
Common Measures, Better Outcomes (COMBO)

A Field Test of Brief Health Behavior Measures in Primary Care

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- Background:** Primary care offices have been characterized as underutilized settings for routinely addressing health behaviors that contribute to premature death and unnecessary suffering. Practical tools are needed to routinely assess multiple health risk behaviors among diverse primary care patients. The performance of a brief set of behavioral measures used in primary care practice is reported here.
- Methods:** Between August 2005 and January 2007, 75 primary care practices assessed four health behaviors, using a 21-item patient self-report questionnaire for adults or a 16-item questionnaire for adolescents. Data were collected via telephone, paper, or electronic means, either with or without assistance. The performance of these measures was evaluated by describing risk-behavior prevalences, combinations of risk behaviors, and missing data.
- Results:** Of 227 adolescents and 5358 adults, most patients completed all of the survey questions. Two or more unhealthy behaviors were reported by 47.1% of adolescents and 69.2% of adults. Percentages of adults who completed all the survey items varied by health behavior: tobacco use, 98.5%; diet, 98.2%; physical activity, 96.2%; alcohol use, 85.1%. Missing data rates were higher for unassisted patient self-reporting.
- Conclusions:** A relatively brief set of health behavior measures was usable in a variety of primary care settings with adults and adolescents. The performance of these measures was uneven across behaviors and administration modes, but yielded estimates of unhealthy behaviors consistent overall with what would be expected based on published population estimates. Further work is needed on measures for alcohol use and physical activity to bring practical assessment tools for key health behaviors to routine primary care practice.
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Introduction

The health consequences of how Americans smoke, eat, exercise, and drink have been well documented.^{1–7} Approximately 90% of U.S. adults do not meet recommendations for healthy behaviors, and, by one estimate, 58% of the adult U.S. population have two or more risk behaviors.⁸ The primary care physician's office is the largest single

platform of formal health care in the U.S.,^{9,10} yet U.S. primary care offices have been characterized as potent but underutilized sites for routinely identifying and helping patients with their health risk behaviors of tobacco use, unhealthy diet, physical inactivity, and risky alcohol use.^{11–15}

Coups et al.¹¹ found that while most patients report having more than one risk behavior, approximately 28% were not screened for any. Regular screening for tobacco use, unhealthy diet, physical inactivity, and risky alcohol use in the primary care clinician's office is impeded by insufficient time,¹⁶ lack of reimbursement,¹⁷ low provider self-efficacy,¹⁸ lengthy assessments impractical for routine use, and relatively few effective interventions for physical activity and nutrition.¹⁹ Yet assessing these health risk behaviors may provide powerful individual-level metrics for both clinical decisions and for population-level decisions.¹² Tobacco use, obesity, and risky alcohol use contribute significantly to clinic or hospital visits and total healthcare charges,²⁰ and adopting even modestly healthier behaviors ap-

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pears to lower the risk of cardiovascular disease and mortality in a relatively short period of time.²¹

Previous work has noted the lack of consensus on health risk assessments suitable for routine use in primary care across settings and populations.²² Although measures have been recommended, little is known about their use and performance in the primary care setting. The Prescription for Health program provided an opportunity to field-test recommended measures of health behaviors in diverse primary care settings and populations. This article reports the use of this brief set of health behavior measures in routine primary care practices, assessing how they performed by (1) describing the percentages of health risk behaviors in patients, (2) examining the combinations of health risk behaviors compared to national survey data, and (3) assessing missing data by age group and question.

Methods

Program Overview

Prescription for Health was a national initiative designed to identify, test, and evaluate practical evidence-based tools, cues, and techniques to improve the delivery and effectiveness of health behavior-change strategies in routine primary care practice.²³ Focusing on four leading health risk behaviors associated with premature death (tobacco use, unhealthy diet, physical inactivity, and risky alcohol use), Round 2 of the program funded ten practice-based research networks (PBRNs) to test interventions to improve health behavior change in primary care patients. As a condition of funding, PBRNs agreed to use a common set of patient-level measures. To combine data across the ten projects, the Prescription for Health National Program Office (NPO) formalized the study as COMmon Measures, Better Outcomes (COMBO) and assumed responsibility for combining and analyzing the data.

Study Population

The COMBO study population consisted of adult and adolescent patients from 75 practices. Patients completed the measures between August 2005 and January 2007. The projects had different interventions, specific aims, staffing patterns, and target populations; thus sampling and data-collection procedures were not standardized across projects. Patients who received surveys differed in how they were enrolled (e.g., random versus convenience sample, prescreened for risk versus no prescreening). Additionally, data collection across networks occurred in a variety of formats (e.g., paper versus electronic means, aided versus unaided). Completion of the questionnaires was considered aided if study staff were present to help respondents complete or clarify questions.

Measures

Patient measures were selected to assess patient-reported information about the four health risk behaviors. Based on previous work by Glasgow et al.,²⁴ a set of 21 questions constituted the adult assessment tool and a 16-question set constituted the adolescent assessment.²⁴ Criteria for selecting

these measures included sensitivity to change, brevity, breadth of applicability, relation to public health goals, and validation in English and Spanish.

Adult measures consisted of items from the following surveys: Behavioral Risk Factor Surveillance System (BRFSS) 2003 (smoking and alcohol use)²⁵; Society for Research on Nicotine and Tobacco (smoking)²⁶; the Behavior Change Consortium (smoking)²⁷; and Starting the Conversation (eating patterns).^{28,29} Following concerns about the usability and validation of the original recommendation for physical activity assessment, the short version of the International Physical Activity Questionnaire (IPAQ) was selected as an acceptable replacement.³⁰ The final set of COMBO self-reported measures in Spanish and English appears in the [Appendix](#).

Adolescent measures included items from the Smoking Uptake Continuum (smoking)³¹; Youth Risk Behavior Surveillance System (YRBSS) 2003 (alcohol use)³²; BRFSS 2003 (alcohol use)²⁵; Physical Activity and Nutrition Behaviors Monitoring Form (eating patterns)³³; Patient-centered Assessment and Counseling for Exercise plus Nutrition (PACE+; physical activity)³⁴; and YRBSS 2003 (physical activity).³²

Also selected were a set of variables to be collected for each patient, including gender; age; height; weight; quality of life; income (adults only); and education (adults only). These demographic items, selected from the BRFSS, have been validated in Spanish and English and widely applied.

Data Transmission and Aggregation into the COMBO Data Set

Each project was responsible for collecting, storing, cleaning, and transmitting de-identified COMBO data to the NPO for merging. A common set of rules outlined the parameters for the COMBO data, including variable names, variable types, values, and ranges for each question on the common measures. Data were submitted to the NPO for consolidation into final baseline data sets used for analysis. The COMBO study was approved by the University of Colorado Denver human subjects review board. Individual PBRN projects were approved by their respective human subjects review boards.

Health Risk Behavior Variables

From subsets of the individual survey items, binary categorical variables for the risk behaviors were calculated to enable analyses of combinations of unhealthy behaviors as outcome variables (Table 1).

For data cleaning and the creation of categorical variables, published recommendations or procedures for the specific measures were followed. Additionally, for adult eating patterns, up to two of seven missing dietary questions were imputed with the mean of the provided responses.²⁸ For adult physical activity, if the respondents had complete data for at least one intensity level (vigorous, moderate, or walking), responses of zero were assumed for other intensity levels rather than considered missing, which retained as many patients' data as possible. Although the physical activity questions asked about sitting, it was not considered in any of the analyses because there is no established recommendation for an amount of sitting.

Table 1. Definitions of health risk behavior variables used in analysis

	Definition
Adolescents	
Never smoked	Never tried or experimented with cigarette smoking
Experimental smoker	Has tried cigarette smoking, but smoked on fewer than 30 days in the past 30 days ^{24,35}
Regular smoker	Has smoked all 30 days in the past 30 days ^{24,35}
Current drinker	Has had at least one alcoholic drink in the past 30 days ³⁶
Binge drinker	In the past 30 days, there was at least one occasion when at least five alcoholic drinks were consumed in a row. ³⁶
Television viewing	Indicated 2 or more hours of television watched on an average weekday ³⁷
Underactive	The two questions about physical activity of 60 minutes or more are averaged; if average is fewer than 5 days/week, then categorized as underactive. ³⁶
Less than recommended fruit and vegetable intake	The sum of the fruit and vegetable consumption questions indicated fewer than five servings/day. ³⁶
Adults	
Current smoker	Anyone who has smoked at least 100 cigarettes and has smoked at least part of a cigarette in the past 30 days (similar to BRFSS coding) ³⁸
Former smoker	Anyone who has smoked at least 100 cigarettes, but none in the past 30 days ³⁸
Never smoker	Has not smoked at least 100 cigarettes in lifetime ³⁸
Less than recommended fruit and vegetable intake	Eats fewer than five servings of fruit and vegetables each day ³⁹
Underactive	Fewer than 5 days of at least 30 minutes of vigorous or moderate physical activity per week ³⁹
Heavy drinker	Average drinks per day is calculated. More than two drinks per day for men or more than one drink per day for women is considered a heavy drinker. ^{19,40}

BRFSS, Behavioral Risk Factor Surveillance Survey

Analysis

There were several analysis objectives, all focused on evaluating the performance of the measures by (1) describing the characteristics of the study population and the percentage of patients who reported each of the four health risk behaviors using basic descriptive statistics (mean, SD, frequencies, percentages); (2) examining patterns of the co-occurrence of multiple health risk behaviors to further assess the value of using this set of measures, much like what has been done using nationally representative data^{8,11,12,41}; and (3) assessing the prevalence of missing data. In the co-occurrence analysis, a total risk-behavior score was created for each respondent with sufficient data on tobacco use, diet, and physical activity by summing the number of risk behaviors, ranging from 0 to 3.

Less than 3% (2.2%) of the sample had three or more missing responses to the seven dietary questions after imputation of the mean for missing data. The percentage of adults missing the two questions needed to create the drinking outcome variable exceeded 40%. With no reliable method to impute missing data, heavy drinking was dropped from the analysis of the co-occurrence of health behaviors to maintain a larger sample across more networks. For consistency in reporting, alcohol use was also dropped from the co-occurrence analysis among adolescents. The overall prevalence of heavy drinking was 7.2% among adults in this sample. A detailed analysis of missing data among adolescents was not performed because missing data appeared in just 2.2% of the sample—and only for the questions about alcohol use.

For the analysis of multiple risk behaviors, respondents with missing data for any one of the three behaviors (tobacco use, unhealthy diet, or physical inactivity) were excluded

from the analyses (12.2% of adults). Because the percentage of adults excluded from the analyses exceeded 10%, the differences between those who responded to questions and those who did not were examined, using chi-square and t-tests to determine potential bias that may exist in the results using complete data only.

Results

A total of 5358 adult patients from 67 practices in nine PBRNs constituted the adult COMBO data set. A total of 227 adolescent patients from 17 practices in two PBRNs constituted the adolescent data set.

Percentages of Health Risk Behaviors Among Adolescent Patients

The average age of adolescents was 15 years. Just over half (56%) were girls (Table 2). This sample of adolescents was mostly non-Hispanic white (80.7%); had never smoked (75.8%); and was underactive (59.0%). Just 27.8% ate at least five servings of fruit and vegetables daily, while 12.6% reported having drunk at least one alcoholic drink in the past 30 days.

Combinations of Health Risk Behaviors Among Adolescent Patients

Nearly 15% in this sample of adolescent patients (14.5%) reported no unhealthy behaviors (Table 3). More than one third (38.3%) had just one unhealthy behavior; almost half (47.1%) had two or more unhealthy behav-

Table 2. Characteristics of adolescent patients in COMBO including health behaviors (N=227)

Characteristic	COMBO totals n (%)
DEMOGRAPHIC	
M age in years (SD)	15.0 (2.0)
Gender	
Female	127 (56.0)
Male	100 (44.0)
Race/ethnicity	
Non-Hispanic white	146 (80.7)
Non-Hispanic black	8 (4.4)
Hispanic	7 (3.9)
Other	20 (11.1)
HEALTH-RELATED	
BMI (kg/m²) M (SD)	22.5 (4.37)
Smoking	
Never smoked	172 (75.8)
Experimental smoker ^a	47 (20.7)
Regular smoker ^b	8 (3.5)
Less than recommended fruit and vegetable intake^c	164 (72.3)
Underactive^d	134 (59.0)
Current drinker^e	28 (12.6)
Binge drinker (of current drinkers)^f	14 (50.0)

^aSmoked on fewer than 30 days in the past month

^bSmoked every day in the past 30 days

^cAte fewer than five servings of fruit and vegetables on a typical day

^dFewer than 5 days per week of at least 60 minutes of physical activity per day

^eHad at least one alcoholic drink in the past 30 days

^fAt least one occasion where at least five alcoholic drinks were consumed (in a row) in the past 30 days

iors; 2.2% had three. Consuming fewer than five servings of fruit and vegetables—alone or in combination with smoking, underactivity, or both—was the unhealthy behavior most commonly reported among adolescents (72.2%).

Missing Data in the Adolescent Data Set

Adolescents in the sample completed responses to nearly all of the survey questions used in this analysis. Just 2.2% of the sample had incomplete data, and this was for the drinking questions only.

Table 3. Combinations of multiple health risk behaviors among adolescents (N=227)

Number of risks	Smoker	Less than recommended fruit and vegetable intake	Underactive	Frequency	Percent ^a
0	N	N	N	33	14.5
1	Y	N	N	0	0
1	N	Y	N	57	25.1
1	N	N	Y	30	13.2
2	Y	Y	N	3	1.3
2	Y	N	Y	0	0
2	N	Y	Y	99	43.6
3	Y	Y	Y	5	2.2

^aPercents may not equal 100% due to rounding.

Percentages of Health Risk Behaviors Among Adult Patients

Most of the adult sample were women (71.7%), and most had a high school education or higher (84.7%). The sample was mostly non-Hispanic white (60.2%), although 17.8% were Hispanic and 17.2% African American. There was a good distribution of income; 45% had an annual household income of <\$25,000 (Table 4). Seventy-five percent of the respondents were overweight or obese (75.6%), and 66% reported good or better general health status.

Approximately one quarter of the people in the sample were current smokers, while 88.2% ate fewer than the recommended five servings or more of fruit and vegetables, and 69.5% were underactive. Just over 7% (7.2%) of the respondents reported being a heavy drinker.

Combinations of Health Risk Behaviors Among Adult Patients

When the patterns and distribution of multiple risk behaviors were examined (Table 5), less than 4% of the adults in COMBO reported no health risk behaviors. Nearly 28% had just one unhealthy behavior, while 69.2% had two or more unhealthy behaviors, and 15.2% had three unhealthy behaviors. The combination of unhealthy diet and underactivity was the most common (46%). Patients reporting unhealthy diets alone or in combination with other risk behaviors appeared in 88% of the sample. Most current smokers (96.9%) also reported unhealthy diets, underactivity, or both. The overall mean number of risks was 1.81. Respondents who were Hispanic, aged <55 years, had less than a high school education, and had a lower income were more likely to have a higher mean number of risk behaviors.

Missing Data in the Adult Data Set

Missing data patterns for adults varied across the behavior measures (Table 6). Calculation of the binary categorical variables did not rely on all the items within a behavior. Imputation and assumptions made about each risk behavior helped to preserve the sample size.

Still, physical activity and alcohol use had high percentages of missing data. When the percentage of the sample missing physical activity data (binary categorical variable) was assessed across administration modes, the percentages varied: 12.7% of the paper/unaided; 9.4% of telephone/unaided; 1.5% of telephone/aided; 0.5%

Table 4. Characteristics of adult patients in COMBO including health behaviors (N=5358)

Characteristic	COMBO totals n (%)
DEMOGRAPHIC	
M age in years (SD)	50.4 (16.6)
Gender	
Male	1508 (28.4)
Female	3811 (71.7)
Race/ethnicity	
Non-Hispanic white	3112 (60.2)
Non Hispanic black	890 (17.2)
Hispanic	918 (17.8)
Other	246 (4.8)
Education level	
<High school	778 (15.3)
≥High school	4296 (84.7)
Annual household income (\$)	
<25,000	2059 (44.9)
25,000–49,999	1171 (25.6)
≥50,000	1354 (29.5)
HEALTH-RELATED	
BMI (kg/m²)	
<25.0	1253 (24.4)
25.0–29.9	1515 (29.5)
≥30.0	2367 (46.1)
General health status	
Excellent, very good, or good	3451 (66.0)
Fair or poor	1782 (34.1)
M unhealthy days^a (SD)	10.8 (11.7)
Smoking	
Current smoker ^b	1290 (24.8)
Former smoker ^c	1300 (25.0)
Never smoker	2615 (50.2)
Less than recommended fruit and vegetable intake^d	4602 (88.2)
Underactive^e	3355 (69.5)
Heavy drinker^f	237 (7.2)

^aSum of the number of days that physical and mental health were not good in past 30 days

^bSmoked at least 100 cigarettes in their lifetime and at least part of a cigarette in the past 30 days

^cSmoked at least 100 cigarettes in their lifetime and no cigarettes in the past 30 days

^dAte fewer than recommended five or more servings of fruit and vegetables each day

^eFewer than 5 days of at least 30 minutes of vigorous or moderate physical activity per week

^fAn average of more than two drinks per day for men; more than one drink per day for women

Table 5. Combinations of multiple health risk behaviors among adults (n=4703^a)

Number of risks	Smoker	Less than recommended fruit and vegetable intake	Underactive	Frequency	Percent ^b
0	N	N	N	151	3.2
1	Y	N	N	35	0.7
1	N	Y	N	946	20.1
1	N	N	Y	324	6.9
2	Y	Y	N	314	6.7
2	Y	N	Y	59	1.3
2	N	Y	Y	2161	46.0
3	Y	Y	Y	713	15.2

^aHeavy drinking and cases with incomplete or missing data for at least one of the three health behaviors were excluded from this analysis.

^bPercents may not equal 100% due to rounding.

Table 6. Percentage of adult respondents with missing data by behavior and type of missing data

Assessed behavior	% with no data (variable missing; responses to all items missing)	% with data insufficient for binary categorical variable assignment (item missing; responses missing for items needed for categorical variable)
Diet	1.8	2.2
Tobacco use	1.5	2.9
Physical activity	3.8	9.9
Alcohol use	14.9	35.0

of computer/unaided. For alcohol-use data, percentages of the sample with missing data also varied, but higher rates persisted across modalities: 44.0% paper/unaided; 11.3% telephone/unaided; 1.2% telephone/aided; 6.3% computer/unaided.

The differences between those who responded to questions and those who did not were examined, using chi-square and t-tests to determine potential bias that may exist in the results using complete data only for the co-occurrence analysis. There were significant differences ($p<0.05$) between the two groups on several variables. Those who were included in the analysis tended to be younger, more highly educated, have higher incomes, have a higher BMI, and were more likely to be non-Hispanic white. A sensitivity analysis replacing missing values on the three risk behaviors with negative responses resulted in non-overlapping 95% CIs for data with imputed values versus responders only for poor diet and underactivity. This suggests that when nonresponders are assumed not to have a risk behavior, the resulting prevalence is an underestimate of the behavior. In contrast, smoking rates were similar in responders and nonresponders.

Discussion

The COMBO study demonstrated that a brief set of health risk behavior measures could be applied across a variety of primary care settings that include adults and adolescents. This field test of a common set of brief measures revealed reasonable and relatively complete results for smoking and dietary status. However, some limitations must be overcome before the adoption of all of these or other brief measures can be recommended. Less than 3% of the adult sample lacked sufficient data to deter-

mine their smoking or dietary status, but substantially higher percentages lack sufficient data on physical activity (9.9%) and alcohol use (41.2%).

Despite missing data, the COMBO study findings confirmed high rates of unhealthy behaviors among patients seen in these frontline primary care practices. Although not directly comparable to rates reported from national surveillance data,⁴²⁻⁴⁴ the COMBO data demonstrated credible prevalence estimates. For example, prevalence data from the 2006 BRFSS showed that 20.0% of adults were current smokers, 76.8% ate fewer than five servings of fruit and vegetables, 50.9% were underactive, and 4.9% were heavy drinkers—all of which are lower than the COMBO rates presented in Table 4, but are of similar magnitude and patterns.⁴²

Using the measures to categorize patients and create an overall risk score allowed the examination of data across practices and demographic variables. This analysis illustrates the complex nature of most patients' having more than one health risk behavior. Further, in this study, adult patients aged <55 years or those with lower household incomes (<\$25,000) were more likely to have more unhealthy behaviors.

Importantly, those with sufficient data for analysis of multiple health behaviors tended to be younger, more highly educated, of a higher income level, have a higher BMI, and were more likely to be non-Hispanic white. This likely led to an underestimate in the prevalence of unhealthy behaviors.

The reasons for the relatively high percentage of missing data on physical activity and alcohol use are not precisely known. Missing physical activity data could be due to the complexity of the instrument and the scoring algorithm⁴⁵ recommended by IPAQ that sets out-of-range data to missing. However, the variation of missing data for exercise suggests a possible connection between missing data and the administration mode. Participating networks reported that the adult physical activity questionnaire was difficult for some patients to complete. Because the IPAQ was originally designed for population surveillance purposes, it may be that self-administration in the clinical setting is inappropriate, especially with its complex scoring. Additionally, the question about sitting appears to have little value, given that there is no recommendation for judging appropriate levels of sitting.

The large percentage of adult respondents who reported no data about their alcohol use points to issues about the self-reporting of alcohol use that go beyond the instrument itself. These missing alcohol-use data might reflect known difficulties in addressing problem drinking in primary care.^{46,47}

Limitations

Due to the nonstandardized methods in the administration of the instruments, the patient populations, the

enrollment criteria, and the intervention designs, it is not possible to generalize to all primary care practices or to all primary care patients. Differences in sociodemographic characteristics between responders and nonresponders to risk-behavior questions further limit generalizability. However, these data do reflect a variety of primary care patients and practices not previously studied with a common, focused set of health risk assessments. While the COMBO measures were able to assess key unhealthy behaviors in most of the patients seen in these frontline primary care practices, this study did not evaluate whether these measures are clinically useful on an individual-patient basis for making decisions about care. Also, it may not be possible to assess overall dietary quality with brief measures, and this analysis of fruit and vegetable intake is just one component of diet quality.

The question of the feasibility of routinely assessing the four major health risk behaviors for Americans has not been settled, although the use of COMBO measures points to important work needed to bring practical self-reporting measures to routine primary care practice. The refinement of these or other proposed health behavior measures will require careful study of patients' abilities to reliably and quickly complete questionnaires about their health behaviors. Such studies will need to consider ways to reduce the questionnaires' complexity and the time needed to complete them, and to understand the clinical significance even when the data are complete and reliable.

Conclusion

Most patients were able to complete a set of relatively brief measures about their tobacco use, diet, physical activity, and alcohol use, although their performance in a variety of primary care settings was uneven across health behaviors and administration modes. Items related to alcohol use and physical activity probably require revision to enhance the usefulness of these measures in routine primary care practice. Despite limitations, these measures yielded estimates of unhealthy behaviors that align with what would be expected in primary care practices based on published population estimates, suggesting that they may work in practice settings. Progress has been made toward a set of brief measures, moving closer to what primary care practices need for routine use.

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References

1. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980–2000. *N Engl J Med* 2007;356:2388–98.
2. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the U.S. 2000. *JAMA* 2004;291:1238–45.
3. McGinnis JF, Foegen WH. Actual causes of death in the U.S. *JAMA* 1993;270:2207–12.
4. Eaton DK, Kann L, Kinchen S, et al. Youth risk behavior surveillance—U.S., 2005. *MMWR Surveill Summ* 2006;55:1–108.
5. Troiano RP, Flegal KM. Overweight children and adolescents: description, epidemiology, and demographics. *Pediatrics* 1998;101:497–504.
6. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the U.S., 1999–2004. *JAMA* 2006;295:1549–55.
7. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among U.S. children and adolescents, 1999–2000. *JAMA* 2002;288:1728–32.
8. Fine LJ, Philogene GS, Gramling R, Coups EJ, Sinha S. Prevalence of multiple chronic disease risk factors: 2001 national health interview survey. *Am J Prev Med* 2004;27(2S):18–24.
9. Green LA, Fryer GE Jr., Yawn BP, Lanier D, Dovey SM. The ecology of medical care revisited. *N Engl J Med* 2001;344:2021–5.
10. Cherry DK, Burt CW, Woodwell DA. National ambulatory medical care survey: 2001 summary. Advance data from vital and health statistics; no 337. Hyattsville MD: National Center for Health Statistics, 2003.
11. Coups EJ, Gaba A, Orleans CT. Physician screening for multiple behavioral health risk factors. *Am J Prev Med* 2004;27(2S):34–41.
12. Pronk NP, Anderson LH, Crain AL, et al. Meeting recommendations for multiple healthy lifestyle factors: prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *Am J Prev Med* 2004;27(2S):25–33.
13. Pronk NP, Peek CJ, Goldstein MG. Addressing multiple behavioral risk factors in primary care. A synthesis of current knowledge and stakeholder dialogue sessions. *Am J Prev Med* 2004;27(2S):4–17.
14. Goldstein MG, Whitlock EP, DePue J. Multiple behavioral risk factor interventions in primary care: summary of research evidence. *Am J Prev Med* 2004;27(2S):61–79.
15. Berrigan D, Dodd K, Troiano RP, Krebs-Smith SM, Barbash RB. Patterns of health behavior in U.S. adults. *Prev Med* 2003;36:615–23.
16. Yarnall KS, Pollak KI, Ostbye T, Krause KM, Michener JL. Primary care: is there enough time for prevention? *Am J Public Health* 2003;93:635–41.
17. Rosen MA, Logsdon DN, Demak MM. Prevention and health promotion in primary care: baseline results on physicians from the INSURE project on lifecycle preventive health services. *Prev Med* 1984;13:535–48.
18. Thompson SC, Schwankovsky L, Pitts J. Counseling patients to make lifestyle changes: the role of physician self-efficacy, training and beliefs about causes. *Fam Pract* 1993;10:70–5.
19. U.S. Preventive Services Task Force. The guide to clinical preventive services, 2007: recommendations of the U.S. Preventive Services Task Force. Rockville MD: Agency for Healthcare Research and Quality, 2007.
20. Bertakis KD, Azari R. The influence of obesity, alcohol abuse, and smoking on utilization of health care services. *Fam Med* 2006;38:427–34.
21. King DE, Mainous AG 3rd, Geesey ME. Turning back the clock: adopting a healthy lifestyle in middle age. *Am J Med* 2007;120:598–603.
22. Babor TF, Sciamanna CN, Pronk NP. Assessing multiple risk behaviors in primary care: screening issues and related concepts. *Am J Prev Med* 2004;27(2S1):42–53.
23. Cifuentes M, Fernald DH, Green LA, et al. Prescription for health: changing primary care practice to foster healthy behaviors. *Ann Fam Med* 2005;3S2:S4–11.
24. Glasgow RE, Ory MG, Klesges LM, Cifuentes M, Fernald DH, Green LA. Practical and relevant self-report measures of patient health behaviors for primary care research. *Ann Fam Med* 2005;3:73–81.
25. CDC. National Center for Chronic Disease Prevention and Health Promotion. BRFSS—CDC's behavioral risk factor surveillance system. www.cdc.gov/brfss.
26. Hughes JR, Keely JP, Niaura RS, Ossip-Klein DJ, Richmond RL, Swan GE. Measures of abstinence in clinical trials: issues and recommendations. *Nicotine Tob Res* 2003;5:13–25.
27. Ory MG, Jordan P, Bazzarre T. Behavioral change consortium: setting the stage for a new century of health behavior change research. *Health Educ Res* 2002;17:500–11.
28. Gaskins ND, Sloane PD, Mitchell CM, Ammerman A, Ickes SB, Williams CS. Poor nutritional habits: a modifiable predecessor of chronic illness? A North Carolina family medicine research network (NC-FM-RN) study. *J Am Board Fam Med* 2007;20:124–34.
29. Paxton AE, Ammerman AS, Gizlice Z, Johnston LF, Keyserling TC. Validation of a very brief diet assessment tool designed to guide counseling for chronic disease prevention. Oslo Norway: International Society of Behavioral Nutrition and Physical Activity, 2007.
30. Craig CL, Marshall AL, Sjostrom M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;35:1381–95.
31. Choi WS, Gilpin EA, Farkas AJ, Pierce JP. Determining the probability of future smoking among adolescents. *Addiction* 2001;96:313–23.
32. CDC, National Center for Chronic Disease Prevention and Health Promotion. YRBSS—youth risk behavior surveillance system—DASH/HealthyYouth. www.cdc.gov/healthyyouth/yrbss/.
33. North Carolina Department of Health and Human Services. Physical activity and nutrition behaviors monitoring form. www.eatsmartmovemorenc.com/data/_docs/PAN%20Behaviors%20Monitoring%20Form.pdf.
34. Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. *Arch Pediatr Adolesc Med* 2001;155:554–9.
35. Kaufman NJ, Castrucci BC, Mowery PD, Gerlach KK, Emont S, Orleans CT. Predictors of change on the smoking uptake continuum among adolescents. *Arch Pediatr Adolesc Med* 2002;156:581–7.
36. Eaton DK, Kann L, Kinchen S, et al. Youth risk behavior surveillance—U.S., 2007. *MMWR Surveill Summ* 2008;57:1–131.
37. USDHHS. Healthy people 2010. 2nd ed. Washington DC: Government Printing Office, 2000. www.healthypeople.gov/publications/.
38. CDC. Behavioral risk factor surveillance system survey data. Atlanta GA: USDHHS, CDC, 2004.
39. CDC. Chronic disease indicators: indicator definitions. apps.nccd.cdc.gov/cdi/DefSearchResults.aspx.
40. Strine TW, Hootman JM, Chapman DP, Okoro CA, Balluz L. Health-related quality of life, health risk behaviors, and disability among adults with pain-related activity difficulty. *Am J Public Health* 2005;95:2042–8.
41. Poortinga W. The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Prev Med* 2007;44:124–8.
42. CDC. Behavioral risk factor surveillance system survey data. www.cdc.gov/brfss.
43. Chowdhury PP, Balluz L, Murphy W, et al. Surveillance of certain health behaviors among states and selected local areas—U.S., 2005. *MMWR Surveill Summ* 2007;56:1–160.
44. CDC. Youth risk behavior surveillance—U.S., 2005. Surveillance summaries. *MMWR* 2006;55(SS-5).
45. Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ)—short form, version 2.0. 2004. www.ipaq.ki.se/scoring.pdf.
46. Rush BR, Powell LY, Crowe TG, Ellis K. Early intervention for alcohol use: family physicians' motivations and perceived barriers. *CMAJ* 1995;152:863–9.
47. Peterson KA, Mendenhall T, Allen S, et al. Minnesota clinicians motivating health improvement (MINIT) study: motivating healthy habits. *Ann Fam Med* 2005;3(2S):S56–8.

Appendix

Adult COMBO Health Behavior Measures (English and Spanish)

SMOKING

English

1. Have you smoked at least 100 cigarettes in your entire life?
 Yes
 No [If no, go to next section.]
2. Have you smoked at least part of a cigarette in the last 7 days?
 Yes [If yes, go to Question 4.]
 No [If no, go to next question.]
3. Have you smoked at least part of a cigarette in the last 30 days?
 Yes [If yes, go to Question 4.]
 No [If no, go to next section.]
4. During a typical 7-day period, how many cigarettes do you smoke per day?
_____ cigarettes per day

Spanish

1. ¿Ha fumado por lo menos 100 cigarrillos durante toda su vida?
 Sí
 No [Si "no", pase hacia el siguiente módulo.]
2. ¿Ha fumado por lo menos un fragmento de un cigarrillo durante los últimos 7 días?
 Sí [Si "sí", vaya a la pregunta numero 4.]
 No [Si "no", siga con la próxima pregunta.]
3. ¿Ha fumado por lo menos un fragmento de un cigarrillo durante los últimos 30 días?
 Sí [Si "sí", vaya a la pregunta numero 4.]
 No [Si "no", pase hacia el siguiente módulo.]
4. ¿Durante un periodo típico de 7 días, cuantos cigarrillos se fumaría por día?
_____ cigarrillos por día

DRINKING

English

A drink of alcohol is defined as one can or bottle of beer, one glass of wine, one can or bottle of wine cooler, one cocktail, or one shot of liquor.

1. During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage? [If none, go to next section.]
_____ days per week or in last 30 days
2. On the days when you drank, about how many drinks did you drink on average?
_____ number of drinks
3. Considering all types of alcoholic beverages, how many times during the past 30 days did you have five or more drinks on an occasion?
_____ number of times

Spanish

Un trago de alcohol es una lata o botella de cerveza, 1 copa de vino, 1 lata o botella de *wine cooler*, 1 cóctel o 1 copita de licor.

1. Durante los últimos 30 días, ¿cuántos días a la semana o al mes bebió por lo menos 1 trago de alguna bebida alcohólica? [Ningún, pase a la siguiente sección.]
_____ días a la semana o en los últimos 30 días

2. En los días en que bebió, ¿aproximadamente cuántos tragos bebió en promedio?
_____ número de tragos
3. Tomando en consideración todas las bebidas alcohólicas, ¿cuántas veces durante los últimos 30 días tomó 5 o más tragos en la misma ocasión?
_____ número de veces

EATING PATTERNS

English

The questions below ask you about the food you ate during the past 7 days. If you were sick during the past 7 days, please think back to the last 7 days that you were not sick.

1. How many times a week do you eat fast food or snacks?
 Less than 1 1-3 4 or more
2. How many servings of fruit and/or vegetables do you eat each day?
 5 or more 3-4 2 or less
3. How many regular soft drinks (sodas or glasses of sweet tea) do you drink each day? (one glass is an 8 oz. serving.)
 Less than 1 1-2 3 or more
4. How many times a week do you eat chicken, fish, or beans (like pinto beans or black beans)?
 3 or more 1-2 Less than 1
5. How many times a week do you eat regular snack chips or crackers (not low-fat)?
 1 or less 2-3 4 or more
6. How many times a week do you eat desserts or other sweets?
 1 or less 2-3 4 or more
7. How much margarine, butter, or meat fat do you use to season vegetables or put on potatoes, bread, or corn?
 Very little Some A lot

Spanish

1. ¿Cuántas veces a la semana come usted comida rápida o golosinas? bocadillos?
 menos de 1 1-3 4 o más
2. ¿Cuántas porciones de frutas o verduras come cada día?
 5 o más 3-4 2 o menos
3. ¿Cuántas sodas o vasos de té dulce toma cada día?
 menos de 1 1-2 3 o más
4. ¿Cuántas veces a la semana come pollo, pescado, o frijoles (pintos o negros)?
 3 o más 1-2 menos de 1
5. ¿Cuántas veces a la semana come papalinas, papas fritas o galletas (no dietéticas)?
 1 o menos 2-3 4 o más
6. ¿Cuántas veces a la semana come postres y otras golosinas?
 1 o menos 2-3 4 o más
7. ¿Cuánta margarina, mantequilla, o grasa de carne usa para sazonar los vegetales, o para poner en las papas, carne, o maíz?
 muy poca algo de mucha

PHYSICAL ACTIVITY

English

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise, or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
_____ days per week No vigorous physical activities [If none, skip to Question 3.]
2. How much time did you usually spend doing **vigorous** physical activities on one of those days?
_____ hours per day _____ minutes per day Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
_____ days per week No moderate physical activities [If none, skip to Question 5.]
4. How much time did you usually spend doing **moderate** physical activities on one of those days?
_____ hours per day _____ minutes per day Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?
_____ days per week No walking [If none, skip to Question 7.]
6. How much time did you usually spend **walking** on one of those days?
_____ hours per day _____ minutes per day Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a week day?
_____ hours per day _____ minutes per day Don't know/Not sure

Spanish

Estamos interesados en saber acerca de la clase de actividad física que la gente hace como parte de su vida diaria. Las preguntas se referirán acerca del tiempo que usted utilizó siendo físicamente activo(a) en los **últimos 7 días**. Por favor responda cada pregunta aún si usted no se considera una persona activa. Por favor piense en aquellas actividades que usted hace como parte del trabajo, en el jardín y en la casa, para ir de un sitio a otro, y en su tiempo libre de descanso, ejercicio o deporte.

Piense acerca de todas aquellas actividades **vigorasas** que usted realizó en los últimos 7 días. Actividades **vigorasas** son las que requieren un esfuerzo físico fuerte y le hacen respirar mucho más fuerte que lo normal. Piense *solamente* en esas actividades que usted hizo por lo menos 10 minutos continuos.

1. Durante los **últimos 7 días**, ¿Cuántos días realizó usted actividades físicas **vigorasas** como levantar objetos pesados, excavar, aeróbicos, o pedalear rápido en bicicleta?
_____ días por semana Ninguna actividad física vigorosa [Ningún, pase a la pregunta 3.]
2. ¿Cuánto tiempo en total usualmente le tomó realizar actividades físicas vigorosas en uno de esos días que las realizó?
_____ horas por día _____ minutos por día No sabe/No está seguro(a)

Piense acerca de todas aquellas actividades **moderadas** que usted realizo en los **últimos 7 días** Actividades **moderadas** son aquellas que requieren un esfuerzo físico moderado y le hace respirar algo más fuerte que lo normal. Piense *solamente* en esas actividades que usted hizo por lo menos 10 minutos continuos.

3. Durante los **últimos 7 días**, ¿Cuántos días hizo usted actividades físicas **moderadas** tal como cargar objetos livianos, pedalear en bicicleta a paso regular, o jugar dobles de tenis? No incluya caminatas.
_____ días por semana Ninguna actividad física moderada [Ningún, pase a la pregunta 5.]
4. Usualmente, ¿Cuánto tiempo dedica usted en uno de esos días haciendo actividades físicas moderadas?
_____ horas por día _____ minutos por día No sabe/No está seguro(a)

Piense acerca del tiempo que usted dedicó a **caminar** en los **últimos 7 días**. Esto incluye trabajo en la casa, caminatas para ir de un sitio a otro, o cualquier otra caminata que usted hizo únicamente por recreación, deporte, ejercicio, o placer.

5. Durante los últimos 7 días, ¿Cuántos días caminó usted por al menos 10 minutos continuos?
_____ días por semana No caminó [No caminó, pase a la pregunta 7.]
6. Usualmente, ¿Cuánto tiempo gastó usted en uno de esos días **caminando**?
_____ horas por día _____ minutos por día No sabe/No está seguro(a)

La última pregunta se refiere al tiempo que usted permanenció **sentado(a)** en la semana en los **últimos 7 días**. Incluya el tiempo sentado(a) en el trabajo, la casa, estudiando, y en su tiempo libre. Esto puede incluir tiempo sentado(a) en un escritorio, visitando amigos(as), leyendo o permanecer sentado(a) o acostado(a) mirando television.

7. Durante los **últimos 7 días**, ¿Cuánto tiempo permanenció **sentado(a)** en un **día en la semana**?
_____ horas por día _____ minutos por día No sabe/No está seguro(a)