University of Michigan Retirement Research Center

Working Paper

WP 2003-057

The Impact of Poor Health Behaviors on Workforce Disability

Caroline Richardson, Jennifer T. Hanlon, Hillary J. Mull, Sandeep Vijan, Rodney Hayward, Linda A. Wray, and Kenneth M. Langa

MRRC

Project #: UM02-12

"The Impact of Poor Health Behaviors on Workforce Disability"

Caroline Richardson, MD
University of Michigan

Jennifer T. Hanlon, MPH
University of Michigan

Hillary J. Mull, MPP
University of Michigan

Sandeep Vijan, MD
University of Michigan

Rodney Hayward, MD
University of Michigan

Linda A. Wray, PhD
Pennsylvania State University

Kenneth M. Langa, MD, PhD
University of Michigan

June 2003

Michigan Retirement Research Center
University of Michigan
P.O. Box 1248
Ann Arbor, MI 48104

Acknowledgements
This work was supported by a grant from the Social Security Administration through the Michigan Retirement Research Center (Grant # 10-P-98358-5). The opinions and conclusions are solely those of the authors and should not be considered as representing the opinions or policy of the Social Security Administration or any agency of the Federal Government.

The Impact of Poor Health Behaviors on Workforce Disability

Caroline Richardson, MD
Jennifer T. Hanlon, MPH
Hillary J. Mull, MPP
Sandeep Vijan, MD
Rodney Hayward, MD
Linda A. Wray, PhD
Kenneth M. Langa, MD, PhD

Abstract

The effects of poor health habits on mortality have been studied extensively. However, few studies have examined the impact of these health behaviors on workforce disability. In the Health and Retirement Study, a nationally representative cohort of 6044 Americans who were between the ages of 51 and 61 and who were working in 1992, we found that both baseline smoking status and a sedentary lifestyle predict workforce disability six years later. If this relationship is causal, cost-benefit analyses of health behavior intervention that neglect workforce disability may substantially underestimate the benefits of such interventions.

Authors' Acknowledgements

Funding for this study was provided by a grant from the Social Security Administration and the Michigan Retirement Research Center. Dr. Langa was supported by a Career Development Award from the National Institute on Aging (K08 AG19180), a New Investigator Research Grant from the Alzheimer's Association, and a Paul Beeson Physician Faculty Scholars in Aging Research Award. The National Institute on Aging provided funding for the Health and Retirement Study (U01 AG09740), data from which were used in this analysis. Sandeep Vijan was supported by a Veterans Affairs Health Services Research and Development Career Development Award.

BACKGROUND

Work force disability (WFD) is a limitation or inability to perform work tasks due to a disability. (Anonymous, 2001; LaPlante, Kennedy, Kaye, & Wenger, 1996; McNeil, 1997) Almost 18 million Americans report workforce disability and of these, two-thirds are unable to work at all. Besides the inability to work, disabled individuals also experience lower health related quality of life and higher rates of poverty than the nondisabled (Anonymous, 1998; Lantz et al., 1998). Families of disabled workers are at risk as well, experiencing high rates of poverty and increased caregiver burden. Employers face disability payments, lost productivity, and workforce turnover [Institute of Medicine (U.S.) Committee on a National Agenda for Prevention of Disabilities, 1991 #666]. Therefore, WFD results in substantial individual hardship and burden and the prevalence of WFD also has important implications for society in terms of decreased productivity, lost wage taxes and direct medical costs.

Common causes of WFD include chronic diseases such as arthritis, heart disease, cancer, respiratory problems, or diabetes. (Anonymous, 2001; McNeil, 1997; LaPlante, 1996) Certain modifiable health behaviors have been linked to many of these chronic conditions, specifically smoking, a sedentary lifestyle, and obesity. (Anonymous, 1994; Chyou et al., 1997; Knowler et al., 2002; Manson et al., 1999; Pan et al., 1997; Petrella & Bartha, 2000; Rao, Donahue, Pi-Sunyer, & Fuster, 2001; Rimm, Chan, Stampfer, Colditz, & Willett, 1995; Sahyoun, Hochberg, Helmick, Harris, & Pamuk, 1999; Tuomilehto et al., 2001; US Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, & Office on Smoking and Health, 1989; Williams, 2001) Using a large nationally representative longitudinal cohort study, we sought to quantify the

extent to which cigarette smoking; a sedentary lifestyle and obesity are independent modifiable risk factors for WFD.

METHODS

Data, Study Design, Population and Sampling

We examined the impact of cigarette smoking, a sedentary lifestyle, and obesity on WFD using data from the Health and Retirement Study (HRS), (University of Michigan Survey Research Center, 1999) a large nationally representative cohort study of 51-61 year old Americans. HRS is a panel study of pre-retirement aged community dwelling Americans born between 1931-1941 who were first interviewed in 1992. Follow-up interviews were conducted every two years after enrollment. The HRS was designed to assess the relationship between health, economic factors, and retirement. Trained survey research staff conducted the structured interviews face-to-face at baseline and subsequent interviews were largely completed by telephone. Although institutionalized persons were not included in the baseline interviews, respondents who moved into nursing homes or other institutions were followed and re-interviewed in subsequent waves of data collection. The HRS used a complex sampling design with stratification, clustering and over-sampling of African Americans, Hispanics and Floridians. The response rate for the baseline data collection was 82%. (Juster & Suzman, 1995) Further details on the HRS have been published elsewhere. (University of Michigan Survey Research Center, 1999; Juster & Suzman, 1995) The data and detailed documentation for the HRS are available at http://hrsonline.isr.umich.edu.

Sample

For this analysis, we included only those HRS participants who were working in 1992. Thus, individuals who had already retired or who were disabled in 1992 are not included in the analysis. Participants who met the age eligibility criteria and who reported that they were either working or were both working and a homemaker in 1992 were classified as working and were included in the analysis. Some participants gave two or three responses to the HRS baseline question about employment status. For example, a respondent had the option of answering that he was both working and disabled. Except for those who responded as both working and homemaker, participants who gave multiple responses in 1992 were excluded from the analysis.

Primary Outcome - Work Status

The primary analytic outcome was work status in 1998. Participants were classified into one of five exhaustive and mutually exclusive work status outcome categories: dead, working, disabled, retired, and other/lost to follow-up. Vital status was determined by proxy informant interviews and was confirmed by National Death Index matching. Most (92%) of the surviving sub-sample, participants gave a single work status response to the 1998 work status question. For another 3%, the second work status response was "homemaker" and these respondents were classified according to their first response. This left only 5% of respondents (n = 490) with multiple work status categories in 1998. For those who responded with multiple answers to the work status item in 1998, the following classification algorithm was used: a respondent who reported being disabled in 1998 was classified as disabled even if he or she also reported working or having retired. Respondents who had been working at baseline but reported being a homemaker at follow-up were classified as retired. Respondents who reported "working" as the first response

to the 1998 work status item and retired as the second response were classified as working. Similarly, respondents who reported "retired" as the first response and "working" as the second were classified as retired. Respondents who reported any combination of "leave", "unemployed", or "other" or who did not respond to the survey were classified as other/lost to follow-up.

Independent Variables

Health Behaviors

Baseline health behaviors in the analysis included smoking, physical activity level and obesity. Based on two smoking history items "Have you ever smoked cigarettes?" and "Do you smoke cigarettes now?", participants were classified as current smokers, former smokers, or never smokers.

The first wave of the HRS contained three questions about physical activity:

1. How often do you participate in light physical activity such as walking, dancing, gardening, golfing, bowling, etc? Would you say 3 or more times a week, 1 or 2 times a week, 1 to 3 times a month, less than once a month or never?
2. How often do you participate in vigorous physical exercise or sports such as aerobics, running, swimming, or bicycling? Would you say 3 or more times a week, 1 or 2 times a week, 1 to 3 times a month, less than once a month or never?

3. How often do you do heavy housework like scrubbing floors or washing windows? Would you say 3 or more times a week, 1 or 2 times a week, 1 to 3 times a month, less than once a month or never?

These activities were coded for intensity using the Ainsworth Compendium of Physical Activity. (Ainsworth et al., 1993) The total physical activity scale for each person was computed by multiplying self-reported frequency by average intensity in METS (metabolic units expended while doing the activity divided by metabolic units expended at rest) for each question and adding these totals to yield a single number. This number reflects a relative measure physical activity including both leisure time and housework-related physical activity.

Individuals in the lowest quintile of physical activity were classified as sedentary. Those in the upper 80% were classified as moderately physically active. Our previous research on this cohort has shown that this classification has criterion validity for predicting all cause mortality in the age eligible HRS sample. This dichotomous classification of sedentary versus at least moderately physically active is also similar to the classification by physical fitness level used in a previous study on physical activity and mortality. (Blair et al., 1989) The HRS physical activity items measure frequency and intensity of physical activity, but not duration. Therefore, it is difficult to quantify exactly the cutoff in terms of actual minutes of physical activity or metabolic units of energy expended. In this older cohort, the most sedentary 20% of the population are likely to be very sedentary compared to the average American.

Body mass index (BMI) was calculated using self reported height and weight. Obesity was defined as a BMI greater than or equal to 30 consistent with the World Health Organization definition.

Covariates

We used total annual gross household income as the primary measure of SES. (Daly, Duncan, McDonough, & Williams, 2002; Krieger, Williams, & Moss, 1997; Bassuk, Berkman, & Amick, 2002) Household income was constructed from an extensive series of self-reported responses about various types of income. Because the HRS was designed to look closely at financial measures, special techniques (e.g. bracketing, flash cards) were used to reduce item non-response, increasing the quality and detail of the financial data. Further, analyses of the quality of HRS assets data have been previously published. (Smith, 1995) In this study's regression analyses, total household income was coded as a three-category variable, by income tertiles.

Health status was measured by self-report in which each respondent was asked to describe his or her general health status as poor, fair, good, very good, or excellent. Responses were converted into a dichotomous variable classifying individuals reporting poor or fair health in the first category, and classifying those reporting good, very good or excellent together in the second category. Self-reported general heath status has proven to be a strong predictor for mortality in previous studies. (Idler & Benyamini, 1997)

Demographic characteristics including age in 1992, sex, and race were self-reported. Participants were classified into three categories based on self-reported ethnic background: non-

Hispanic African American, Hispanic, and non-Hispanic White. Those individuals who identified themselves as other than African American, Hispanic or White were included in the White category for all analyses.

Statistical Analysis

We used multivariate multinomial logistic regression to model the independent effects of baseline smoking, physical activity, and obesity on work status at the six-year follow-up survey. The categorical dependent variable, work status in 1998, classified respondents as: dead, disabled, working, retired, and other or lost to follow-up. Potential confounders controlled for in the regression model included sex, age, race, self-reported health status, and total household income. The model predicted population estimates for workforce disability and death (adjusted marginal predictions) (Korn & Graubard, 1999) related to each of the three health behaviors and also for individuals with all three poor health behaviors. Marginal relative risks were then computed from these adjusted marginal predictions. For clarity of presentation, the tables only include the results for death and workforce related disability, however coefficients were estimated for the other three outcomes (working, retired, and other/lost to follow-up) simultaneously. Adjusted Wald tests were used for statistical significance testing of model coefficients. Stratification and algebraic methods testing for significant interactions between health behaviors indicated some initial evidence for an interaction between smoking and physical activity; however, subsequent tests showed no significant improvement in the model and no significant effect on our resulting estimations. Therefore, we did not include the interaction term in the final model. Confidence intervals on statistics that were calculated from post estimation predictions were calculated using bootstrapping techniques appropriate for stratified and clustered sampling design. (Guan, 2003)

In order to reduce the effects of competing risk of retirement and death on the risk of becoming disabled, we ran a parallel analysis on the sub-sample of younger respondents who were aged 51-56 at baseline. Respondents in this group were under 62 years of age at follow-up.

In order to account for the complex sampling design of the HRS, regression coefficients were estimated using pseudo-likelihood calculations adjusting for sampling strata, clustering, and person level weights. All statistical analyses were conducted using STATA Version 8 statistical software. (Stata Corporation, 2001) The HRS was approved by an institutional review board at the University of Michigan. The data used for this analysis contained no unique identifiers so respondent anonymity was maintained.

RESULTS

Of the estimated 23 million Americans aged 51-61 represented by respondents in the Health and Retirement Study, about 64% or 14.6 million individuals (95% CI 13.8 – 15.3 million) were working in 1992. Of those who were working, 27% were smokers, 36% were former smokers, 28% met our criteria for obesity (BMI greater than or equal to 30) and 21% were classified as sedentary. Details of demographics by health behavior category can be found in Table 1.

Coefficients and p-values for the independent variables in our final model are listed in Table 2. In this sample, both smoking and a sedentary lifestyle were associated with increased workforce related disability and mortality. However, after controlling for covariates, obesity was not independently associated with increased workforce disability or mortality. Relative risk of death

and relative risk of disability attributable to each of the three health behaviors are also listed in Table 3. Smoking has a more substantial impact on death (RR 2.6) than on WFD (RR 2.0). In contrast, a sedentary lifestyle has a similar impact on both workforce disability and mortality. Individuals who are smokers and sedentary have almost 4 times the risk of WFD as those who are active and do not smoke. Having at least one of these two poor health behaviors accounts for 14% of all disability and 27% of mortality in this cohort. Limiting the analyses to those who were 56 or younger did not substantially affect the above results.

DISCUSSION

In a nationally representative sample of pre-retirement aged working Americans, we found that smoking and a sedentary lifestyle had a significant impact on the incidence of work force disability and death. Obesity, when defined as a BMI greater than or equal to 30 was not correlated with increased mortality or disability. More than a quarter of all deaths and 14% of all cases of WFD reported in this cohort can be attributed to smoking and a sedentary lifestyle and may be preventable by lifestyle change. These results are consistent with previous studies demonstrating that high-risk health behaviors are independent factors associated with death, days of lost work, and WFD. (Manning, Keeler, Newhouse, Sloss, & Wasserman, 1991; Sturm, 2002)

As a single health habit, smoking has the most profound impact on both mortality (RR=2.6) and disability (RR=2.0). This finding is consistent with much prior research in that many of the diseases attributable to smoking such as coronary artery disease, arthritis, and cancer are common causes of disability. (Anonymous, 2001; US Department of Health and Human Services et al., 1989; Sturm, 2002) However, the impact of smoking on death is much greater than the

impact on disability. This suggests that individuals who smoke are more likely to suffer sudden premature death than prolonged illness and disability prior to death.

Unlike smoking, a sedentary lifestyle has almost as much impact on disability (RR=1.3) as it has on mortality (RR=1.4). However, because disability is more common than death in this cohort, the estimated number of individuals affected by disability associated with a sedentary lifestyle (89,000) is actually greater than the estimated number of deaths that are associated with a sedentary lifestyle (68,000). A sedentary lifestyle is an independent risk factor for medical conditions such as diabetes, CAD and arthritis, which not only increase the risk of developing a disability but also can impede physical activity. (Sahyoun et al., 1999; Sturm, 2002; Rimm, Stampfer et al., 1995) The economic impact of a sedentary lifestyle on the individual, family members, the employer and the community is substantially greater if the costs associated with workforce disability are considered along with losses due to excess mortality.

Obesity, when defined as a BMI greater than or equal to 30, does not appear to play a significant role in predicting disability or death. While previous studies have documented a strong correlation between obesity and mortality, (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999; Fontaine, Redden, Wang, Westfall, & Allison, 2003) there is a growing body of literature demonstrating that when controlling for physical activity level, obesity is not correlated strongly with mortality. (Farrell, Braun, Barlow, Cheng, & Blair, 2002; Crespo et al., 2002; Blair & Brodney, 1999) Furthermore, older individuals such as those enrolled in the HRS have been shown to have less excess mortality associated with obesity than younger individuals. (Bender, Jockel, Trautner, Spraul, & Berger, 1999) While we used a standard definition of obesity, a

higher cutoff would classify fewer individuals as obese but might show a stronger association between obesity and mortality.

As with mortality, our results suggest that obesity does not correlate strongly with disability in this cohort after controlling for physical activity. Much less has been published on the relationship between obesity and workforce disability, however the link between obesity and common chronic disabling conditions, particularly arthritis and coronary artery disease, is well established. (Sahyoun et al., 1999) Again, using a higher cutoff for BMI in the definition of obesity may yield a stronger association between obesity and disability.

There are several potential limitations to our study. As with any study, care must be taken when generalizing the results to other populations. Our results are based on data from a large sample of working Americans who were 51 to 61 years old in 1992. Generalizing to younger cohorts or to cohorts from other countries may not be valid. We have shown a strong correlation between high-risk health behaviors and WFD, but, as with any observational study, causality is not proven. That is, we cannot be sure that improving population health behaviors will decrease rates of death and disability. However, there is a growing body of literature demonstrating a causal link between poor health behaviors and medical conditions that increase the risk of death and disability. For example, three large randomized controlled trials have demonstrated that intensive interventions to promote physical activity and dietary change substantially decrease the risk of developing diabetes in a high-risk population. (Knowler et al., 2002; Pan et al., 1997; Tuomilehto et al., 2001) We have controlled for the most important known confounders including age, sex, race, baseline health status, and socioeconomic status in all of our analyses.

We were not able to directly account for diet, an important and modifiable health behavior, because detailed information on diet was not collected for the Health and Retirement study. However, a measure of obesity combined with information about physical activity level does provide a proxy for total caloric intake.

While the above limitations must be considered when interpreting these results, our study provides several important contributions to the current literature on health behaviors and workforce related disability. The cohort we studied represents the U.S. population of working 51-61 year olds in 1992 and allows accurate assessment of outcomes over 6 years of follow-up. Few studies have been able to evaluate effects of health behaviors on a population-wide scale. Additionally, since all of the data used in our analysis come from a single large cohort, our estimates can be used to compare the magnitude of associated mortality and disability across health behaviors. Moreover, we have created a model that allows continued monitoring of the longitudinal effects of health behaviors on disability as later follow-up data are collected. This may provide insight into the impact of changes in health behaviors on disability, labor force participation, and mortality over time as the demography of the population changes. Rising numbers of obese and inactive people and declining rates of smoking are likely to change the outcomes of the model in future analyses.

While previous cross-sectional studies have quantified lost productivity among workers with poor health habits, (Manning et al., 1991) the longitudinal nature of this study allows us to quantify the lost productivity for those individuals who drop out of the workforce entirely. Since there is a strong correlation between smoking, obesity, and low physical activity, (Lahti-Koski,

Pietinen, Heliovaara, & Vartiainen, 2002) isolating the independent risk associated with each behavior is challenging. Because we use a multivariate regression model, we are able to estimate independent effects of health behaviors on WFD taking this correlation into account. By documenting the relationship between poor health behaviors, mortality and disability, we gain a further understanding of the profound impact of poor health behaviors and their costs to society.

CONCLUSION

Smoking and physical activity are substantial modifiable risk factors for WFD. In contrast to smoking, sedentary lifestyle has a greater impact on disability than on mortality. Studies that focus on mortality as a primary outcome may dramatically underestimate the societal costs associated with obesity and low physical activity. WFD is costly to individuals, families, businesses, and society. Behavior modification programs, possibly implemented at the work site, may reduce the burden of WFD.

REFERENCES:

1. Anonymous, "Prevalence of disabilities and associated health conditions among adults--United States, 1999," *MMWR - Morbidity & Mortality Weekly Report* (23 Feb 2001): 120-125.

2. M. P. LaPlante, J. Kennedy, H. S. Kaye, and B. L. Wenger, "Disability and Employment," 1 January 1996, <http://www.dsc.ucsf.edu/UCSF/pub> (31 January 2002).

3. J. McNeil, "Americans with Disabilities: Current Population Reports - 1997," February 2001, <http://www.census.gov/prod/2001pubs/p70-73.pdf> (16 March 2002).

4. Anonymous, "Health-related quality of life and activity limitation--eight states, 1995," *MMWR Morbidity & Mortality Weekly Report* (Feb 27 1998): 134-140.

5. P. M. Lantz, J. S. House, J. M. Lepkowski, D. R. Williams, R. P. Mero, and J. Chen, "Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. [see comments.]," *Journal of the American Medical Association* (3 Jun 1998): 1703-1708.

6. Institute of Medicine (U.S.) Committee on a National Agenda for Prevention of Disabilities, A. M. Pope, and A. R. Tarlov, *Disability in America: toward a national agenda for prevention* (Washington, D.C.: National Academy Press, 1991), 362.

7. M. P. LaPlante, "Health Conditions and Impairments Causing Disability," 1 September 1996, <http://www.dsc.ucsf.edu/UCSF/pub> (31 January 2002).

8. Anonymous, "Arthritis prevalence and activity limitations - United States, 1990," *MMWR Morbidity & Mortality Weekly Report* (24 Jun 1994): 433-438.

9. P. H. Chyou, C. M. Burchfiel, K. Yano, D. S. Sharp, B. L. Rodriguez, J. D. Curb, et al., "Obesity, alcohol consumption, smoking, and mortality," *Annals of Epidemiology* (May 1997): 311-317.

10. W. C. Knowler, E. Barrett-Connor, S. E. Fowler, R. F. Hamman, J. M. Lachin, E. A. Walker, et al., "Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin," *New England Journal of Medicine* (7 Feb 2002): 393-403.

11. J. E. Manson, F. B. Hu, J. W. Rich-Edwards, G. A. Colditz, M. J. Stampfer, W. C. Willett, et al., "A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women," *New England Journal of Medicine* (26 Aug 1999): 650-658.

12. X. R. Pan, G. W. Li, Y. H. Hu, J. X. Wang, W. Y. Yang, Z. X. An, et al., "Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study," *Diabetes Care* (Apr 1997): 537-544.

13. R. J. Petrella, and C. Bartha, "Home based exercise therapy for older patients with knee osteoarthritis: a randomized clinical trial," *The Journal of Rheumatology* (Sep 2000): 2215-2221.

14. S. V. Rao, M. Donahue, F. X. Pi-Sunyer, and V. Fuster, "Results of Expert Meetings: Obesity and Cardiovascular Disease. Obesity as a risk factor in coronary artery disease," *American Heart Journal* (Dec 2001): 1102-1107.

15. E. B. Rimm, J. Chan, M. J. Stampfer, G. A. Colditz, and W. C. Willett, "Prospective study of cigarette smoking, alcohol use, and the risk of diabetes in men [see comments.]," *British Medical Journal* (4 Mar 1995): 555-559.

16. N. R. Sahyoun, M. C. Hochberg, C. G. Helmick, T. Harris, and E. R. Pamuk, "Body mass index, weight change, and incidence of self-reported physician-diagnosed arthritis among women," *American Journal of Public Health* (Mar 1999): 391-394.

17. J. Tuomilehto, J. Lindstrom, J. G. Eriksson, T. T. Valle, H. Hamalainen, P. Ilanne-Parikka, et al., "Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance," *New England Journal of Medicine* (3 May 2001): 1343-1350.

18. US Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, and Office on Smoking and Health, *Reducing the health consequences of smoking: 25 years of progress: a report of the Surgeon General: 1989 executive summary* (Rockville, Md.: U.S. Dept. of Health and Human Services, 1989), 703.

19. P. T. Williams, "Physical fitness and activity as separate heart disease risk factors: a meta-analysis [see comments.]," *Medicine & Science in Sports & Exercise* (May 2001): 754-761.

20. University of Michigan Survey Research Center, "Survey Design: Health and Retirement Study (HRS) and Asset and Health Dynamics Among the Oldest Old (AHEAD)," 20 Jun 2003, <http://www.umich.edu/~hrswww/studydet/design.html> (26 Jun 2003).

21. F. T. Juster, and R. Suzman, "An Overview of the Health and Retirement Study," *Journal of Human Resources* (1995): S7-S56.

22. B. E. Ainsworth, W. L. Haskell, A. S. Leon, D. R. Jacobs, Jr., H. J. Montoye, J. F. Sallis, et al., "Compendium of physical activities: classification of energy costs of human physical activities," *Medicine & Science in Sports & Exercise* (Jan 1993): 71-80.

23. S. N. Blair, H. W. Kohl, 3rd, R. S. Paffenbarger, Jr., D. G. Clark, K. H. Cooper, and L. W. Gibbons, "Physical fitness and all-cause mortality. A prospective study of healthy men and women [see comments.]," *Journal of the American Medical Association* (3 Nov 1989): 2395-2401.

24. M. C. Daly, G. J. Duncan, P. McDonough, and D. R. Williams, "Optimal Indicators of Socioeconomic Status for Health Research," *American Journal of Public Health* (Jul 2002): 1151–1157.

25. N. Krieger, D. R. Williams, and N. E. Moss, "Measuring social class in US public health research: concepts, methodologies, and guidelines," *Annual Review of Public Health* (May 1997): 341-378.

26. S. S. Bassuk, L. F. Berkman, and B. C. Amick, 3rd, "Socioeconomic status and mortality among the elderly: findings from four US communities," *American Journal of Epidemiology* (15 Mar 2002): 520-533.

27. J. P. Smith, "Racial and Ethnic Differences in Wealth in the Health and Retirement Study," *Journal of Human Resources* (1995): S159-183.

28. E. L. Idler, and Y. Benyamini, "Self-rated health and mortality: a review of twenty-seven community studies," *Journal of Health and Social Behavior* (Mar 1997): 21-37.

29. E. L. Korn, and B. I. Graubard, *Analysis of Health Surveys* (New York: John Wiley & Sons, Inc., 1999), 382.

30. W. Guan, From the help desk: bootstrapped standard errors In H. J. Newton (Ed.), *The Stata Journal* (College Station, TX: Stata Press, 2003), 71-80.

31. Stata Corporation, *Overview of survey estimation: Hypothesis testing and Pseudo likelihoods* (College Station, TX: Stata Press, 2001), 343-358.

32. W. G. Manning, E. B. Keeler, J. P. Newhouse, E. M. Sloss, and J. Wasserman, *The cost of poor health habits* (Cambridge: Harvard University Press, 1991), 1-223.

33. R. Sturm, "The Effects of Obesity, Smoking, and Drinking on Medical Problems and Costs," *Health Affairs* (Mar/Apr 2002): 245-253.

34. E. B. Rimm, M. J. Stampfer, E. Giovannucci, A. Ascherio, D. Spiegelman, G. A. Colditz, et al., "Body size and fat distribution as predictors of coronary heart disease among middle-aged and older US men," *American Journal of Epidemiology* (15 Jun 1995): 1117-1127.

35. D. B. Allison, K. R. Fontaine, J. E. Manson, J. Stevens, and T. B. VanItallie, "Annual deaths attributable to obesity in the United States," *Journal of the American Medical Association* (27 Oct 1999): 1530-1538.

36. K. R. Fontaine, D. T. Redden, C. Wang, A. O. Westfall, and D. B. Allison, "Years of life lost due to obesity," *Journal of the American Medical Association* (8 Jan 2003): 187-193.

37. S. W. Farrell, L. Braun, C. E. Barlow, Y. J. Cheng, and S. N. Blair, "The relation of body mass index, cardiorespiratory fitness, and all-cause mortality in women," *Obesity Research* (Jun 2002): 417-423.

38. C. J. Crespo, M. R. Palmieri, R. P. Perdomo, D. L. McGee, E. Smit, C. T. Sempos, et al., "The relationship of physical activity and body weight with all-cause mortality: results from the Puerto Rico Heart Health Program," *Annals of Epidemiology* (Nov 2002): 543-552.

39. S. N. Blair, and S. Brodney, "Effects of physical inactivity and obesity on morbidity and mortality: current evidence and research issues," *Medicine & Science in Sports & Exercise* (Nov 1999): S646-662.

40. R. Bender, K. H. Jockel, C. Trautner, M. Spraul, and M. Berger, "Effect of age on excess mortality in obesity," *Journal of the American Medical Association* (28 Apr 1999): 1498-1504.

41. M. Lahti-Koski, P. Pietinen, M. Heliovaara, and E. Vartiainen, "Associations of body mass index and obesity with physical activity, food choices, alcohol intake, and smoking in the 1982-1997 FINRISK Studies," *American Journal of Clinical Nutrition* (May 2002): 809-817.

TABLE 1: Sample size, demographic characteristics and workforce outcomes by health behaviors, not adjusted for confounders.

Mean or % (95% CI)	**All Workers**	**Smokers**	**Sedentary**	**Obese (BMI > =30)**	**Smoker, obese and sedentary**
Sample N	6044	1637	1333	1781	128
Estimated Population N	14.6 million (13.8-15.3)	3.9 million (3.6-4.1)	3.1 million (2.9-3.3)	4.1 million (3.8-4.4)	0.29 million (0.24-0.34)
% of working Americans age 51 to 61 in 1992		27%	21%	28%	2%
Sex					
Female	52%	51%	54%	53%	54%
Male	48%	49%	46%	47%	46%
Race					
White (and other)	83%	83%	80%	80%	81%
African American	9%	11%	12%	13%	13%
Hispanic	6%	6%	8%	7%	6%
Health Status					
Good to Excellent	80%	73%	65%	73%	60%
Fair to Poor	20%	27%	35%	27%	40%
Mean Body Mass Index	27	26	28	34	33
Disabled in 1998	8.2% (7.3-9.1%)	12.7% (10.8-14.5%)	13.7% (11.3-16.1%)	10.8% (9.3-12.4%)	16.8% (9.9-23.8%)
Dead in 1998	5.7% (5.0-6.3%)	10.2% (8.7-11.7)	9.1% (7.6-10.6)	5.9% (4.8-6.9%)	12.8% (6.8-18.9%)

TABLE 2. Multinomial multivariate regression results for death and work force disability in 1998 (6-yr follow-up).

	Death			Disability		
	RRR	**Sig**	**95% CI**	**RRR**	**Sig**	**95% CI**
Smoking Status						
Never Smoked	1			1		
Former Smoker	2.07	**	1.40-3.05	1.30		0.97-1.73
Current Smoker	4.41	**	3.03-6.41	2.05	**	1.49-2.69
Physical Activity						
Moderately Active	1			1		
Sedentary	1.37	*	1.03-1.83	1.31	*	1.01-1.70
Body Mass Index						
Not obese	1			1		
Obese (BMI >= 30)	1.04		0.77-1.39	1.20		0.96-1.59
Age	1.22	**	1.17-1.28	1.06	**	1.02-1.10
Sex						
Female	1			1		
Male	1.50	**	1.14-1.99	0.79		0.64-1.04
Race						
White	1			1		
Hispanic	0.57	*	0.35-0.92	0.96		0.66-1.47
African American	1.55	**	1.13-2.13	1.65	**	1.26-2.17
Baseline Health						
Fair to Poor	1			1		
Good to Excellent	0.14	**	0.10-0.19	0.10	**	0.07-0.13
Income						
Lowest 1/3rd	1			1		
Middle 1/3rd	0.67	*	0.49-0.93	0.48	**	0.37-0.64
Highest 1/3rd	0.56	**	0.39-0.79	0.27	**	0.20-0.38

Results for the other two outcomes, retired and other, were estimated simultaneously but they are not listed here. RRR = relative risk ratio and not simple relative risk. The reference relative risk for all relative risk ratios is the relative risk of working in 1998.

* Indicates significance of the coefficient at the 0.05 level.
** Indicates significance of the coefficient at the 0.01 level.

TABLE 3. Relative and absolute risk of both workforce disability and death associated with poor health behaviors for Americans age 51 to 61 in 1992.

	WORK FORCE DISABILITY			
	RR	**RR CI**	**Number disabled attributable to poor health behavior**	**% of all disability attributable to poor health behavior**
Current Smokers°	2.0	1.53 - 2.52	78,000	7%
Sedentary Lifestyle	1.3	1.02 - 1.76	89,000	8%
Sedentary and Smokers Combined			166,000	14%

	DEATH			
	RR	**RR CI**	**Deaths Attributable to poor health behavior**	**% of all deaths attributable to poor health behavior**
Current Smokers°	2.6	2.27 - 3.01	152,000	20%
Sedentary Lifestyle	1.4	1.23 - 1.67	68,000	9%
Sedentary and Smokers Combined			211,000	27%

Relative risk represents the independent marginal effects of health behaviors after adjusting for age, sex, race, income and baseline health status.

* Indicates significance of the coefficient at the 0.05 level in the regression model.

° Reference group is former smokers, not never smokers.