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# Trends in low-risk lifestyle factors among adults in the United States: Findings from the Behavioral Risk Factor Surveillance System 1996–2007☆

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ABSTRACT

*Objective.* Our objective was to examine recent trends in low-risk lifestyle factors for chronic diseases (not currently smoking, any exercise during the past 30 days, consuming fruits and vegetables ≥5 times per day, and body mass index <25 kg/m$^2$) among U.S. adults.

*Methods.* We used data from 1,580,220 adults aged ≥18 years who participated in one of seven Behavioral Risk Factor Surveillance System surveys conducted from 1996 to 2007.

*Results.* The age-adjusted percentage of adults meeting all four low-risk lifestyle factors was 8.5% in 1996 and 7.7% in 2007 ($p$ for linear trend <0.001). Significant decreasing trends were noted for men, women, whites, Hispanics, and most age groups. The percentages of participants who were not currently smoking, who had done any exercise during the past 30 days, who reported consuming fruits and vegetables ≥5 times per day, and who had a body mass index <25 kg/m$^2$ were 70.9%, 76.2%, 47.9% and 24.3%, respectively, in 1996 and 77.1%, 80.0%, 37.8%, and 24.5%, respectively, in 2007. Women and whites were more likely than their counterparts to meet all four criteria.

*Conclusions.* From 1996 to 2007, the percentage of U.S. adults meeting all four low-risk lifestyle factors decreased slightly.



## Introduction

A large body of research has shown that smoking, inadequate physical activity, poor nutrition, and excess body weight increase the risk for developing various chronic diseases. Several analyses have estimated the number of deaths attributable to these behaviors in the United States (McGinnis and Foege, 1993; Mokdad et al., 2004; Danaei et al., 2009). The preventable nature of these diseases is reinforced by studies that have shown marked reductions in the risk of developing coronary heart disease, stroke, diabetes, and cancer or in the risk of premature death among participants who had a low-risk lifestyle factor profile that included factors such as not currently smoking, having an appropriate body mass index (BMI), getting good nutrition, and engaging in adequate physical activity (Stampfer et al., 2000; Hu et al., 2001; Haveman-Nies et al., 2002; Knoops et al., 2004; Spencer et al., 2005; Chiuve et al., 2006; Kurth et al., 2006; Akesson et al., 2007; King et al., 2007; Chiuve et al., 2008; Khaw et al., 2008; Mozaffarian et al., 2009; Ford et al., 2009).

The low prevalence of a healthy lifestyle comprising not currently smoking, having an appropriate BMI, getting good nutrition, and engaging in adequate physical activity is sobering: generally fewer than 10% of United States adults can be classified as having a healthy lifestyle (Ford et al., 2001; Reeves and Rafferty, 2005; King et al., 2007). The percentage of adults who are not currently smoking has steadily increased (Centers for Disease Control and Prevention, 2009c; Duval et al., 2008; Sarna et al., 2008). Recent trends regarding participation in physical activity are not entirely consistent (Steffen et al., 2006; Carlson et al., 2009). Information concerning the intake of fruits and vegetables suggests little change (Casagrande et al., 2007; Blanck et al., 2008). The increase in overweight and obesity and the decrease in the percentage of adults who have a recommended body mass index have been well documented (Flegal et al., 2010).

A major drawback of an index summarizing multiple healthy behaviors is the masking of information about the individual components. However, this drawback is easily remedied by decomposing the index. An advantage of an index is that it reflects a more holistic view of health at the individual, clinical, and public health level providing valuable complementary information. Furthermore, assessing the trend in healthy lifestyle provides important information for program development, planning, and evaluation. Because the trend in healthy lifestyle is unknown, our objective was to examine the trend in the prevalence of a healthy lifestyle among adults in the United States.

☆ Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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## Methods

We used data from the Behavioral Risk Factor Surveillance System (BRFSS) for the years 1996, 1998, 2000, 2002, 2003, 2005, and 2007 (Centers for Disease Control and Prevention, 2009b). We limited our analyses to all 50 states and the District of Columbia. State health agencies selected for interview an independent probability sample from noninstitutionalized adults aged ≥18 years with telephones by using mostly disproportionate stratified sampling. All states used an identical core questionnaire administered over the telephone by trained interviewers. The median response rate as calculated according to standards by the Council of American Survey Research Organizations ranged from 49% to 63%. The survey was reviewed by the Human Research Protection Office at the Centers for Disease Control and Prevention and determined to be exempt from human subject guidelines.

We included four healthy lifestyle factors in our analyses: not currently smoking, participating in any exercise during the past 30 days, consuming fruits and vegetables ≥5 per day, and having a BMI <25 kg/m$^2$. Participants were defined as not currently smoking if they had either not smoked at least 100 cigarettes during their life or had smoked at least 100 cigarettes during their life but reported not smoking at the time of the interview. Participants who answered affirmatively to the question "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" were considered to show evidence of being physically active. Because of a change in the physical activity questions in 2001, continuity in using a common set of physical activity questions was not possible. The intake of fruits and vegetables was calculated from responses to a brief set of questions. The consumption of fruits and vegetables ≥5 times per day was counted as a healthy behavior. A BMI <25 kg/m$^2$, calculated from self-reported weight and height, was used as a measure of favorable body weight. We considered participants who met all four low-risk lifestyle factors to be at low risk and have a healthy lifestyle.

Covariates in our analyses were age, gender, race or ethnicity, and educational status. All of these variables were based on self-reported data.

We limited the analyses of the surveys to men and nonpregnant women aged ≥18 years. For each year, we calculated the age-adjusted and age-specific prevalence of a healthy lifestyle and of the individual low-risk lifestyle factors. We examined trends in the prevalence of a healthy lifestyle and of the individual low-risk lifestyle factors among six age groups among men and women, and among whites, African Americans, and Hispanics. When age-adjustment was performed, we directly adjusted to the U.S. projected population aged ≥18 years in the year 2000. We tested differences in prevalence estimates with the chi-square test. We assessed linear trend by using a time variable corresponding to the elapsed time between the year when a survey was conducted and 1996 in log-binomial regression models after adjustment for age (except age-specific models), sex (except sex-specific models), ethnicity (except for race or ethnic-specific models), and educational status and assessed nonlinear trend by adding a squared time variable to the models. We used SUDAAN (Software for the Statistical Analysis of Correlated Data) for analyses to account for the complex sampling design.

## Results

In all, 1,757,549 adults participated in one of the seven surveys. After excluding respondents with missing data for age (12,604), race or ethnicity (14,808), educational level (4,613), exercise (6,534), smoking (5,963), BMI (79,879) and fruits and vegetables (25,522), 1,580,220 participants were included in the analyses. Sample sizes ranged from 113,637 in 1996 to 385,642 in 2007. Over the 11-year period of the study, mean age increased by about 1.5 years ($p<0.001$), the percentage men changed from 49.7% to 50.2% ($p=0.390$), the percentage of participants who were white decreased from 76.9% to 70.6% ($p<0.001$), and the level of educational achievement increased steadily ($p<0.001$).

The age-adjusted percentage of adults at low risk decreased from 8.5% in 1996 to 7.7% in 2007 ($p<0.001$) (Table 1). In each year, women were more likely to be at low risk than men ($p<0.001$ for each year), and white participants were more likely to be at low risk than African American and Hispanic participants.

In 2007, 3.2% of adults had 0 healthy lifestyle factors, 19.0% had 1 healthy lifestyle factor, 41.2% had 2 healthy lifestyle factors, 28.9% had 3 healthy lifestyle factors, and 7.6% had 4 healthy lifestyle factors (Fig. 1). The distribution of the number of healthy lifestyle factors differed significantly between men and women ($p<0.001$) and between whites and African Americans ($p<0.001$) and Hispanics ($p<0.001$).

The decrease in the percentage of participants at low risk reflected different patterns among the individual lifestyle factors (Table 1). A significant favorable trend was observed for the percentage of participants who were not currently smoking and for the percentage of participants who indicated that they were physically active. The percentage of participants who reported that they consumed fruits and vegetables ≥5 times per day remained relatively stable. However, the percentage of participants with a BMI <25 kg/m$^2$ decreased substantially. No significant trends were observed for the percentage of African Americans not currently smoking and for the percentage of Hispanics eating fruits and vegetables ≥5 times per day.

## Discussion

Despite decades of public health efforts to improve the low-risk lifestyle factor profile of U.S. adults, the percentage of adults in the United States who had a healthy lifestyle decreased from 1996 through 2007. These decreases were broad-based as they were observed among men, women, whites, Hispanics, and most age groups. Although progress was made in improving the percentage of adults who were not currently smoking and who reported participating in physical activity, much of this progress was undone by the decrease in the percentage of participants with a BMI below 25 kg/m$^2$. Because the prevalence of obesity calculated from self-reported weight and height underestimates the prevalence calculated from measured weight and height (Merrill and Richardson, 2009) and because the prevalence of reported participation in any physical activity overestimates that of participants meeting physical activity recommendations, our estimates of low risk are likely to be overestimated.

Three previous analyses using a similar set of lifestyle factors as the current analysis found that 6.8% of adults in the Third National Health and Nutrition Examination Survey (1988–1994), 3% of adults from BRFSS 2000, and 8.5% of the participants in the Atherosclerosis Risk in Communities Study (1987–1989) were at low risk (Ford et al., 2001; Reeves and Rafferty, 2005; King et al., 2007).

A downward trend in the prevalence of a healthy lifestyle could herald future increases in the incidence and prevalence of various chronic diseases like diabetes and hypertension. However, many factors influence the incidence of chronic diseases besides the ones we included in our analysis. Thus, the balance of the trends among the four lifestyle factors that we included in our analysis and the relative strength of these factors coupled with trends in other risk factors for chronic diseases will determine the future incidence in chronic diseases.

Data on the incidence of coronary heart disease and stroke in the United States are spotty. Several cohort studies showed decreases in the incidence of coronary and cardiovascular heart disease over various periods (Hu et al., 2000; Ergin et al., 2004; Parikh et al., 2009). Regional data from Olmsted County, Minnesota suggested that the incidence of coronary disease declined between 1979 and 1998 (Arciero et al., 2004). Other data suggested little change in the incidence of myocardial infarction and cardiovascular disease (Haan et al., 1996; Rosamond et al., 1998).

Data from the Framingham Heart Study showed that the incidence of diabetes mellitus doubled from the 1970s through the 1990s (Fox et al., 2006). These results are consistent with other data showing increases in the incidence of diabetes in the United States (Geiss et al., 2006; Centers for Disease Control and Prevention, 2008; Centers for Disease Control and Prevention, 2009a). Data from the Surveillance, Epidemiology and End Results (SEER) Program show an average decrease of 1% per year in the incidence of cancer during the period