29.4±6.9	ns	ns
≥ 27.3 kg/m^2 [5]	52%	63%	49%	50%	ns	
Percentage of body fat	35.5±5.4	34.9±7.8	34.2±7.4	36.1±12.5	ns	ns
Waist/Hip ratio	1.1±0.3	1.1±0.5	1.0±0.8	1.1±0.4	ns	ns

Footnote for Table 3

[1]Mean ± s.d.
[2]One-way analysis of variance among stages of change
[3]Chi-square analysis
[4] Linear trend in the group means of four stages
[5] Percent of subjects who met the criteria
[abc] Means not sharing the same superscript are significantly different at $p<0.05$, using post-hoc contrasts.

Table 4. Psychosocial factors at various stages of change for increasing fiber intake

	Contemplation	Preparation	Action	Maintenance	F[3]	Linearity
Belief in diet-disease connection[1]	4.2±0.6[2]	4.6±0.5	4.4±0.8	4.5±0.8	ns	ns
Perceived barriers to a healthy diet	2.8±0.6[a]	2.7±0.5[a]	2.7±0.8[a]	2.0±0.8[b]	$p<0.05$	$p<0.001$
Perceived benefits of a healthy diet	3.3±0.3[a]	3.7±0.5[b]	3.7±0.8[b]	3.8±0.8[b]	$p<0.05$	$p<0.05$
Perceived norms for healthy eating	2.7±0.6	2.7±1.0	3.0±0.8	3.0±0.8	ns	ns
Social support	2.8±0.6	2.7±1.0	2.9±0.8	2.9±1.2	ns	ns
Self-efficacy for change	3.6±0.3	4.1±1.0	4.0±0.8	4.1±0.8	ns	ns
Motivation	3.4±0.6[a]	4.3±1.0 [b]	4.3±0.8[b]	4.3±0.8[b]	$p<0.001$	$p<0.001$

[1] 1-5 Liker scale (1=strongly disagree, 5=strongly strong)
[2] Mean ±s.d.
[3] One-way analysis of variance among stages
[4] Linear trend in the groups mean of four stages
[abc] Means not sharing the same superscript are significantly different at $p<0.05$, using post-hoc contrasts.

Chapter Six

CONCLUSIONS AND IMPLICATIONS

Conclusions

1. Dietary fat intake and motivation at the time of the enrollment were strong predictors for reduction in fat intake at the end of the nutrition program and at the 4-month follow-up. In addition, BMI, previous weight loss experience and perceived benefits of a health diet at the enrollment were significant predictors for reducing fat intake at the 4-month follow-up, but these associations were not found at the end of the program.
2. Dropouts were more likely to be overweight or to have diets containing more than 30% kcal from fat. The dropouts needed the nutrition programs to modify dietary intake more than those who completed the programs.
3. Most of the subjects who participated in the worksite nutrition programs were in Preparation or Action stages of change for reducing fat intake and/or reducing fiber intake. Those who were in Maintenance stage consumed lower fat plus higher fiber than those in other stages. The most significant psychosocial factors in distinguishing those in the Maintenance from Action stages were perceived benefits and barriers to a healthy diet. Motivation was most important

psychosocial factor in distinguishing those in Preparation from those in the Contemplation stages

Implications

1. The action-oriented activities of the worksite nutrition program would appear to be appropriate for the majority of subjects in Preparation and Action stages, but not for those in Contemplation who had higher fat intakes, higher BMI and waist/hip ratio. Prochaska and DiClemente (1983) and Campell et al. (1994) suggest different strategies such as conscious raising, self-evaluation, and self-liberation should be developed to move those in the Contemplation stage into the Preparation stage.
2. The complete absence of anyone in the Precontemplation stage in this worksite nutrition program, potentially 12-20 % of the population, means that a large number of people are neither ready nor willing to consider dietary change in fat intake. Targeting those in the Precontemplation stages with information messages about the health benefits for adopting healthy diet, along with the information about the health risk associated with high fat and low fiber diet, may be more effective at recruiting those in early stage of change into the nutrition programs.
3. Worksite nutrition programs designed to increase motivation, the perceived benefit of a healthy diet and designed to prevent relapse from previous weight loss experiences are needed to help participants adopt more healthful diets.
4. Prior to enrollment, two-thirds of our subjects previously lost the weight they

wanted to lose but had gained back all or some of the weight. In order to prevent the infinite diet-relapse cycle, the prevention of relapse and coping with the negative psychological impact from relapse prior to the enrollment need to be taken into the consideration in the beginning as well as throughout the program.

5. Innovative strategies to retain those who dropout from the programs are needed for successful worksite nutrition programs.

Chapter Seven

RECOMMENDATIONS FOR FUTURE STUDIES

Based on the findings of this study the following recommendation are made for future studies:

1. Since this study was conducted in a university setting with predominantly Caucasian women, additional research is needed in different worksite settings and ethnic groups as well as in men.
2. It would be important to evaluate further if the predictors we found in this study can help people to change their diet successfully and improve the effectiveness of the worksite nutrition program.
3. It is necessary to identify the underlying reasons why those were overweight or consumed > 30% kcal from fat at the enrollment were more likely to dropout from the worksite nutrition programs.
4. We found that subjects in Contemplation and Preparation stages of change for reducing fat intake had higher BMI and waist/hip ratio than those in Action and Maintenance stages, but this relationship was not found in the stages of change for increasing fiber intake. The cross-sectional nature of this study does not permit us to evaluate whether the lower BMI and low waist/hip ratio are due to their low fat

diet or whether those with low BMI and low waist/hip ratio are more likely to adopt low fat eating and maintain the change. However, the findings are interesting and deserves further study.

APPENDICES

APPENDIX A

OUTLINE OF THE WORKSITE NUTRITION PROGRAM

Diet/Weight Management Program

Spring, 1995

1-16	**Session 1**	<u>Establishing a baseline</u>
		• course overview • assessment of current health status
		# announce health fair (pretest)
1-23	**Session 2**	<u>How food affects your health</u>
		• risk factors (diet, anthropometric, blood lipid) for chronic disease • interpretate the result of lipid profile and body composition
		# feedback from lipid profile and body composition # collect a 3-day dietary record from participants
1-30	**Session 3**	<u>Close look of your eating habits</u>
		• sources of dietary fat • source of dietary fiber • interpretation of a 3-day dietary records
		# feedback of the 3-day dietary record
2-6	**Session 4**	<u>Creating an eating plan that's right for you</u>
		• being a smart consumers • alternative eating plans for lifestyles
		# feedback from 3 day dietary record

2-13	**Session 5**	**Behavior change- The key to success** • behavior chain • weight cycling • food label
2-20	**Session 6**	**Demonstration of healthy food preparation** • easily prepared and low fat foods • foods prepared for different lifestyle
2-27	**Session 7**	**Maintaining positive health habits** • develop[network of support • high risk situations(2 examples) • continue "behavioral change" (session 5)
3-6 - 3-10		**spring break**
3-13	**Session 8**	**Physical activity and weight control(I)** • importance of physical activity for health • various physical activities
3-20	**Session 9**	**Physical activity and weight control(II)** • develop physical activity program for lifestyle • strength and weakness of different of exercise program # announce health fair (posttest)
3-27	**Session 10**	**Plan for long-tern success: pot luck** # announce health fair(follow-up) and follow-up plan # collect 3-day dietary record

APPENDIX B

UCRIHS APPROVAL

MICHIGAN STATE
UNIVERSITY

December 16, 1994

TO: Ya-Li Huang
208 Food Science Bldg.

RE: IRB#: 94-577
TITLE: HEALTH PROMOTION (HEALTHY-U) PROJECT-DIET/WEIGHT MANAGEMENT PROGRAM (FOR STAFF AND FACULTY)
REVISION REQUESTED: N/A
CATEGORY: 1-A
APPROVAL DATE: 12/14/94

The University Committee on Research Involving Human Subjects'(UCRIHS) review of this project is complete. 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 including any revision listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for 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, investigators must 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 any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)336-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:pjm

cc: Won O. Song

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIES

University Committee on Research Involving Human Subjects (UCRIHS)

Michigan State University
225 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX: 517/432-1171

APPENDIX C

INFORMED CONSENT

Healthy U Diet/Weight Management Program

Informed Consent

I enrolled voluntarily in this DIET/WEIGHT MANAGEMENT PROGRAM which is sponsored by the Healthy U at MSU. The purpose of the program is to promote healthy eating habits by reducing fat intake and increasing dietary fiber intake.

My full participation in the program will involve a) attendance of all 10 weekly classes and follow-up meetings offered at designated sites; b) completing questionnaires on dietary and health habits; c) body measurements such as height, weight, percentage of body fat, waist/hip ratio; and d) measurements for blood total cholesterol, HDL, LDL, triglyceride and hemoglobin with a finger prick sample.

All of the above measurements will be done by trained Healthy-U Program staff and faculty following the standard procedure. I understand that blood lipid measurements are considered screening only. I am aware of no medical conditions which would limit my participation in the program. Should this change during the course of the program, I will immediately notify my program leader.

The Healthy-U Program will keep all individual data strictly confidential. I consent that my result may be used in research projects which are to improve the efficacy and quality of this Program. All data will be reported in aggregate form with no individuals identified. My consent to the research project is completely voluntary without affecting my enrollment in the Program. I can withdraw at any time from the research projects or the Program. I can request the Healthy-U Program any information regarding the projects or the Program at any time.

Name (Print) : _____

(Signature) : _____ Date:_____

Address: _____

_____

Phone: _____ circle (Home or Work)

APPENDIX D

THREE-DAY DIET RECORD FORM

THREE - DAY DIET RECORDS

Accurate assessment of current dietary habits is important to identify any changes to make. Please record all the food and drink you consume on **two typical weekdays and one weekend day.** This record should not reflect any modification of your current dietary habits.

Be sure to include:

1) beverages: water, milk, soft drinks, juice, tea, coffee, alcoholic beverages, etc.
2) condiments: butter, margarine, mayonnaise, catsup, mustard, pickle relish, cream jelly, sauce, etc.
3) method of preparation: fried, baked, boiled, broiled , etc.
4) anything added during preparation :oils, milk, wine etc.
5) for combination foods, list all ingredients as accurately as possible.

BE SURE TO ESTIMATE QUANTITY OF FOOD AS CLOSE AS POSSIBLE. Describe portion sizes by ounces, cups, tablespoons, etc. rather than a glass of milk.

1 cup = 8 ounces (fluid)
1 Tablespoon = 3 teaspoons
1/4 pound =4 ounces (weight)

Please bring the completed 3-day diet records to your second class. You will receive your diet analysis results with recommendations in the following class.

NAME: Bart Simpson Healthy-U ID # 007

ITEM AND DESCRIPTION		PORTION
Meal 1	Black Coffee, Brewed	1 coffee cup
	Orange Juice, unsweetened	1/2 cup
	Cheerios	3/4 cup
	Skim Milk	1 glass (8 oz)
	Toast, whole wheat	1 slice
	Margarine, stick	1 tsp.
Snack(s)	Coffee w/ Cream & sugar	1 coffee cup (1 tsp. each)
Meal 2	Tuna Sandwich:	
	Bread, whole wheat	2 slices
	Tuna packed in water	2 oz.
	Mayonnaise	1 tsp.
	Celery, chopped; Onion, chopped	1 tsp. each
	Pepsi, regular	1 can (12 oz.)
	Nacho Chips (Doritos)	2 1/8 oz. (small bag)
Snack(s)	Apple	1 medium
Meal 3	Chicken Legs, fried w/out skin	2 pieces
	Rice, steamed	1/2 cup
	Mixed Vegetables	1/2 cup
	Margarine (stick)	2 tsp.
	Salad (Tomato, Lettuce and Relishes)	1 cup
	Dressing (Italian, light)	1 TBSP.
	Water	1 glass (8 oz.)
Snack(s)	Yogurt, strawberry (Dannon)	8 oz.

Vitamin/Mineral Supplement(s) None

Is this a complete one-day intake? X Yes ____ No

Was this a TYPICAL day? X Yes ____ No

The following information are needed for the analysis of dietary intakes

Age :_____ Gender : _____

Height : _____feet_____inches

Weight : _____lb

Type of Physical Activity

Time (Hour)	Type of Physical Activity
_____	Sleeping
_____	Light activity ex. studying, typing, cooking, driving. swimming, walking
_____	Moderate activity ex. sailing, dancing, chid care, golf, swimming, walking fast (3 mph)
_____	Heavy activity ex. basketball, aerobics, running, skiing, rowing, cycling, tennis

** The total of physical activity should be 24 hours in one day

(DAY 1)

NAME: _____ Healthy-U ID # _____

ITEM AND DESCRIPTION	PORTION
Meal 1	
Snack(s)	
Meal 2	
Snack(s)	
Meal 3	
Snack(s)	

Vitamin/Mineral Supplement(s) _____

Is this a complete one-day intake? _____ Yes _____ No

Was this a TYPICAL day? _____ Yes _____ No

(DAY 2)
NAME: _____ Healthy-U ID # _____

ITEM AND DESCRIPTION	PORTION
Meal 1	
Snack(s)	
Meal 2	
Snack(s)	
Meal 3	
Snack(s)	

Vitamin/Mineral Supplement(s) _____

Is this a complete one-day intake? _____ Yes _____ No

Was this a TYPICAL day? _____ Yes _____ No

(DAY 3)

NAME: _____ Healthy-U ID # _____

ITEM AND DESCRIPTION	PORTION
Meal 1	
Snack(s)	
Meal 2	
Snack(s)	
Meal 3	
Snack(s)	

Vitamin/Mineral Supplement(s) _____

Is this a complete one-day intake? _____ Yes _____ No

Was this a TYPICAL day? _____ Yes _____ No

APPENDIX E

PSYCHOSOCIAL FACTORS QUESTIONNAIRE

Healthy U Diet/Weight Management Program

Name: _____ Healthy U ID: _____

	strongly agree				strongly disagree
1. Eating a lot of fruits and vegetables decreases my chances of getting serious diseases like heart disease or cancer.	1	2	3	4	5
2. Eating a lot of whole grain, bread, and cereals decrease my chances of getting serious disease like heart disease or cancer.	1	2	3	4	5
3. Eating a lot of fried foods increases my chances of developing serious illnesses like heart disease or cancer.	1	2	3	4	5
4. It is hard for me to get fruits and vegetables when I'm at work.	1	2	3	4	5
5. There is so much advice about health ways to eat. I don't know what is good or bad	1	2	3	4	5
6. What I eat is one of the most important things for my health.	1	2	3	4	5
7. Low fat foods taste good.	1	2	3	4	5
8. There is a lot of information on health eating where I work.	1	2	3	4	5
9. At my workplace, it's easy to eat a healthy diet.	1	2	3	4	5
	very much				none
10. How much encouragement for eating low-fat foods do you get from your co-workers?	1	2	3	4	5
11. How much encouragement for eating low-fat foods do you get from friends and family?	1	2	3	4	5
	very important				none
12. How important to you is eating low-fat foods?	1	2	3	4	5

	very confident				not confident
13. How confident are you that you will decrease the amount of fat in your diet during the next 6 months?	1	2	3	4	5
14. How confident are you that you will eat more fruits and vegetables in your diet during the next 6 months?	1	2	3	4	5
15. How confident are you that you will eat more whole grain, bread, and cereals in your diet during the next 6 months?	1	2	3	4	5

	very high				very low
16. How high in fat is your overall diet?	1	2	3	4	5

* If low or very low, please answer this one
How long have you followed a diet that is low fat?
(circle one)
≤6 months 1-6 month 6-12 month ≥12 months

	very high				very low
17. How high in fiber is your overall diet?	1	2	3	4	5

* If high or very high, please answer this one
How long have you followed a diet that is high in fiber?

(circle one)
≤6 months 1-6 month 6-12 month ≥12 months

	definitely yes				definitely no
18. Over the next 6 months, do you plan to cut down on fats?	1	2	3	4	5
19. Over the next 6 months, do you plan to eat more fruits and vegetables?	1	2	3	4	5
20. Over the next 6 months, do you plan to eat more whole grain, bread, and cereals?	1	2	3	4	5

21. Have you tried to make any changes to lower the fat in your diet in the past 6 months?

Yes No

extremely success not success

* If yes, please answer this one
How successful were you in making those changes? 1 2 3 4 5

22. Have you tried to make any changes to increase the fiber in your diet in the past 6 months?

Yes No

extremely success not success

* If yes. please answer this one
How successful were you in making those changes? 1 2 3 4 5

23. Have you ever tried to lose 10 pound or more? Yes No

If yes, please answer this one
Think about your most recent effort to lose weight.
How would you describe the results?

1. Lost all I want to and kept it off
2. Lost part of the weight I wanted to and kept is off
3. Lost weight, but gained some of it back
4. Lost weight, but gained all of it back
5. Didn't lose any weight
6. Still on a diet now
7. Other: _____

24. In the past 2 years (except pregnancy), how many times has you weight gone up and down by al least 8 to 10 pounds?

_____ times

25. If you were trying to choose more low-fat foods, which food in each of the following pairs would you select because it was lower in fat?

Pair I	Pair II	Pair III
a. saltines/soda crackers	a.margarine	a. potato chips
b. Ritz crackers	b. butter	b. pretzels
c. neither one	c. neither one	c. neither one
d. don't know	d. don't know	d. don't know

26. If you were trying to choose more high-fiber foods, which food in each of the following pairs would you select because it was higher in fiber?

Pair I	Pair II	Pair III
a. chile w/beans	a. bran muffin	a. canned pears
b. spag. w/meat balls	b. bran cereal	b. stewed prunes
c. neither one	c. neither one	c. neither one
d. don't know	d. don't know	d. don't know

APPENDIX F

STAGES OF CHANGE FOR FAT: ALGORITHM

STAGES OF CHANGE FOR FAT: ALGORITHM

Stages	Definition	Items Used
Maintenance	Healthy diet for > 6 months	Self-rated diet
Action	Healthy diet for < 6 months or tried to changes with some success in the last 6 months	Self-rated diet Reported changes
Preparation	Tried to make healthy diet changes in last 6 months but not successful, or Definitely plan to change	Self-rated diet Reported changes
Contemplation	Maybe/probably plan to change diet in the next 6 months; and no attempts to change in the last 6 months	Self-rated diet Behavior intentions to change diet Reported changes
Precontemplation	No plan to change diet in the next 6 months;and no attempts to in the last 6 months	Self-rated diet Behavior intentions to change diet Reported changes

* Assignment to stage is done sequentially, beginning with maintenance. Once an individual is assigned to a stage, the remaining response are not processed.

* Healthy diet= low/very low fat, or high/very high fiber

APPENDIX G

FEEDBACK ON DIETARY INTAKE AND BLOOD LIPIDS

MSU NutriGuide

NUTRITIONAL ANALYSIS FOR [redacted], ON 00/03/99
ID (STUDENT) NUMBER: 0000000
SEX: F

This analysis is based on 42 years of age, 5 feet 6 inches, and 116 pounds.

ENERGY EXPENDITURE

	TIME (hour)	KCAL (needed)
RESRING ENERGY EXPENDITURE *		1284
SLEEPING	7.0	0
LIGHT ACTIVITY ..... ex. studying, typing, cooking,driving, watch TV, walking	16.0	422
MODERATE ACTIVITY ..... ex. sailing, dancing, child care, golf, swimming, walking fast (3 mph)	1.0	79
HEAVY ACTIVITY ..... ex. basketball, aerobics, running, skiing, rowing, cycling, tennis	0.0	0
DAILY TOTAL ENERGY EXPENDITURE **		1963

* Resting Energy Expenditure refers to the energy needed to sustain life at rest. ** Daily total energy expenditure includes thermogenesis.

LIST OF FOODS CONSUMED

MEAL	FOOD DESCRIPTION	AMOUNT
B	MEDIUM BANANA	1 each
B	CHEERIOS	1 cup
B	SKIM MILK NONFAT	.5 cup
S	DIET COKE W/ASPARTAME	12 fl oz
L	BLUEBERRY MUFFIN	.6 each
L	CHICKEN SALAD	.5 cup
L	NECTARINE, MEDIUM	1 each
S	DIET COKE W/ASPARTAME	12 fl oz
S	MILK CHOCOLATE BAR	1 each
D	ICEBERG LETTUCE-RAW,SHRED	1 cup
D	MEDIUM RED TOMATOES, RAW	3 slice
D	ITALIAN DRESSING(LOW CAL)	.66 Tbsp
D	LOCAL VEAL PARMIGIANA+VEG	1 serv

DIET ANALYSIS

NUTRIENT NAME	AMOUNT CONSUMED	RDA %	0 50 100 150
CALORIES	1177 --	53	!================
TOT-PROT	50 gm	100	!==============================
TOT-CARB	125 gm	41	*!============
TOT-FAT	56 gm	76	*!========================
POLY-FAT	17 gm	70	*!======================
SAT-FAT	19 gm	78	*!========================
CHOLESTROL	138 mg	46	*!==============
ALCOHOL	0 gm	---	!
VIT-A	1003 RE	125	!======================================
VIT-D	3 IU	2	!
VIT-E	13 mg	163	!==
THIAMIN	0.9 mg	82	!==========================
RIBOFLAVIN	1.6 mg	123	!======================================
NIACIN	17 mg	113	!==================================
PYRIDOXINE	2.0 mg	125	!======================================
VIT-B12	3.2 ug	160	!==
FOLACIN	116 ug	64	!====================
VIT-C	65 mg	108	!================================
IRON	10 mg	67	!====================
CALCIUM	592 mg	74	!=======================
PHOSPHORUS	987 mg	123	!======================================
SODIUM	1376 mg	57	*!=================
POTASSIUM	2296 mg	---	!
MAGNESIUM	213 mg	76	!========================
ZINC	7 mg	58	!==================
DIET-FIBER	11 gm	31	*!========
CAFFEINE	111 mg	---	!

The Recommended Dietary Allowance (RDA) is a daily nutrient intake believed to be appropriate for practically all healthy Americans of your age and sex group. Nutrients flagged with "*" are based on recommendations other than the RDA.

NUTRITIONAL ANALYSIS SUMMARY

ENERGY INTAKE vs ENERGY OUTPUT

Based on your Restingl Energy Expenditure (calorie expended at rest), energy for activity and thermogenesis, your body expends 1963 kcal/day.

Your diet analysis reveals that you consumed 1177 kcal on 00/03/99

From this, you can see that you have consumed 786 fewer calories than your body requires to maintain current weight.

DESIRABLE BODY WEIGHT RANGE

Your desirable weight range is 117 - 143 lb.

ENERGY BALANCE

If you continue to consume fewer calories than your body needs, weight loss will occur.

You are currently less than 90% desirable body weight and have consumed fewer calories than your body needs. This is considered to be unhealthy.

ENERGY SOURCES

40% of the calories in your diet (excluding alcohol) came from carbohydrate, 17% from protein, and 43% from fat. Alcohol provided 0 kcal.

Current recommendations suggest that your diet consist of 55% or more of the total calories from carbohydrates, 15% from protein, and 30% or less from fat. It is suggested that no more than 150 calories from alcohol be consumed per day.

Healthy U Diet/Weight Management Program
Mini Health Fair, Spring Semester
January, 1995

Name: _____ Healthy U ID # : _____

Biochemical Measurement

- Total cholesterol : _____ mg/dl

<200	(desirable)
200-239	(borderline high)
≥240	(high risk)

- HDL - cholesterol : _____ mg/dl

≥60	(negative risk factor)
≤35	(high risk)

- LDL - cholesterol : _____ mg/dl

<130	(desirable)
130-159	(borderline high)
≥160	(high risk)

- Triglyceride : _____ mg/dl

<200	(desirable)
200-399	(borderline high)
≥400	(high risk)

Blood Pressure : _____ mmHg ≥ 140/90 mmHg (high risk)

Anthropometric Measurement

- Body Weight : _____ lb
- Percentage of body fat : _____ %
- Waist/Hip ratio : _____

Female	> 0.8	(high risk)
Male	> 1.0	(high risk)

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