Appendix

This appendix provides additional information on the calculations in the paper, "Forecasting the Effects of Obesity and Smoking on U.S. Life Expectancy." For all statistical analyses, population weights appropriate to each of the three surveys were used,[1-4] and analyses were performed primarily using SAS© software version 9.1 for UNIX.[5] (Cox regressions were performed using Stata© version 10[6]).

Life Table Methodology

Forecasts used period life tables from the U.S. National Center for Health Statistics for 1990[7] and 2004.[8] These tables combine the oldest participants into a single group (labeled age 85 in 1990 and age 100 in 2004). To obtain data on individual ages older than this, we used period life tables from the U.S. Social Security Administration.[9]

Smoothing Smoking and Obesity by Age

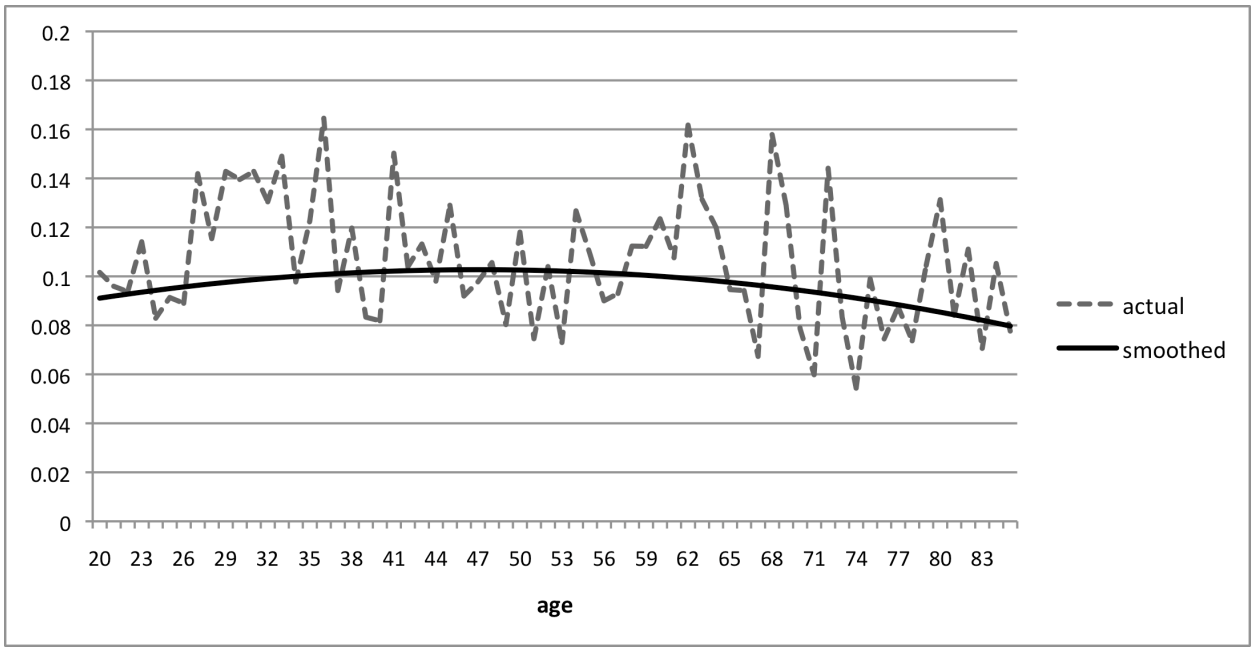
For each year of our forecasts we smoothed the population distribution of smoking and obesity by regressing an indicator for being in each BMI/smoking category on age and age squared. Table A1 shows the coefficients from the baseline NHANES 2003-2006 data used to predict the distribution of each category by year of age. Figure A1 shows an example for never smoking obese individuals of the actual NHANES data at each age in 2003-2006 and the smooth predicted trend derived from regression coefficients.

Table A1: Coefficients from 12 OLS Regressions Used to Predict the Distribution of Combined BMI and Smoking Categories, NHANES 2003-2006

		Normal Weight		Overweight		Obese		Morbidly Obese	
		beta	p-value	beta	p-value	beta	p-value	beta	p-value
Never	Intercept	0.548	<.0001	0.178	<.0001	0.077	0.002	-0.027	0.214
Smokers	Age	-0.015	<.0001	-0.000	0.758	0.001	0.229	0.005	<.0001
	Age Squared	0.000	<.0001	0.000	0.751	-0.000	0.168	-0.000	<.0001
Former	Intercept	0.074	<.0001	0.028	0.019	-0.012	0.223	-0.018	0.022
Smokers	Age	-0.002	<.0001	0.000	0.598	0.001	0.003	0.001	0.000
< 10 years	Age Squared	0.000	.0001	0.000	0.582	0.000	0.002	0.000	0.000
Former	Intercept	0.001	0.966	-0.085	<.0001	-0.061	<.0001	-0.074	<.0001
Smokers	Age	0.000	0.567	0.003	<.0001	0.003	<.0001	0.003	<.0001
10+ years	Age Squared	0.000	0.000	0.000	0.986	0.000	0.055	0.000	<.0001
Current	Intercept	0.192	<.0001	0.052	0.015	0.024	0.143	0.006	0.678
Smokers	Age	-0.002	0.044	0.002	0.007	0.002	0.023	0.002	0.005
	Age Squared	0.000	0.986	0.000	<.0001	0.000	0.001	0.000	0.000

Categories for weight were defined according to the World Health Organization criteria: normal weight (body-mass index [BMI], the weight in kilograms divided by the square of the height in meters, 18.5 to 24.9), overweight (BMI, 25.0 to 29.9), obese (BMI, 30.0 to 34.9; obesity class I), and morbidly obese (BMI, ≥35.0; obesity classes II and III). Current smokers and short and long-term former smokers were those who had ever smoked at least 100 cigarettes and who still smoked, had smoked within the previous 10 years, and had not smoked for 10 years or more, respectively.

Figure A1: Rates of Obese Never Smokers by Age in NHANES 2003-2006



Mortality Relative Risks

We estimate the relative risk of all-cause mortality using data from combined NHANES I, II, and III surveys, matched to subsequent death records from the National Death Index (the NHANES I Epidemiologic Follow-up Study[10] and the public-use versions of the NHANES II[11] and III[12] linked mortality files.) Table A2 shows the sample characteristics for the mortality data.

Table A2: Sample Characteristics of NHANES I, II and III Data used for Mortality Analyses Ages 25-70

	NHANES I	NHANES II	NHANES III
Baseline Survey years	1971-1975	1976-1980	1988-1994
Year of mortality follow-up	1992	1992	2000
Unweighted sample size*	5,959	7,578	11,221
Number of deaths -total	1,242	1,145	569
-under age 60	204	136	189

*respondents age 25 to 70 at baseline with non-missing data on BMI and smoking in baseline interview, excluding those classified as underweight at baseline and deaths within the first 4 years of follow-up.

The results of the Cox proportional hazards model predicting risk of death by smoking-BMI status are shown in Table A3. Separate models were fit for deaths that occurred before and after age 60. Deaths among those aged 60+ were right censored in the first model, and deaths under age 60 were left censored in the second.* Forty-three percent of our analytic sample attained age 60 or greater. Those lost to follow-up were assigned a survival time of ½ the possible survival interval before the time when they were lost, but were censored on mortality. Models also included race (white, black, and other), and age in 5-year age groups (coefficients not shown). These analyses omit those who died within the first 4 years of follow-up. Alternate analyses that included all deaths did not yield appreciably different relative risks (not shown). Alternate analyses controlling for education yielded similar results (shown in the last column of Table A3).

*The SAS entry= option was used with proc phreg.

Table A3: Relative Risks of Death from all Causes among Respondents Aged 25-70 in NHANES I, II and III Combined

Group	Multivariate Hazard Ratio	95% CI		Hazard Ratio Controlling for College Education
Attained age under 60				
Normal weight never smokers	1.00	--	--	1.00
Overweight never smokers	0.86	0.44	1.68	0.86
Obese never smokers	1.10	0.62	1.98	1.09
Morbidly obese never smokers	2.73	1.54	4.82	2.66
Normal weight former smokers < 10 years	1.09	0.62	1.92	1.11
Overweight former smokers < 10 years	1.35	0.70	2.59	1.25
Obese former smokers < 10 years	1.31	0.53	3.22	1.25
Morbidly obese former smokers < 10 years	1.62	0.57	4.62	1.55
Normal weight former smokers 10+ years	0.51	0.19	1.33	0.51
Overweight former smokers 10+ years	0.74	0.34	1.62	0.74
Obese former smokers 10+ years	1.18	0.33	4.24	1.17
Morbidly obese former smokers 10+ years	1.47	0.39	5.54	1.44
Normal weight current smokers	2.10	1.39	3.18	2.02
Overweight current smokers	1.37	0.80	2.33	1.31
Obese current smokers	2.39	1.23	4.65	2.32
Morbidly obese current smokers	3.95	2.00	7.79	3.74
Attained age 60 or over				
Normal weight never smokers	1.00	--	--	1.00
Overweight never smokers	0.84	0.68	1.05	0.83
Obese never smokers	1.11	0.87	1.43	1.10
Morbidly obese never smokers	1.68	1.28	2.21	1.63
Normal weight former smokers < 10 years	1.48	1.15	1.92	1.50
Overweight former smokers < 10 years	1.39	1.10	1.75	1.34
Obese former smokers < 10 years	1.51	1.04	2.19	1.47
Morbidly obese former smokers < 10 years	1.42	0.78	2.59	1.41
Normal weight former smokers 10+ years	0.85	0.64	1.13	0.86
Overweight former smokers 10+ years	1.08	0.85	1.37	1.08
Obese former smokers 10+ years	1.32	0.96	1.82	1.30
Morbidly obese former smokers 10+ years	1.92	1.10	3.37	1.90
Normal weight current smokers	2.30	1.93	2.75	2.25
Overweight current smokers	1.99	1.58	2.50	1.94
Obese current smokers	3.03	2.31	3.96	2.94
Morbidly obese current smokers	4.04	3.29	5.89	4.28

Table A3 notes: Categories for weight were defined according to the World Health Organization criteria: normal weight (body-mass index [BMI], 18.5 to 24.9), overweight (BMI, 25.0 to 29.9), obese (BMI, 30.0 to 34.9; obesity class I), and morbidly obese (BMI, ≥35.0; obesity classes II and III). Current smokers and short and long-term former smokers were those who had ever smoked at least 100 cigarettes and who still smoked, had smoked within the previous 10 years, and had not smoked for 10 years or more, respectively. In combining the three waves of NHANES, sampling weights from each individual survey were used. Weights specific to follow-up were required for NHANES I;[13] baseline weights were used for NHANES II and III. Strata variables from the three surveys were considered independent. Alternate analyses that weighted the sampling weights from each wave of NHANES by the sample size in that wave yielded similar results.

Measuring Quality of Life

Coefficients from regressions of self-rated general health on smoking and obesity status are shown in Table A4. (Health ratings were transformed from a 0-100 to a 0-1 scale for regression analyses.) Summary health scores were calculated on the basis of these regression coefficients by 10-year age groups for smokers and nonsmokers and for each of the 4 weight categories. Predicted scores were treated as disutilities (decrements to health on a 0-1 scale on which 1 and 0 were equal to perfect health and death, respectively). Utilities for each group were obtained by subtracting predicted disutilities from 1.

Our weights were derived from a 100-point visual analog rating scale, which typically yields lower utilities than standard gamble or time-tradeoff methods. However, it was the differences across groups that were more important to our forecasts than the absolute values.

Table A4: Multivariate Linear Regression of 100-Point Self Rating of Health (transformed to a 0-1 scale) on Smoking, Obesity, and Sociodemographic Variables in MEPS 2003

Covariates	Population percent	beta	p-value
Current smoker	22.1	-0.053	<.0001
BMI (kilograms/meters^2)			
18.5-<25 (normal weight/referent)	37.8	--	--
25-<30 (over weight)	36.5	-0.008	0.0012
30-<35 (obese)	16.1	-0.039	<.0001
35+ (morbidly obese)	9.5	-0.090	<.0001
Age and Gender			
Age		-0.007	<.0001
Age squared		0.000	0.0053
Age cubed		0.000	0.0033
Male	48.7	0.044	<.0001
Age x Male		-0.001	<.0001
Race/Ethnicity			
Black	10.7	0.003	0.5948
Non-White Other	5.8	-0.025	<.0001
Income (relative to 400% of poverty and above)			
< 100% poverty	10.5	-0.098	<.0001
100-<125% poverty	4.0	-0.075	<.0001
125-<200% poverty	13.1	-0.055	<.0001
200-<400% poverty	30.4	-0.027	<.0001
400% poverty and over (referent)	42.1	--	--
Intercept		1.028	<.0001
Summary statistics			
N		18,530	
R^2		0.160	

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