Published in final edited form as:

Prev Med. 2008 March ; 46(3): 196–202. doi:10.1016/j.ypmed.2007.10.005.

PATTERNS AND CORRELATES OF MULTIPLE RISK BEHAVIORS IN OVERWEIGHT WOMEN

Alvaro Sanchez, PhD^{a,*}, Gregory J. Norman, PhD^b, James F. Sallis, PhD^c, Karen J. Calfas, PhD^c, Cheryl Rock, PhD^b, and Kevin Patrick, MDMS^b

^a Primary Care Research Unit of Bizkaia, Basque Health Services-Osakidetza, Bilbao, Spain

^b University of California, San Diego

^c San Diego State University

Abstract

Background—Knowledge about the prevalence, co-occurrence, and correlates of lifestyle related behaviors of overweight women is needed to inform the design of health promotion interventions for weight loss.

Methods—Cross-sectional study involving 394 overweight and obese women, aged 18 to 55 (mean age = 41.26), 39% from minority backgrounds, recruited through primary care clinics for a weight loss trial. Dependent variables were the proportion meeting recommended levels of physical activity (measured with an Actigraph), percent calories from fat, and servings of fruits and vegetables (assessed with a Food Frequency Questionnaire, FFQ) and accumulating less than 8 hr/day of sedentary time for sedentary behavior (Actigraph). Covariates included socio-demographics, psychosocial variables, diet behaviors, and depression.

Results—Seventy-five percent of the sample did not engage in at least 30 min/day of physical activity, and 56% spent less than 8 hr/day in sedentary activities. About 76% and 79% of the sample did not meet the dietary fat, and fruits and vegetable consumption guidelines, respectively. Two thirds of the sample had three or more risk factors. Being employed full-time, lower education level, less use of physical activity change strategies, and low levels of social support were associated with higher likelihood of having a greater total number of health risk behaviors.

Conclusion—Nearly 80% of the sample had multiple lifestyle risk behaviors. Poor dietary behaviors were present in all of the most prevalent risk behavior combinations. Lower socioeconomic and educational status, and family and employment obligations characterize overweight and obese women with unhealthy activity and dietary behaviors in need of health promotion interventions.

Keywords

Overweight and obesity; Lifestyle risk behaviors; Women; Psychosocial correlates

*Corresponding Author: Primary Care Research Unit of Bizkaia, Unidad de Investigación de Atención Primaria de Bizkaia, Luis Power 18, 4^a planta, 48014. Bilbao. Spain, Alvaro.Sanchez@osakidetza.net.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

INTRODUCTION

Recent data suggests that 60% of the U.S. adult population is overweight, 24% is obese, and among women, obesity prevalence is estimated at 23.5% (CDC, 2006). Obesity is one of the most important causes of premature morbidity and mortality (NHLBI, 1998). From 1995–2005 obesity prevalence increased significantly and continues to surpass the 15% prevalence goal proposed in Healthy People 2010 (U.S. Department of Health and Human Services, 2000).

Obesity prevention and control requires changes in multiple factors that contribute to energy balance (NIH, 2004). Behavioral risk factors including energy dense diets, poor eating patterns, high levels of sedentary behavior and low levels of physical activity are independent risk factors for weight gain and obesity (Astrup, 2001; McCrory et al, 2002). There is evidence that these behaviors tend to occur in combination within individuals (Pronk et al, 2004; Berrigan et al, 2003; Galan et al., 2006), and among those who are obese, it is estimated that 46% have at least an additional risk factor (Fine et al., 2004). Although the majority of overweight and obese young adults report trying to lose or maintain their weight (McCracken et al., 2007), only a small fraction of them attain recommended physical activity and dietary guidelines (Bish et al., 2005; Kruger et al., 2004).

Considering that prevention and treatment of overweight and obesity is of high priority, increasing our understanding about the prevalence, clustering patterns, and associated correlates of multiple behavioral risk factors pertaining to overweight women involved in weight loss programs may be a critical step toward planning and implementing of effective health intervention programs for weight management. The aims of the present study were to: 1) describe the prevalence and clustering patterns of four lifestyle risk behaviors (physical activity, sedentary behavior, fruit and vegetable consumption, and dietary fat intake) of overweight women; and 2) to examine the socio-demographic, behavioral and psychosocial correlates of the risk behaviors. These aims were considered exploratory and primarily hypothesis generating with the goal of informing further research on health behavior interventions for weight loss and weight maintenance.

METHODS

Participants

Women aged 18 to 55, with a BMI between 25 and 40 kg/m², were recruited through their primary care provider to participate in a behavior change intervention trial. Thirty-seven primary care providers at 7 clinic sites in San Diego, CA, sent letters to women within the eligible age range informing them that they may be contacted to participate in a research study. Trained recruiters contacted 1,649 women by telephone from August 2002 through February 2003, of whom 570 women were not eligible to participate (mainly due to not meeting minimum BMI criteria), 286 women were eligible but declined to participate (64% never completed an initial Internet screener, 36% were no longer interested in participating), and 392 refused to provide information to determine eligibility. Study recruitment resulted in a 58% participation rate. From the 401 women assessed at baseline, overweight or obesity was confirmed in 394 women. All study procedures were approved by university and clinic institutional review boards.

Measures

Height was measured with a wall stadiometer and weight was measured with a calibrated digital scale. Body Mass Index (BMI) was calculated as kilograms/meter². Minutes of moderate and vigorous physical activity were measured with the Actigraph accelerometer (WAM 7164). The Actigraph has been shown to be valid for quantifying activity levels in laboratory and field

settings (Nichols et al., 2000). The Actigraph stored acceleration counts at 1-minute intervals. A monitored hour was not considered valid if the number of consecutive minutes of 0 counts exceeded 30 minutes. Acceleration counts were translated into minutes of moderate and vigorous physical activity using accepted cut points of 1952 and 5725, respectively (Freedson et al., 1998). Daily hours of sedentary behavior were estimated by summing minutes with acceleration counts between 0 and 100 for valid hours of monitoring. Data from the monitors were considered valid if the monitor was worn for at least 3 of the 7 days and for at least 10 hours each day. A range of 3 to 7 days of monitoring has been found to give reliable estimates of physical activity, but may be a source of variation in inactivity estimates (Mathews et al., 2002; Trost et al., 2005).

The Fred Hutchinson Cancer Research Center Food Frequency Questionnaire (FFQ) was used to estimate daily fruit and vegetable servings and percent calories from fat (Kristal et al., 2000; Patterson et al., 1999). Women reported the frequency and portion size of 122 foods and beverages consumed in the past month. Frequency responses ranged from 'never or less than once per month' to 'two or more times per day' for foods and up to 'six or more times per day' for beverages.

Brief psychosocial scales were developed to measure the following constructs: decisional balance, self-efficacy, behavior change strategies, and social support. In the measure development process four of the study authors individually generated potential items drawing upon previously developed scales that represented operational definitions of the theoretical constructs. Each item was then rated for face validity (i.e., singularity of concept, appropriate item length, reading level). The highest rated items were retained. Two-week test-retest reliability was found to be excellent in a sample of 49 college students (intraclass correlations coefficients ranged from .78 to .90).

Decisional balance comprises two constructs called the 'Pros' and 'Cons' of behavior change that address cognitive and motivational aspects of human decision-making (Velicer et al., 1985). For the current study, separate scales for the pros and cons of physical activity, fruit & vegetable consumption, and reducing dietary fat consumption were adapted from previously developed measures (Marcus et al., 1992; Rossi et al., 2001). Participants rated the importance of each item on a 5-point Likert scale ranging from 1 'not at all important' to 5 'extremely important'. Internal consistency for the pros scales ranged from $\alpha = .71$ to .73, and $\alpha = .54$ to .72 for the cons scales.

Participants completed brief measures of self-efficacy pertaining to increasing physical activity, increasing fruit and vegetable consumption and decreasing dietary fat intake. The physical activity scale includes the 5 items from Marcus et al. (1992) scale. Six newly developed items comprised the fruit and vegetable self-efficacy scale, while the dietary fat scale was based on 6 items originally in a scale developed for adolescents (Rossi et al., 2001). Participants responded to each item on a 5-point Likert scale ranging from 1 'not at all confident' to 5 'extremely confident'. Internal consistency for the self-efficacy scales ranged from $\alpha = .80$ to .89.

Behavior change strategies for physical activity and healthy eating were each measured with a 15-item scale that included cognitive (e.g., think about the benefits, make back-up plans) and behavioral (e.g., put reminders around my home, keep track of what I eat) strategies. The change strategies items were based on a previously developed scale (Saelens et al., 2000) with several items similar to the processes of change from the transtheoretical model (Prochaska et al., 1997). Participants responded to each item on a 5-point Likert scale ranging from 1 'never' to 5 'very often'. Both change strategy scales had internal consistency coefficients of $\alpha = .90$.

Social support for physical activity and healthy eating were each assessed with 5-item scales. These scales assessed how often, in the past 30 days, family or friends did supportive actions (e.g. encourage, discuss, remind) related to physical activity and eating healthy foods. Item content and response format were based on previously developed scales (Sallis et al., 1987). Internal consistency for both scales was $\alpha = .90$.

Participants also completed a 16-item Eating Habits questionnaire (Muckleroy et al., 2005), the 10 item Center for Epidemiological Studies Depression Scale short form (CES-D) to assess symptoms of depression (Miller et al., 1997), and a demographic characteristics questionnaire.

Procedure

All survey measures were completed in 30 to 40 minutes as part of a computer-based assessment battery during the baseline assessment of the intervention trial. The Actigraph accelerometer was worn for one week after completing the assessments and returned by mail. Four accelerometers were lost during data collection and three women refused to wear the monitor. A total of 309 women (77%) had valid accelerometer data with 65% of these women wearing the monitor as instructed for 7 days. Reasons for women not having physical activity data for analysis were having less than 3 valid days of data recorded, monitor malfunction during data recording or downloading, and lack of available devices at the time of the assessment. Women with and without valid physical activity data from the accelerometers did not differ on socio-demographic characteristics or BMI category ($p > 0.05$). Women's health behaviors and socio-demographics did not vary by valid days of monitoring, with the exception of sedentary behavior where lower average hours of sedentary activity were observed for women having less valid monitored days ($p=0.01$).

Statistical Analysis

Variables were computed to classify each participant as meeting national US guidelines (U.S. Department of Health and Human Services, 2000). Meeting the physical activity guideline was defined as accumulating 30 minutes or more of moderate to vigorous physical activity a day. This definition accounts for intensity and duration of activity but may overestimate the number of women meeting the guideline specification of being active on 5 or more days per week. Accumulating more than 8 hr/day of sedentary time defined being sedentary. We determined this cut-point by considering that if an average adult sleeps roughly 8 hours/day, then 8-hrs represents half of the time a person spends awake. Low dietary fat intake was defined as $<30\%$ of the total daily energy intake, whereas the guideline for fruit and vegetables was ≥ 5 servings per day. We created a total risk factor score for each participant by summing the number of unmet health guidelines. The total risk factor score ranged from 0 (having no risk factors) to 4 (having all four risk factors). From these variables the proportion of women meeting each guideline was computed and then the proportion of women within each possible multiple risk factor combination was determined.

Correlates of each health behavior (defined as meeting or not meeting the guideline) were assessed with multivariate logistic regression models. In the first step of the model building process age (centred to the mean), ethnicity (White vs. Hispanic or other minority), highest household education level, and BMI status were retained as control variables. In a second step, behavior-specific psychosocial variables, socio-demographics, the remaining health behaviors, poor eating practices, and depression were entered as independent variables. Backward selection determined which behavioral predictors remained in each model with a significance criterion for removing variables set at $p > .05$. In order to adjust for possible bias in activity related estimates, the number of valid days of monitoring was included in models where physical activity or sedentary behaviour was the dependent variable or covariate.

The total risk factor score was regressed onto the socio-demographic, behavioral and psychosocial variables with a proportional odds logistic model. We collapsed the ordinal outcome to have four levels (0 to 1, 2, 3, or 4 risk behaviors). Consequently, three separate logits (intercepts), cumulative over the level of the response were modelled. Backward selection determined the covariates included in the final model in addition to control variables. The likelihood ratio tested the proportional odds assumption. If the assumption is not rejected, the odds ratio (effect) for a covariate is taken to be constant across all three of the cut-points in the dependent variable. All statistical models were fit using maximum likelihood estimation in SAS version 8 (SAS Institute, Cary NC, 2000).

RESULTS

Demographic Characteristics

About 61% of the participants identified themselves as being non-Hispanic white. The majority of women were employed full-time, were married or lived with a partner, and had 1 or more children. Nearly half the sample had an education level of at least college graduate. Two thirds of the participants were classified as obese ($BMI \geq 30$). For health behaviors, the amount of moderate to vigorous physical activity (MVPA) was 22.1 min/day ($SD=16.7$) and the estimated amount of sedentary time was 8.3 hours/day ($SD=1.6$). The percent of total calories consumed from total fat was 35.3 ($SD = 7.1$), whereas the mean servings per day of fruit or vegetables was 1.3 ($SD = 1.2$) and 2.2 ($SD = 1.5$), respectively. (Table 1)

Prevalence and patterns of risk behaviors

Table 2 describes the proportion of women with each of the risk behaviors and all possible behavior clusters. A third of the sample had all 4 of risk behaviors and another third had 3 risk behaviors. Only 2% of the sample met all the guidelines.

Correlates of physical activity, sedentary and dietary behaviors

Factors associated with meeting the health behaviour criteria after adjusting for control variables and independently of valid days of activity monitoring, are presented in Table 3. Non-significant p -values for the Hosmer-Lameshow tests of overall model fit indicated an adequate fit to the data for all of the risk behavior models. The explained variance in fitted models ranged from 19% to 27%. The proportional odds model for the total risk factor score in Table 4 presents the covariates positively or negatively associated to the number of lifestyle risk behaviors. The likelihood ratio test indicated that the proportional odds assumption holds for the model ($p = .93$). Included variables accounted for 16% of the variance of the dependent variable.

DISCUSSION

Nine out of ten women in this study had two or more obesity-related risk behaviors, with a third having all four. Two thirds of the sample had at least 3 risk behaviors and only 2% met national guidelines for all four of behaviors. This coexistence of low levels of energy expenditure through insufficient physical activity and excessive sedentary leisure, combined with poor dietary practices is consistent with previous studies of multiple-risk behaviors (Berrigan et al, 2003; Fine et al., 2004; Galan et al., 2006; Bish et al., 2005; McCracken et al., 2007), and describes a population in critical need of interventions to improve health behaviors. Compared to national averages pertaining to overweight and obese women (McCracken et al., 2007; CDC, 2007; Kruger et al., 2004), women in this sample had a similar prevalence of not meeting the dietary guidelines, while a higher proportion did not meet the physical activity guideline.

Both dietary behaviors were included in the most prevalent 2-risk and 3-risk factor clusters along with insufficient physical activity. These findings provide additional evidence to support the need for interventions to improve diet behaviors in overweight women because control of energy intake appears to be achieved when diet is balanced by an increase in the consumption of fruits and vegetables and a decrease in fat intake (Djuric et al., 2002; Ledikwe et al., 2006).

In addition to decreasing caloric intake, recent recommendations to address overweight and obesity include changing behaviors to increase physical activity with a multi-level approach targeting personal, family, education, community, and policy factors (US Department of Health and Human Services, 2001). This study examined multiple correlates of life-style risk behaviors including socio-demographic, psychosocial variables, and behaviors that may inform the development of effective interventions for weight loss or control in women. Each multivariate model included at least 4 statistically significant covariates but accounted for limited total variance suggesting that while some important correlates were identified, other environmental and psychosocial factors not measured in this study need to be considered.

Demographics and socio-economical factors such as employment status, income and children in the household have been associated with health-related lifestyle behaviors in women (Hart et al., 2006; Kristal et al., 2001; Fine et al., 2004; Gillman et al., 2001; Laaksonen et al., 2003; Eyler et al., 2003). In the present sample of overweight women, socio-economic status and educational level correlated with not meeting the dietary fat and fruits and vegetables consumption guidelines, while a lower education level an ethnic minority background was associated with a higher number of risk behaviors. Employed overweight women were more likely to be sedentary compared to those not employed, possibly due to lack of time or competing obligations. In addition, women with children were less likely to meet PA guidelines but also spent less time being sedentary suggesting that for these women a significant amount of time is spent engaged in light intensity activities. These results suggest that unique and potentially more complex interventions might be required for disadvantaged overweight women and for those with demanding obligations such as work or family occupation, as they face more obstacles to meet health behavior recommendations.

Interventions that target changes in knowledge, attitudes, motivation and skills, may be an important means to facilitate changes in physical activity and dietary behaviors (McTigue et al., 2003; Kahn et al., 2002; Pignone et al., 2003). In the present study, some psychosocial variables emerged as significant correlates of the health behaviors. Specifically, self-efficacy beliefs were associated with meeting the physical activity and fruit and vegetable guidelines. In addition, the decisional balance construct of cons of change was correlated with meeting both the servings of fruits and vegetables, and the dietary fat guidelines. These findings point to possible psychosocial constructs that may be targeted in interventions aimed to increase physical activity level and fruits and vegetables consumption in overweight women.

Consistent with previous studies about associations among health behaviors (Gillman et al., 2001; Trudeau et al., 1998; Jago et al., 2005), we found that those overweight women who met the PA recommendation were more likely to meet the fruits and vegetables guideline. In addition, a strong association was found between meeting the fruit and vegetable guideline and meeting the dietary fat guideline. Sedentary activity, in particular TV viewing, has been shown to be associated with unhealthy eating practices and may partly explain the relationship between sedentary behavior and obesity (Blass et al., 2006; Huot et al., 2004). In this sample of overweight women, frequent poor eating practices were associated with sedentary behavior, but not in the expected direction. That is, women with poor eating behaviors were less likely to be sedentary. It may be that this association reflects women 'on the go' who tend to eat quickly, snack frequently, and over-eat at meals. These associations warrant further

investigation because they reveal different patterns that may contribute to energy balance maintenance in overweight women. Finally, the finding of higher depression scores among sedentary women adds evidence to what is known about the relationship between depression and sedentary behavior (Yancey et al., 2004)

Study limitations and strengths

A cross-sectional design, sampling women from one geographic region of the U.S., and modest explained variance in the fitted models are notable limitations of the present study. Strengths of the study include a sample that was diverse in ethnicity and SES status and a validated measure of dietary intake. While objective assessment of physical activity and sedentary behavior through accelerometers was a strength of this study, not obtaining 7 days of monitoring on each participant is a limitation. Incomplete and varying days of accelerometer data reduced the sample size for analyses and potentially introduced bias in physical activity estimates. However, the statistical models controlled for the number of valid days of monitoring in an effort to remove this source of bias.

The present study contributes knowledge about the prevalence and clustering patterns of physical activity, dietary and sedentary risk behaviors among overweight women trying to lose or control their weight. The findings point to several modifiable psychosocial and behavioral correlates of these multiple risk behaviors that might be further tested in lifestyle behavior interventions. Further research is needed to determine optimal intervention strategies for changing multiple lifestyle behaviors for the treatment of obesity. Promising evidence found for interventions targeting multiple behaviors in the field of secondary prevention of cardiovascular disease and diabetes (Goldstein et al., 2004) may provide some insights in order to design effective and feasible interventions for weight management.

Acknowledgments

This project was supported by the National Cancer Institute (R01 CA85873, R01 CA113828, and R01 CA098861-03S1).

Alvaro Sanchez was a visiting fellow at University of California in San Diego supported by the Preventive Services and Health Promotion Research Network – redIAPP (file numbers G03/170 and RD06/0018/0018), Carlos III Institute of Health, Ministry of Health, Spain.

References

1. Astrup A. Healthy lifestyle in Europe: prevention of obesity and type II diabetes by diet and physical activity. *Public Health Nutr* 2001;4(2B):499–515. [PubMed: 11683545]
2. Berrigan D, Dodd K, Troiano RP, Krebs-Smith SM, Ballard Barbash B. Patterns of health behaviors in U.S. adults. *Prev Med* 2003;36:615–23. [PubMed: 12689807]
3. Bish CL, Blanc HM, Serdula MK, Marcus M, Kohl HW, Khan LK. Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. *Obes Res* 2005;13(3):596–607. [PubMed: 15833946]
4. Blass EM, Anderson DR, Kirkorian HL, Pempek TA, Price I, Koleini MF. On the road to obesity: Television viewing increases intake of high-density foods. *Physiol Behav* 2006;88(4–5):597–604.
5. Centers for Disease Control and Prevention (CDC). Prevalence of fruit and vegetable consumption and physical activity by race/ethnicity--United States, 2005. *MMWR Morb Mortal Wkly Rep* 2007;56(13):301–4. [PubMed: 17410082]
6. Centers for Disease Control and Prevention. State-specific prevalence of obesity among adults – U.S. 2005. *MMWR* 2006;55:985–88. [PubMed: 16971886]
7. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Heart, Lung, and Blood Institute (NHLBI). Clinical guidelines on the identification,

- evaluation, and treatment of overweight and obesity in adults: the Evidence Report. Bethesda, MD. U.S.: NIH Publications; 1998. NO. 98-4083
8. Djuric Z, Poore KM, Depper JB, Uhley VE, Lababidi S, Covington C, et al. Methods to increase fruit and vegetable intake with and without a decrease in fat intake: compliance and effects on body weight in the nutrition and breast health study. *Nutr Cancer* 2002;43(2):141-51. [PubMed: 12588694]
 9. Eyler AA, Matson-Koffman D, Young DR, Wilcox S, et al. Quantitative study of correlates of physical activity in women from diverse racial/ethnic groups: The Women's Cardiovascular Health Network Project – summary and conclusions. *Am J Prev Med* 2003;25(3 Suppl 1):93-103. [PubMed: 14499815]
 10. Fine LJ, Philogene GS, Gramling R, Coups EJ, Sinha S. Prevalence of multiple behavioral chronic disease risk factors in the United States: Results from the 2001 National Health Interview Survey. *Am J Prev Med* 2004;27(2S):18-24. [PubMed: 15275670]
 11. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. *Res Q Exerc Sport* 1998;30:777-781.
 12. Galan I, Rodriguez-Artalejo F, Diez-Ganan L, Tobias A, Zorrilla B, Gandarillas A. Clustering of behavioural risk factors and compliance with clinical preventive recommendations in Spain. *Prev Med* 2006;42(5):343-7. [PubMed: 16545444]
 13. Gillman MW, Pinto BM, Tennstedt S, Glanz K, Marcus B, Friedman RH. Relationships of physical activity with dietary behaviors among adults. *Prev Med* 2001;32(3):295-301. [PubMed: 11277687]
 14. Goldstein MG, Whitlock EP, DePue J. Multiple behavioral risk factors interventions in primary care: summary of research evidence. *Am J Prev Med* 2004;27(suppl 1):61-79. [PubMed: 15275675]
 15. Hart A Jr, Tinker L, Boewen DJ, Longton G, Beresford SA. Correlates of fat intake behaviors in the eating for a healthy life study. *J Am Diet Assoc* 2006;106(10):1605-13. [PubMed: 17000193]
 16. Huot I, Paradis G, Receveur O, Ledoux M. Quebec Heart Health Demonstration Project Research Group. Correlates of diet quality in the Quebec population. *Public Health Nutr* 2004;7(8):1009-16. [PubMed: 15548338]
 17. Jago R, Nicklas T, Yang SJ, Baranowski T, Zakeri I, Bereson GS. Physical activity and health enhancing dietary behaviors in young adults: Bogalusa Study. *Prev Med* 2005;41(1):194-202. [PubMed: 15917011]
 18. Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab MW, Corso P. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med* 2002;22(4 Suppl):73-107. [PubMed: 11985936]
 19. Kristal AR, Hedderson MM, Patterson RE, Neuhouser M. Predictors of self-initiated, healthful dietary change. *J Am Diet Assoc* 2001;101(7):762-766. [PubMed: 11478472]
 20. Kristal AR, Vizenor NC, Patterson RE, Neuhouser ML, Shattuck AL, McLerran D. Precision and bias of food frequency-based measures of fruit and vegetables intake. *Cancer Epidemiol Biomarkers Prev* 2000;9(9):939-944. [PubMed: 11008912]
 21. Kruger J, Galuska DA, Serdula MK, Jones DA. Attempting to lose weight: specific practices among U.S. adults. *Am J Prev Med* 2004;26(5):402-6. [PubMed: 15165656]
 22. Laaksonen M, Prattala R, Lahti E. Socio-demographic determinants of multiple unhealthy behaviours. *Scand J Public Health* 2003;31(1):37-43. [PubMed: 12623523]
 23. Ledikwe JH, Blanck HM, Khan LK, Serdula MK, et al. Low-energy-density diets are associated with high diet quality in adults in the United States. *J Am Diet Assoc* 2006;106:1172-1180. [PubMed: 16863711]
 24. Marcus BH, Rakowski W, Rossi JS. Assessing motivational readiness and decision making for exercise. *Health Psychology* 1992;11:257-261. [PubMed: 1396494]
 25. Matthews CE, Ainsworth BE, Thompson RW, Bassett DR Jr. Sources of variance in daily physical activity levels as measured by an accelerometer. *Med Sci Sports Exerc* 2002;34(8):1376-81. [PubMed: 12165695]
 26. Miller, GD.; Harrington, ME. Center for epidemiologic studies depression scale. In: Joer, ST., editor. Obesity assessment: Tools, methods, interpretations. New York: Chapman & Hall; 1997.
 27. McCracken M, Jiles R, Blanck HM. Health behaviors of the young adult U.S. population: behavioral risk factor surveillance system, 2003. *Prev Chronic Dis* 2007;4(2):A25. [PubMed: 17362616]Epub
 28. McCrory MA, Suen VM, Roberts SB. Biobehavioral influences on energy intake and adult weight gain. *J Nutr* 2002;132(12):3830S-3834S. [PubMed: 12468634]

29. McTigue KM, Harris R, Hemphill B, Lux L, Sutton S, Bunton AJ, Lohr KN. Screening and interventions for obesity in adults: summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2003;139(11):933–49. [PubMed: 14644897]
30. Muckleroy, S.; Calfas, KJ.; Norman, GJ.; Elder, J.; Patrick, K. Validation of a self-report overeating assessment with overweight women. Paper presented at the 26th annual meeting of the Society of Behavioral Medicine Conference; Boston, MA. 2005 Apr.
31. National Institutes of Health. Strategic plan for NIH obesity research: a report of the NIH Obesity Research Task Force (draft). 2004. Available at: <http://obesityresearch.nih.gov>
32. Nichols JF, Morgan CG, Chabot LE, Sallis JF, Calfas KJ. Assessment of physical activity with the Computer Science and Applications, Inc. Accelerometer: laboratory versus field validation. *Res Q Exerc Sport* 2000;71:36–43. [PubMed: 10763519]
33. Patterson RE, Kristal AR, Tinker LF, Carter RA, Bolton MP, Agurs-Collins T. Measurement characteristics of the Women's Health Initiative food frequency questionnaire. *Ann Epidemiol* 1999;9(3):178–87. [PubMed: 10192650]
34. Pignone MP, Ammerman A, Fernandez L, Orleans CT, Pender N, Woolf S, Lohr KN, Sutton S. Counseling to promote a healthy diet in adults: a summary of the evidence for the U.S. Preventive Services Task Force. *Am J Prev Med* 2003;24(1):75–92. [PubMed: 12554027]
35. Prochaska JO, Velicer WF. The Transtheoretical Model of health behavior change. *Am J Health Promot* 1997;12(1):8–48. [PubMed: 10170438]
36. Pronk NP, Anderson LH, Crain AL, Martinson BC, et al. Meeting recommendations for multiple healthy lifestyle factors. Prevalence, clustering, and predictors among adolescents, adult, and senior health plan members. *Am J Prev Med* 2004;27(2S):25–33. [PubMed: 15275671]
37. Rossi SR, Greene GW, Rossi JS, Plummer BA, Benisovich SV, Keller S, Velicer WF, Redding CA, Prochaska JO, Pallonen UE, Meier KS. Validation of decisional balance and situational temptations measures for dietary fat reduction in a large school-based population of adolescents. *Eating Behaviors* 2001;2:1–18. [PubMed: 15001046]
38. Saelens BE, Gehrman CA, Sallis JF, et al. Use of self-management strategies in a 2-year cognitive-behavioral intervention to promote physical activity. *Behav Ther* 2000;31:365–379.
39. Sallis JF, Grossman RM, Pinski RB, Patterson TL, Nader PR. The development of scales to measure social support for diet and exercise behaviors. *Prev Med* 1987;16:825–836. [PubMed: 3432232]
40. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. *Med Sci Sports Exerc* 2005;37(11suppl):S531–43. [PubMed: 16294116]
41. Trudeau E, Kristal AR, Li S, Patterson RE. Demographic and psychosocial predictors of fruit and vegetable intakes differ: implications for dietary interventions. *J Am Diet Assoc* 1998;98(12):1412–7. [PubMed: 9850109]
42. U.S. Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. Vol. 2. Washington, DC: U.S. Government Printing Office; 2000.
43. US Department of Health and Human Services. The surgeon general's call to action to prevent and decrease overweight and obesity. Rockville, MD: US Department of Health and Human Services, Public Health Service, Office of the Surgeon General; 2001. Available at <http://www.surgeongeneral.gov/topics/obesity>
44. Velicer WF, DiClemente CC, Prochaska JO, Brandenburg N. Decisional balance measure for assessing and predicting smoking status. *J Pers Soc Psychol* 1985;57(1):207–15.
45. Yancey AK, Wold CM, McCarthy WJ, Weber MD, et al. Physical inactivity and overweight among Los Angeles County adults. *Am J Prev Med* 2004;27(2):146–52. [PubMed: 15261902]

Table 1

Demographic, anthropometric, and health behavior sample characteristics. Values are mean (standard deviation), otherwise indicated

	(N = 394)
Age	41.26 (8.7)
Ethnicity n (%)	
Asian/Pacific Islander	21 (5.3%)
African American	28 (7.1%)
Native American	1 (0.2%)
Hispanic	81 (20.6%)
Non-Hispanic White	239 (60.7%)
Multi-ethnic/Other	24 (6.1%)
Income n (%)	
<10k to <35K	63 (16.0%)
35K to <50k	75 (19.0%)
50K to <75K	94 (23.9%)
75K to 100K+	115 (29.2%)
did not report	47 (11.9%)
Employ n (%)	
Full-time	286 (72.8%)
Part-time	64 (16.3%)
Unemployed	43 (10.9%)
Education level n (%)	
Some High School	63 (16.1%)
Some College	149 (38.0%)
College Graduate	97 (24.7%)
Post grad	83 (21.2%)
Marital status n (%)	
Married or partner	262 (66.8%)
Single, separated, widow, divorced	130 (33.2%)
Number of children n (%)	
No children	117 (29.7%)
1 or more children	277 (70.3%)
Height in centimeters	163.6 (6.5)
Weight (kilograms)	185.7 (30.3)
Percent Body Fat	35.9 (5.4)
BMI	32.5 (4.4)
BMI category n (%)	
25–29.9 (kg/m ²)	134 (34.0%)
30 – 34.9 (kg/m ²)	147 (37.3%)
≥ 35 (kg/m ²)	113 (28.7%)
Daily Fruit Consumption	1.3 (1.2)
Daily Vegetables Consumption*	2.2 (1.5)

(N = 394)	
% Kilojoules from Fat per day	35.3 (7.1)
Min/day Physical Activity ^a	22.1 (16.7)
Sedentary behavior hours/day ^a	8.3 (1.6)

^aVariables derived from Actigraph, n=304

Table 2
Prevalence and Clustering Patterns of Life-style Risk Behavior (N=304)

Number of risk behaviors	PA < 30 min/day	Fat > 30% Fat	Frt/Veg < 5 servings	Sedentary > 8 hours/day	Percent of sample
4	Yes	Yes	Yes	Yes	32.9
3	Yes	Yes	Yes	No	17.8
3	Yes	Yes	No	Yes	3.6
3	Yes	No	Yes	Yes	6.9
3	No	Yes	Yes	Yes	4.3
2	Yes	Yes	No	No	4.3
2	Yes	No	Yes	No	4.3
2	Yes	No	No	Yes	2.6
2	No	Yes	Yes	No	8.5
2	No	Yes	No	Yes	2.3
2	No	No	Yes	Yes	2.3
1	Yes	No	No	No	2.6
1	No	Yes	No	No	2.3
1	No	No	Yes	No	1.6
1	No	No	No	Yes	1.3
0	No	No	No	No	2.3
Totals by risk behavior	75.0	75.9	78.6	56.2	100.0

Table 3

Multivariate Logistic Regression Models for meeting the Health Guidelines

	Meeting Health Criteria			
	Physical Activity	Sedentary Behavior (< 8 hours/day)	Dietary Fat	Fruit & Vegetable Consumption
	Adjusted OR (95%CI)	Adjusted OR (95%CI)	Adjusted OR (95%CI)	Adjusted OR (95%CI)
Age ^a	0.98 (0.95–1.02)	0.98 (0.95–1.01)	1.00 (0.97–1.04)	1.02 (0.98–1.06)
Non-white	0.72 (0.39–1.33)	0.62 (0.36–1.07)	0.88 (0.48–1.58)	0.91 (0.46–1.80)
BMI	0.92 (0.86–0.99)	1.03 (0.97–1.09)	0.94 (0.89–1.01)	0.99 (0.92–1.06)
Valid days of activity monitoring	1.03 (0.81–1.32)	0.74 (0.58–0.93)		1.18 (0.86–1.63)
Lower education employed ^b		0.29 (0.12–0.73)		0.50 (0.27–0.95)
Income $< 75K$			0.41 (0.23–0.75)	
1 or more children in household	0.40 (0.22–0.76)	2.01 (1.10–3.66)	0.47 (0.25–0.86)	2.16 (1.09–4.28)
Meeting PA guideline		3.14 (1.71–5.76)		2.15 (1.09–4.24)
Meet dietary Fat guideline				
Meet Frit/Veg serving guideline			3.72 (2.01–6.88)	
Low-level of Sedentary Behavior	2.82 (1.57–5.07)			
Physical activity self-efficacy	1.11 (1.04–1.18)			
Fruit & vegetable consumption self-efficacy				1.07 (1.00–1.15)
Cons of reducing fruit & vegetable consumption				0.86 (0.76–0.98)
Cons of reducing dietary fat			0.89 (0.82–0.97)	1.14 (1.03–1.27)
Health eating change strategies				1.05 (1.02–1.09)
Poor Eating Habits ^c		1.03 (1.01–1.05)	0.96 (0.93–0.98)	
Depressive symptoms ^d		0.89 (0.82–0.97)		

^aNote: Age centred to the mean

^bCompared to unemployed

^cHigher scores indicate more frequent poor eating habits

^dHigher scores indicate higher depression symptoms. The Hosmer-Lemeshow test of model fit indicated all models provided acceptable fit to the data: Physical activity, Chi-square = 5.46, p = 0.71; Sedentary behavior, Chi-square = 11.97, p = 0.15; Fat intake, Chi-square = 7.34, p = 0.49; Fruit and vegetables, Chi-square = 7.52, p = 0.48. The explained variance (R^2) was 19% and 20% for the physical activity and sedentary behavior models respectively. The fruit and vegetables and fat intake models explained 26% and 27% of the variance respectively.

Table 4
Ordinal Logistic Regression Model for Number of Risk Behaviors

	Estimate (Standard error)	Odds Ratio (95% CI)
Age ^a	0.005 (0.013)	1.00 (0.98 to 1.03)
Non-white	0.532 (0.230)	1.70 (1.08 to 2.67)
BMI	0.030 (0.023)	1.03 (0.98 to 1.08)
Valid days of activity monitoring	0.140 (0.095)	1.15 (0.95 to 1.38)
Low education level	0.283 (0.108)	1.76 (1.15 to 2.69)
Physical activity change strategies	−0.041 (0.011)	0.96 (0.94 to 0.98)
Healthy eating social support	−0.054 (0.020)	0.95 (0.91 to 0.98)

^aNote: Age centred to the mean; Test for proportional odds assumption Chi-square = 7.21, p = 0.93