Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011;364:2391-404.

Supplementary Material

Results for the individual cohorts are shown for dietary factors (Supplementary Table 3, 4, and 5 for the NHS, NHS2, and HPFS, respectively) and overall lifestyle factors (Supplementary Table 6, 7, and 8 for the NHS, NHS2, and HPFS, respectively). Results are also shown stratified by age ≤50 vs. >50 years (Supplementary Table 9) and baseline body mass index (Supplementary Table 10).

In all 3 cohorts, changes in alcohol use were positively associated with weight-change, with the magnitude of association somewhat larger in NHS (per drink/d increase, +0.57lbs; 95%CI: 0.48/0.66) than in NHS2 (+0.33lbs; 95%CI: 0.17/0.49) or HPFS (+0.32lbs; 95%CI: 0.22/0.41). We performed further exploratory analyses by subtypes of alcohol. In the NHS, changes in liquor, beer, and wine were each associated with similar weight-change: +0.67lbs (95%CI: 0.44/0.90), +0.58lbs (95%CI: 0.46/0.70), and +0.60lbs (95%CI: 0.45/0.75), respectively. In the NHS2 and HPFS, positive associations with weight-change were strongest for liquor (NHS2: +0.99lbs; 95%CI: 0.69/1.30; HPFS: +0.54lbs; 95%CI: 0.40/0.68), intermediate for beer (NHS2: +0.43lbs; 95%CI: 0.19/0.67; HPFS: +0.27lbs; 95%CI: 0.13/0.42), and smallest for wine (NHS2: +0.13lbs; 95%CI: -0.06/0.32; HPFS: +0.08lbs; 95%CI: -0.06/0.21). When we explored this further and also based on a prior report from NHS2,[1] we found that some of the associations for modest wine increase in NHS2 appeared nonlinear (Supplementary Figure). Reasons for these potentially nonlinear relationships require more study, as these findings were not seen in the other two cohorts. Potential explanations include chance, differing biologic effects of alcohol in younger women, or residual confounding from other factors associated with decisions to alcohol use, particularly for modest increases in wine (increases up to 0.5 serving/d) seen in the NHS2.

Findings for all other dietary and lifestyle factors were generally similar in both direction and magnitude by gender and in the three separate cohorts (Supplementary Tables 3-8) and by age (Supplementary Table 9). Consistent with greater absolute weight gain among overweight versus normal weight persons, magnitudes of relationships were larger among those who were overweight at baseline, but findings were qualitatively similar in both normal weight and overweight persons (Supplementary Table 10).

Supplementary Table 1. Specific Foods and Beverages Included in Each Food and Beverage Group to Evaluate Dietary Changes.*

Fruits	Vegetables	Processed meats	Unprocessed Meats	Whole-grains	Refined Grains	Sweets	Sugar Sweetened Beverages	Potatoes	Potato Chips	Whole Fat Dairy	Low Fat Dairy	Fruit Juice
Apples. Applesauce. Avocado. Bananas. Blueberries. Cantaloupe. Grapefruit. Oranges. Peaches, fresh, Peaches, canned. Pears, fresh. Pears, canned. Other canned fruit. Prunes. Raisins Strawberries. Watermelon.	Red chili sauce Tofu or soybeans String beans Alfalfa sprouts. Beans, lentils. Broccoli. Brussels sprouts. Cauliflower. Cabbage, cooked. Carrots, raw. Carrots, cooked. Celery. Coleslaw or cabbage, uncooked. Corn. Cucumber. Eggplant, zucchini. Green pepper. Kale, mustard, chard greens. Lettuce, iceberg or head. Lettuce, romaine or leaf. Mixed vegetables Mushrooms. Peas, lima beans. Sauerkraut. Spinach, cooked. Spinach, raw. Tomatoes. Tomato juice. Tomato sauce. Yams, sweet potatoes Yellow squash.	Bacon. Hot dogs. Processed deli meats.	Beef, pork, or lamb as a main dish. Beef, pork, or lamb as a sandwich Hamburger .	Bran. Brown rice. Cold breakfast cereal.† Cooked oatmeal.† Other cooked breakfast cereal.† Dark bread. Wheat germ.	English muffins, bagels, rolls. Muffins, biscuits. Pancakes, waffles. Pasta. White rice. White bread.	Brownies. Cake, home-made Cake, ready-baked. Candy with chocolate. Candy without chocolate. Chocolate bars. Cookies, home-made. Cookies, ready-made. Doughnuts Ice cream. Pie, home-baked. Pie, ready-made. Sweet rolls, coffee cake.	Coke, Pepsi, or other cola.	Potatoes, baked, boiled or mashed. Potatoes, French fried.	Potato chips.	Butter. Cream cheese.‡ Cottage or ricotta cheese.‡ Other cheese.‡ Whole milk.	Skim or low-fat milk. Yogurt.	Apple juice or cider. Grapefruit juice. Orange juice. Other fruit juices.

*This table includes the specific foods used to assess dietary change between 1986 and 1990 in the Nurses Health Study. Median intake frequencies of individual foods in each category were summed to compute average servings/day. As the dietary questionnaire was modified and updated during the 20 years of follow-up, some additional detailed questions on other foods in these groups were added, always matched to provide identical assessments between the start and end of each 4-year period. The same dietary questionnaires and food categories were used in the Nurses Health Study 2 and Health Professionals Follow-up Study cohorts.

†Weighted by the brand-specific servings of whole-grain content, with 30 g of whole-grain set to equal one average serving.

‡Additional dietary information in the latter follow-up periods (1994-1998, 1998-2002, 2002-2006) allowed further sub-stratification of cheeses into whole fat vs. low-fat dairy categories.

Supplementary Table 2. Baseline Characteristics and Average Four-Year Lifestyle Changes among 120,877 US Women and Men in 3 Prospective Cohorts.*

		Nurses Health Study (n=50,422 women)		Nurses Health Study 2 (n=47,898 women)		Health Professionals Study (n=22,557 men)	
		Characteristics at baseline †	Mean change each 4 yrs (5^{th}, 95^{th} percentile) ‡	Characteristics at baseline †	Mean change each 4 yrs (5^{th}, 95^{th} percentile) ‡	Characteristics at baseline †	Mean change each 4 yrs (5^{th}, 95^{th} percentile) ‡
Trans-fat, g/day		3.4 ± 0.7	-0.31 (-1.35, 0.50)	3.2 ± 1.4	-0.26 (-1.08, 0.40)	2.9 ± 0.7	0.02 (-0.81, 1.00)
Fried foods at home, servings/week		0.8 ± 0.6	0.06 (-0.80, 1.00)	0.5 ± 1.0	0.40 (-0.35, 1.00)	1.2 ± 0.7	-0.15 (-1.02, 0.51)
Fried foods away from home, servings/week		0.3 ± 0.4	0.04 (-0.48, 0.49)	0.7 ± 1.1	0.00 (-0.68, 0.33)	1.1 ± 0.7	-0.18 (-1.02, 0.00)
Smoking status, %	Never	44	*Never, no change:* 315,066 *Never → current:* 301	64	*Never, no change:* 360,934 *Never → current:* 516	48	*Never, no change:* 182,923 *Never → current:* 459
	Former	39	*Former, no change:* 274,731 *Former → current:* 5,854	24	*Former, no change:* 128,160 *Former → current:* 7,509	39	*Former,no change:* 128,504 *Former → current:* 3,201
	Current	16	*Current, no change:* 86,404 *Current → former:* 27,335	12	*Current, no change:* 51,531 *Current → former:* 13,761	9	*Current, no change:* 17,201 *Current → former:* 6,977
	Missing	0.2	3,209	0.1	3,597	4	3,325

*Based on 20 years follow-up in the Nurses Health Study (1986-2006), 12 years follow-up in the Nurses Health Study 2 (1991-2003), and 20 years follow-up in the Health Professionals Follow-up Study (1986-2006). Baseline and changes in other dietary and lifestyle characteristics are presented in Table 1 of the main manucript.

†Values are mean±SD for continuous variable and percent for categorical variables.

‡Values are mean changes (5^{th}, 95^{th} percentile of changes) each 4 years for dietary factors and total person-years of follow in each category for changes in smoking.

Supplementary Table 3. Multivariable-Adjusted Relationships of Changes in Dietary Habits with Weight Change among 50,422 US Women Followed from 1986 to 2006.

	Weight Change* (95% CI) each 4 years, lb			
	Age-adjusted	P value	Multivariable-adjusted†	P value
Increased consumption* of:				
Fruits, servings/day	-0.55 (-0.60, -0.49)	<0.001	-0.43 (-0.48, -0.37)	<0.001
Vegetables, servings/day	-0.17 (-0.20, -0.14)	<0.001	-0.15 (-0.18, -0.13)	<0.001
Whole-fat dairy foods, servings/day ‡	0.35 (0.29, 0.41)	<0.001	0.23 (0.17, 0.29)	<0.001
Low-fat dairy foods, servings/day ‡	-0.17 (-0.23, -0.11)	<0.001	-0.03 (-0.08, 0.03)	0.31
Potato chips, servings/day	2.92 (2.62, 3.22)	<0.001	1.68 (1.38, 1.98)	<0.001
Potatoes/fries, servings/day ‡	1.96 (1.76, 2.16)	<0.001	1.30 (1.10, 1.50)	<0.001
Whole-grains, servings/day	-0.60 (-0.70, -0.50)	<0.001	-0.42 (-0.51, -0.32)	<0.001
Refined-grains, servings/day	0.61 (0.55, 0.66)	<0.001	0.40 (0.34, 0.46)	<0.001
Sugar sweetened beverages, servings/day	1.23 (1.06, 1.40)	<0.001	0.95 (0.78, 1.12)	<0.001
Sweets/desserts, servings/day	0.64 (0.59, 0.68)	<0.001	0.41 (0.36, 0.45)	<0.001
Processed meats, servings/day	2.01 (1.81, 2.22)	<0.001	1.07 (0.86, 1.28)	<0.001
Unprocessed red meats, servings/day	1.28 (1.12, 1.43)	<0.001	0.64 (0.48, 0.80)	<0.001
Trans-fat, % energy §	1.47 (1.37, 1.58)	<0.001	0.84 (0.72, 0.95)	<0.001
Fried foods at home, servings/week	0.53 (0.49, 0.56)	<0.001	0.41 (0.38, 0.45)	<0.001
Fried foods away from home, servings/week	0.47 (0.42, 0.51)	<0.001	0.25 (0.20, 0.30)	<0.001

*Weight changes shown are for increased consumption; decreased consumption would be associated with the inverse weight change.

†Adjusted for age, baseline body mass index at the beginning of each 4-year period, television watching, sleep duration, and changes in physical activity, alcohol use, smoking, and all of the dietary factors in the Table simultaneously.

‡We also evaluated multivariable-adjusted relationships with weight-change of changes in consumption of different whole-fat and low-fat dairy foods, different potato preparations, and also nuts, 100%-fruit juice, and diet soda. Per serving/day increase, results were: butter (+0.43lbs, 95%CI: 0.34/0.51), cheese (+0.04lbs, 95%CI: -0.05/0.13), yogurt (-0.75lbs, 95%CI: -0.91/-0.60), whole-fat milk (-0.06lbs, 95%CI: -0.23/0.11), low-fat/skim milk (+0.04lbs, 95%CI: -0.02/0.10), French fries (+4.11lbs, 95%CI: 3.46/4.76), boiled, baked, or mashed potatoes (+0.71lbs, 95%CI: 0.53/0.89), nuts (-0.29lbs, 95%CI: -0.42/-0.16), 100%-fruit juice (+0.26lbs, 95%CI: 0.20/0.32), and diet soda (-0.04lbs, 95%CI: -0.10/0.03).

§Results for average 4-year changes from 1986 through 2002; values for 2006 not available at the time of this analysis.

To convert lb to kg, divide by 0.45.

Supplementary Table 4. Multivariable-Adjusted Relationships of Changes in Dietary Habits with Weight Change among 47,898 US Women Followed from 1991 to 2003.

	Weight Change* (95% CI) each 4 years, lb			
	Age-adjusted	P value	Multivariable-adjusted†	P value
Increased consumption* of:				
Fruits, servings/day	-0.95 (-1.03, -0.87)	<0.001	-0.65 (-0.73, -0.57)	<0.001
Vegetables, servings/day	-0.37 (-0.41, -0.34)	<0.001	-0.35 (-0.38, -0.31)	<0.001
Whole-fat dairy foods, servings/day ‡	0.03 (-0.06, 0.12)	0.48	-0.11 (-0.20, -0.02)	0.01
Low-fat dairy foods, servings/day ‡	-0.14 (-0.21, -0.07)	<0.001	0.03 (-0.04, 0.11)	0.37
Potato chips, servings/day	3.92 (3.55, 4.29)	<0.001	2.08 (1.70, 2.45)	<0.001
Potatoes/fries, servings/day ‡	3.07 (2.81, 3.34)	<0.001	1.68 (1.40, 1.95)	<0.001
Whole grains, servings/day	-0.53 (-0.65, -0.42)	<0.001	-0.24 (-0.36, -0.12)	<0.001
Refined grains, servings/day	0.79 (0.72, 0.86)	<0.001	0.56 (0.49, 0.63)	<0.001
Sugar sweetened beverages, servings/day	1.61 (1.45, 1.76)	<0.001	1.16 (1.01, 1.32)	<0.001
Sweets/desserts, servings/day	1.00 (0.93, 1.07)	<0.001	0.66 (0.59, 0.73)	<0.001
Processed meats, servings/day	1.78 (1.52, 2.04)	<0.001	0.86 (0.60, 1.12)	<0.001
Unprocessed red meats, servings/day	2.31 (2.11, 2.51)	<0.001	1.34 (1.14, 1.55)	<0.001
Trans fat, % energy	1.90 (1.76, 2.04)	<0.001	0.66 (0.50, 0.83)	<0.001
Fried foods at home, servings/week	0.61 (0.56, 0.66)	<0.001	0.47 (0.42, 0.53)	<0.001
Fried foods away from home, servings/week	0.77 (0.71, 0.83)	<0.001	0.49 (0.43, 0.55)	<0.001

*Weight changes shown are for increased consumption; decreased consumption would be associated with the inverse weight change.

†Adjusted for age, baseline body mass index at the beginning of each 4-year period, sleep duration, and changes in physical activity, alcohol use, smoking, television watching, and all of the dietary factors in the Table simultaneously.

‡We also evaluated multivariable-adjusted relationships with weight-change of changes in consumption of different whole-fat and low-fat dairy foods, different potato preparations, and also nuts, 100%-fruit juice, and diet soda. Per serving/day increase, results were: butter (+0.24lbs, 95%CI: +0.10/0.38), cheese (-0.10 lb, 95%CI: -0.22/0.03), yogurt (-0.99 lb, 95%CI: -1.18/-0.80), whole-fat milk (0.00 lb, 95%CI: -0.29/0.30), low-fat/skim milk (+0.21 lb, 95%CI: 0.13/0.29), french fries (+3.63 lb, 95%CI: 3.01/4.25), boiled, baked, or mashed potatoes (+0.77 lb, 95%CI: 0.48/1.05), nuts (-1.04 lb, 95%CI: -1.21/-0.86), 100%-fruit juice (+0.49 lb, 95%CI: 0.41/0.58), and diet soda (-0.10 lb, 95%CI: -0.17/-0.03).

To convert lb to kg, divide by 0.45.

Supplementary Table 5. Multivariable-Adjusted Relationships of Changes in Dietary Habits with Weight Change among 22,557 US Men Followed from 1986 to 2006.

	Weight Change* (95% CI) each 4 years, lb			
	Age-adjusted	P value	Multivariable-adjusted†	P value
Increased consumption* of:				
Fruits, servings/day	-0.57 (-0.64,-0.51)	<0.001	-0.40 (-0.47, -0.33)	<0.001
Vegetables, servings/day	-0.20 (-0.23,-0.16)	<0.001	-0.17 (-0.21, -0.13)	<0.001
Whole-fat dairy foods, servings/day ‡	0.38 (0.29,0.46)	<0.001	0.19 (0.10, 0.27)	<0.001
Low-fat dairy foods, servings/day ‡	-0.21 (-0.29,-0.13)	<0.001	-0.15 (-0.23, -0.07)	<0.001
Potato chips, servings/day	2.20 (1.86,2.54)	<0.001	1.33 (0.99, 1.68)	<0.001
Potatoes/fries, servings/day ‡	1.40 (1.14,1.66)	<0.001	0.87 (0.63, 1.12)	<0.001
Whole grains, servings/day	-0.63 (-0.74,-0.52)	<0.001	-0.43 (-0.54, -0.32)	<0.001
Refined grains, servings/day	0.28 (0.21,0.35)	<0.001	0.22 (0.15, 0.29)	<0.001
Sugar sweetened beverages, servings/day	1.13 (0.96,1.31)	<0.001	0.88 (0.71, 1.06)	<0.001
Sweets/desserts, servings/day	0.33 (0.27,0.38)	<0.001	0.17 (0.11, 0.23)	<0.001
Processed meats, servings/day	1.47 (1.26,1.68)	<0.001	0.84 (0.62, 1.05)	<0.001
Unprocessed red meats, servings/day	1.47 (1.29,1.65)	<0.001	0.86 (0.68, 1.05)	<0.001
Trans fat, % energy	0.96 (0.83,1.09)	<0.001	0.44 (0.30, 0.59)	<0.001
Fried foods at home, servings/week	0.32 (0.27,0.37)	<0.001	0.20 (0.15, 0.26)	<0.001
Fried foods away from home, servings/week	0.31 (0.25,0.36)	<0.001	0.09 (0.03, 0.16)	0.003

*Weight changes shown are for increased consumption; decreased consumption would be associated with the inverse weight change.

†Adjusted for age, baseline body mass index at the beginning of each 4-year period, sleep duration, and changes in physical activity, alcohol use, smoking, television watching, and all of the dietary factors in the Table simultaneously.

‡We also evaluated multivariable-adjusted relationships with weight-change of changes in consumption of different whole-fat and low-fat dairy foods, different potato preparations, and also nuts, 100%-fruit juice, and diet soda. Per serving/day increase, results were: butter (+0.21lbs, 95%CI: 0.08/0.34), cheese (0.11 lb, 95%CI: -0.02/0.24), yogurt (-0.68 lb, 95%CI: -0.94/-0.43), whole-fat milk (-0.11 lb, 95%CI: -0.34/0.12), low-fat/skim milk (-0.05 lb, 95%CI: -0.14/0.03), french fries (+2.33 lb, 95%CI: 1.79/2.87), boiled, baked, or mashed potatoes (+0.24 lb, 95%CI: 0.00/0.49), nuts (-0.44 lb, 95%CI: -0.55/-0.32), 100%-fruit juice (+0.17 lb, 95%CI: 0.10/0.25), and diet soda (-0.21 lb, 95%CI: -0.30/-0.12).

To convert lb to kg, divide by 0.45.

Supplementary Table 6. Multivariable-Adjusted Relationships of Changes in Lifestyle Habits with Weight Change among 50,422 US Women Followed from 1986 to 2006.

	Weight Change (95% CI) each 4 years, lb					
	All Women (n=50,422)				Never Smokers (n=20,750)	
	Age-adjusted	P value	Multivariable-adj.*	P value	Multivariable-adj.*	P value
Dietary change,† quintiles (median score; range 17-85)						
1 (42)	3.74 (3.60, 3.89)	<0.001	3.79 (3.65, 3.94)	<0.001	3.94 (3.71, 4.16)	<0.001
2 (46)	2.32 (2.18, 2.47)	<0.001	2.43 (2.29, 2.57)	<0.001	2.57 (2.35, 2.78)	<0.001
3 (51)	1.83 (1.68, 1.98)	<0.001	1.93 (1.78, 2.08)	<0.001	2.01 (1.78, 2.23)	<0.001
4 (54)	1.55 (1.41, 1.68)	<0.001	1.57 (1.44, 1.71)	<0.001	1.57 (1.36, 1.78)	<0.001
5 (60)	reference		reference		reference	
Physical activity change, quintiles (median change) ‡						
1 (-13.4 METs/week)	reference		reference		reference	
2 (-1.90 METs/week)	-0.23 (-0.38, -0.09)	<0.001	-0.20 (-0.35, -0.06)	0.005	-0.29 (-0.51, -0.08)	0.01
3 (0 METs/week)	-0.80 (-0.95, -0.66)	<0.001	-0.78 (-0.93, -0.64)	<0.001	-0.75 (-0.97, -0.53)	<0.001
4 (+3.8 METs/week)	-1.02 (-1.17, -0.88)	<0.001	-0.93 (-1.07, -0.79)	<0.001	-0.85 (-1.07, -0.64)	<0.001
5 (+16.7 METs/week)	-1.59 (-1.74, -1.44)	<0.001	-1.50 (-1.65, -1.35)	<0.001	-1.97 (-1.78, -1.33)	<0.001
Alcohol use, per drink/day increase §	0.54 (0.45, 0.63)	<0.001	0.57 (0.48, 0.66)	<0.001	0.77 (0.59, 0.96)	<0.001
Total daily sleep, hours/day ¶						
< 6	reference		reference		reference	
6 to 7	-0.35 (-0.45, -0.24)	<0.001	-0.33 (-0.43, -0.23)	<0.001	-0.28 (-0.42, -0.13)	<0.001
> 7 to 8	-0.45 (-0.57, -0.34)	<0.001	-0.40 (-0.51, -0.29)	<0.001	-0.17 (-0.33, -0.01)	0.03
> 8	-0.92 (-1.09, -0.75)	<0.001	-0.79 (-0.95, -0.62)	<0.001	0.03 (-0.26, 0.32)	0.86
missing	-0.86 (-1.25, -0.48)	<0.001	-0.67 (-1.05, -0.29)	<0.001	0.54 (-0.46, 1.53)	0.29
Time spent watching TV, hours/week ¶						
0 to 1	reference		reference		reference	
2 to 5	0.44 (0.28, 0.60)	<0.001	0.38 (0.23, 0.53)	<0.001	0.44 (0.22, 0.66)	<0.001
6 to 20	0.63 (0.48, 0.78)	<0.001	0.56 (0.42, 0.71)	<0.001	0.47 (0.26, 0.67)	<0.001
21 to 40	0.80 (0.62, 0.98)	<0.001	0.72 (0.54, 0.89)	<0.001	0.58 (0.31, 0.84)	<0.001
> 40	0.99 (0.64, 1.34)	<0.001	0.84 (0.50, 1.18)	<0.001	1.07 (0.53, 1.61)	<0.001
Change in smoking status					*N/A*	
Never (no change)	reference		reference			
Former (no change)	0.23 (0.15, 0.31)	<0.001	0.16 (0.08, 0.24)	<0.001		
Current (no change)	-0.81 (-0.93, -0.69)	<0.001	-0.93 (-1.05, -0.80)	<0.001		
Current → Former	5.86 (5.63, 6.10)	<0.001	6.03 (5.80, 6.26)	<0.001		
Former → Current	-3.55 (-4.04, -3.05)	<0.001	-3.85 (-4.34, -3.37)	<0.001		
Never → Current	1.42 (-0.82, 3.66)	0.21	1.53 (-0.69, 3.74)	0.18		

*Adjusted for age, baseline body mass index at the beginning of each 4-year period, and all of the variables in the Table simultaneously.

†Summed changes of the dietary habits associated with weight change in Table 2, derived by summing the ordinal values for quintiles of change of each dietary habit in ascending (1 to 5) or descending (5 to 1) order for habits inversely or positively associated with weight-gain, respectively.

‡Results for average 4-year changes from 1986 through 2002; values for 2006 not available at the time of this analysis.

§Differences in weight-change are for increased alcohol; the inverse difference would be associated with decreased alcohol.

¶Based on absolute levels due to limited serial assessments to assess change in each 4-year period. Sleep duration in 1986 was related to weight-gain in each period between 1986-1998; the average of sleep duration in 1986 and 2000 was related to weight-gain in 1988-2002; and sleep duration in 2000 was related to weight-gain in 2002-2006. Levels of television-watching in 1992 were related to weight-gain in each period; sensitivity analyses using averaged television-watching levels in 1992 and 2004 were similar.

To convert lb to kg, divide by 0.45.

Supplementary Table 7. Multivariable-Adjusted Relationships of Changes in Lifestyle Habits with Weight Change among 47,898 US Women Followed from 1991 to 2003.

	Weight Change (95% CI) each 4 years, lb					
	All Women (n=47,898)				Never Smokers (n=30,297)	
	Age-adjusted	P value	Multivariable-adj.*	P value	Multivariable-adj.*	P value
Dietary change,† quintiles (median score; range 17-85)						
1 (42)	5.15 (4.96, 5.34)	<0.001	5.00 (4.81, 5.20)	<0.001	4.98 (4.75, 5.22)	<0.001
2 (48)	2.64 (2.46, 2.81)	<0.001	2.84 (2.66, 3.03)	<0.001	2.93 (2.70, 3.16)	<0.001
3 (50)	2.90 (2.68, 3.11)	<0.001	2.89 (2.68, 3.10)	<0.001	2.74 (2.49, 3.00)	<0.001
4 (54)	2.08 (1.90, 2.27)	<0.001	2.07 (1.89, 2.26)	<0.001	2.10 (1.87, 2.32)	<0.001
5 (60)	reference		reference		reference	
Physical activity change, quintiles (median change)						
1 (-21.8 METs/week)	reference		reference		reference	
2 (-5.1 METs/week)	0.25 (0.06, 0.45)	0.01	0.21 (0.02, 0.40)	0.03	0.03 (-0.20, 0.26)	0.79
3 (0 METs/week)	-1.12 (-1.30, -0.94)	<0.001	-1.05 (-1.25, -0.84)	<0.001	-1.16 (-1.41, -0.90)	<0.001
4 (3.0 METs/week)	-1.04 (-1.23, -0.85)	<0.001	-0.94 (-1.13, -0.75)	<0.001	-1.03 (-1.25, -0.80)	<0.001
5 (17.6 METs/week)	-2.34 (-2.54, -2.14)	<0.001	-2.15 (-2.34, -1.95)	<0.001	-2.25 (-2.49, -2.01)	<0.001
Alcohol use, per drink/day increase ‡	0.31 (0.14, 0.47)	<0.001	0.33 (0.17, 0.49)	<0.001	0.02 (-0.21, 0.26)	0.84
Total daily sleep, hours/day §						
< 6	reference		reference		reference	
6 to 7	-0.45 (-0.59, -0.31)	<0.001	-0.34 (-0.47, -0.21)	<0.001	-0.33 (-0.49, -0.17)	<0.001
> 7 to 8	-0.32 (-0.48, -0.15)	<0.001	-0.23 (-0.38, -0.08)	0.003	-0.25 (-0.44, -0.07)	0.007
> 8	0.65 (0.37, 0.94)	<0.001	0.56 (0.29, 0.82)	<0.001	0.49 (0.17, 0.81)	0.003
missing	-0.60 (-0.76, -0.43)	<0.001	-0.51 (-0.70, -0.32)	<0.001	-0.44 (-0.68, -0.21)	<0.001
Time spent watching TV, per hour/day increase ‡ ¶	0.06 (0.05, 0.07)	<0.001	0.05 (0.04, 0.06)	<0.001	0.04 (0.03, 0.06)	<0.001
Change in smoking status					*N/A*	
Never (no change)	reference		reference			
Former (no change)	-0.25 (-0.44, -0.06)	0.01	0.08 (-0.04, 0.20)	0.22		
Current (no change)	0.13 (0.00, 0.26)	0.04	-0.31 (-0.49, -0.13)	<0.001		
Current → Former	5.07 (4.69, 5.47)	<0.001	5.36 (4.98, 5.74)	<0.001		
Former → Current	-2.72 (-3.24, -2.19)	<0.001	-3.22 (-3.73, -2.71)	<0.001		
Never → Current	-1.48 (-3.47, 0.50)	0.14	-2.35 (-4.27, -0.42)	0.02		

*Adjusted for age, baseline body mass index at the beginning of each 4-year period, and all of the variables in the Table simultaneously.

†Summed changes of the dietary habits associated with weight change in Table 2, derived by summing the ordinal values for quintiles of change of each dietary habit in ascending (1 to 5) or descending (5 to 1) order for habits inversely or positively associated with weight-gain, respectively.

‡Differences in weight-change are for increased alcohol or television watching; the inverse difference would be associated with decreased alcohol or television watching.

§Based on absolute levels due to limited serial assessments to assess change in each 4-year period. Absolute levels of sleep were only assessed once toward the end of follow-up (2001) and were related to weight-gain in each period.

¶The average annual change in television watching between 1991-1997 was used to estimate 4-year changes between 1991 and 1995; the mean of the average annual change between 1991-1997 and 1999-2003 to estimate 4-year changes between 1999 and 1999; and the average annual change between 1997-2001 to estimate 4-year change between 1999 and 2003.

To convert lb to kg, divide by 0.45.

Supplementary Table 8. Multivariable-Adjusted Relationships of Changes in Lifestyle Habits with Weight Change among 22,557 US Men Followed from 1986 to 2006.

	Weight Change (95% CI) each 4 years, lb					
	All Men (n=22,558)				Never Smokers (n=9,628)	
	Age-adjusted	P value	Multivariable-adj.*	P value	Multivariable-adj.*	P value
Dietary change,† quintiles (median score; range 17-85)						
1 (42)	3.03 (2.85, 3.21	<0.001	2.98 (2.80, 3.16)	<0.001	2.97 (2.73, 3.21)	<0.001
2 (46)	2.00 (1.81, 2.18)	<0.001	1.97 (1.78, 2.15)	<0.001	2.01 (1.76, 2.26)	<0.001
3 (50)	1.51 (1.35, 1.68)	<0.001	1.48 (1.31, 1.65)	<0.001	1.88 (1.64, 2.12)	<0.001
4 (54)	1.29 (1.12, 1.46)	<0.001	1.27 (1.10, 1.44)	<0.001	1.35 (1.13, 1.57)	<0.001
5 (60)	reference		reference		reference	
Physical activity change, quintiles (median change)						
1 (-11.1 METs/week)	reference		reference		reference	
2 (1.2 METs/week)	-0.21 (-0.39, -0.03)	0.02	-0.19 (-0.37, -0.02)	0.03	-0.28 (-0.51, -0.04)	0.02
3 (8.5 METs/week)	-0.64 (-0,82, -0.47)	<0.001	-0.64 (-0.82, -0.46)	<0.001	-0.32 (-0.57, -0.07)	0.01
4 (19.9 METs/week)	-0.94 (-1.12, -0.75)	<0.001	-0.89 (-1.07, -0.72)	<0.001	-0.93 (-1.17, -0.70)	<0.001
5 (49.2 METs/week)	-1.66 (-1.86, -1.46)	<0.001	-1.64 (-1.83, -1.46)	<0.001	-1.65 (-1.90, -1.40)	<0.001
Alcohol use, per drink/day increase ‡	0.32 (0.22, 0.41)	<0.001	0.32 (0.22, 0.41)	<0.001	0.18 (0.03, 0.33)	0.02
Total daily sleep, hours/day §						
< 6	reference		reference		reference	
6 to 7	-0.28 (-0.42, -0.15)	<0.001	-0.27 (-0.40, -0.14)	<0.001	-0.31 (-0.48, -0.13)	<0.001
> 7 to 8	-0.25 (-0.41, -0.10)	0.001	-0.24 (-0.39, -0.09)	0.002	-0.27 (-0.47, -0.07)	0.01
> 8	0.00 (-0.33, 0.33)	0.99	-0.04 (-0.36, 0.29)	0.83	-0.15 (-0.62, 0.31)	0.52
missing	-0.09 (-0.24, 0.06)	0.26	-0.15 (-0.29, 0.00)	0.05	-0.17 (-0.37, 0.04)	0.11
Time spent watching TV, per hour/day increase ‡	0.03 (0.02, 0.04)	<0.001	0.04 (0.03, 0.05)	<0.001	0.04 (0.03, 0.05)	<0.001
Change in smoking status					*N/A*	
Never (no change)	reference		reference			
Former (no change)	0.17 (0.07, 0.27)	0.001	0.15 (0.05, 0.25)	0.002		
Current (no change)	-0.78 (-1.00, -0.56)	<0.001	-0.88 (-1.10, -0.66)	<0.001		
Current → Former	4.00 (3.60, 4.40)	<0.001	4.10 (3.71, 4.50)	<0.001		
Former → Current	-1.13 (-1.72, -0.55)	<0.001	-1.32 (-1.90, -0.74)	<0.001		
Never → Current	1.98 (0.41, 3.54)	0.01	1.74 (0.19, 3.29)	0.03		

*Adjusted for age, baseline body mass index at the beginning of each 4-year period, and all of the variables in the Table simultaneously.

†Summed changes of the dietary habits associated with weight change in Table 2, derived by summing the ordinal values for quintiles of change of each dietary habit in ascending (1 to 5) or descending (5 to 1) order for habits inversely or positively associated with weight-gain, respectively.

‡Differences in weight-change are for increased alcohol or television watching; the inverse difference would be associated with decreased alcohol or television watching.

§Based on absolute levels due to limited serial assessments to assess change in each 4-year period. Absolute levels of sleep in 1987 were related to weight-gain in each period; sensitivity analyses using averaged sleep duration in 1987 and 2000 were similar.

To convert lb to kg, divide by 0.45.

Supplementary Table 9. Multivariable-Adjusted Relationships of Changes in Lifestyle Habits with Weight Change among 120,877 US Women and Men in Three Prospective Cohorts, Stratified by Age.

	Weight Change (95% CI) each 4 years, lb			
	Age ≤ 50 years		Age > 50 years	
	Multivariable-adjusted*	P value	Multivariable-adjusted*	P value
Dietary change,† quintiles				
1	4.26 (3.37, 5.14)	<0.001	5.72 (1.71, 9.73)	0.005
2	2.70 (2.47, 2.94)	<0.001	3.37 (1.33, 5.41)	0.001
3	2.34 (1.65, 3.02)	<0.001	2.95 (1.04, 4.86)	0.002
4	1.74 (1.38, 2.09)	<0.001	2.57 (0.69, 4.45)	0.007
5	reference		reference	
Physical activity change, quintiles				
1	reference		reference	
2	-0.09 (-0.45, 0.27)	0.64	-0.21 (-0.42, 0.00)	0.05
3	-1.05 (-1.20, -0.89)	<0.001	-0.55 (-0.89, -0.21)	0.001
4	-1.09 (-1.27, -0.91)	<0.001	-0.79 (-1.02, -0.55)	<0.001
5	-2.03 (-2.32, -1.73)	<0.001	-1.32 (-1.65, -0.98)	<0.001
Alcohol use, per drink/day increase ‡	0.47 (0.23, 0.72)	<0.001	0.52 (-0.12, 1.16)	0.02
Total daily sleep, hours/day §				
< 6	reference		reference	
6 to 7	-0.35 (-0.46, -0.25)	<0.001	-0.46 (-0.80, -0.13)	0.01
> 7 to 8	-0.33 (-0.48, -0.17)	<0.001	-0.03 (-0.34, 0.28)	0.85
> 8	0.11 (-0.52, 0.74)	0.73	-0.24 (-0.55, 0.07)	0.14
missing	-0.45 (-0.62, -0.29)	<0.001	-0.06 (-0.53, 0.42)	0.82
Time spent watching TV, per hour/day increase ‡ ¶	0.05 (0.03, 0.06)	<0.001	0.04 (0.03, 0.05)	<0.001
Change in smoking status				
Never (no change)	reference		reference	
Former (no change)	0.11 (-0.02, 0.24)	0.12	0.23 (0.10, 0.35)	<0.001
Current (no change)	-0.40 (-0.61, -0.19)	<0.001	-1.31 (-1.73, -0.88)	<0.001
Current → Former	5.28 (4.02, 6.53)	<0.001	4.59 (3.31, 5.87)	<0.001
Former → Current	-2.49 (-3.93, -1.05)	<0.001	-2.42 (-4.57, -0.26)	0.03
Never → Current	-0.73 (-3.03, 1.57)	0.53	--- ¥	

*Adjusted for age, baseline body mass index at the beginning of each 4-year period, and all of the variables in the Table simultaneously.

†Summed changes of the dietary habits associated with weight change in Table 2, derived by summing the ordinal values for quintiles of change of each dietary habit in ascending (1 to 5) or descending (5 to 1) order for habits inversely or positively associated with weight-gain, respectively.

‡Differences in weight-change are for increased alcohol or television watching; the inverse difference would be associated with decreased alcohol or television watching.

§Based on absolute levels due to limited serial assessments in each cohort to assess sleep change in each 4-year period.

¶Based on NHS2 and HPFS; limited serial assessments did not allow assessment of changes in television watching in NHS.

¥Too few individuals in this category to enable any meaningful estimate.

To convert lb to kg, divide by 0.45.

Supplementary Table 10. Multivariable-Adjusted Relationships of Changes in Lifestyle Habits with Weight Change among 120,877 US Women and Men in Three Prospective Cohorts, Stratified by Baseline Body Mass Index.

	Weight Change (95% CI) each 4 years, lb			
	Body mass index < 25 kg/m2		Body mass index 25-30 kg/m2	
	Multivariable-adjusted*	P value	Multivariable-adjusted*	P value
Dietary change,† quintiles				
1	2.66 (1.92, 3.40)	<0.001	6.66 (3.88, 9.44)	<0.001
2	1.59 (1.26, 1.93)	<0.001	4.21 (2.72, 5.70)	<0.001
3	1.40 (0.86, 1.94)	<0.001	3.70 (1.93, 5.46)	<0.001
4	1.05 (0.73, 1.38)	<0.001	2.92 (1.77, 4.07)	<0.001
5	reference		reference	
Physical activity change, quintiles				
1	reference		reference	
2	-0.00 (-0.30, 0.29)	0.97	-0.27 (-0.51, -0.03)	0.02
3	-0.56 (-0.66, -0.45)	<0.001	-1.34 (-1.94, -0.74)	<0.001
4	-0.63 (-0.73, -0.52)	<0.001	-1.47 (-1.94, -1.00)	<0.001
5	-1.25 (-1.53, -0.98)	<0.001	-2.86 (-3.69, -2.03)	<0.001
Alcohol use, per drink/day increase ‡	0.38 (0.22, 0.53)	<0.001	0.45 (0.07, 0.84)	0.02
Total daily sleep, hours/day §				
< 6	reference		reference	
6 to 7	-0.32 (-0.39, -0.24)	<0.001	-0.31 (-0.44, -0.17)	<0.001
> 7 to 8	-0.28 (-0.40, -0.16)	<0.001	-0.35 (-0.51, -0.19)	<0.001
> 8	0.06 (-0.93, 1.05)	0.90	-0.30 (-1.00, 0.41)	0.41
missing	-0.47 (-0.83, -0.11)	0.01	-0.25 (-0.58, 0.08)	0.13
Time spent watching TV, per hour/day increase ‡ ¶	0.04 (0.02, 0.05)	<0.001	0.06 (0.03, 0.09)	<0.001
Change in smoking status				
Never (no change)	reference		reference	
Former (no change)	0.13 (0.02, 0.24)	0.02	0.18 (0.02, 0.35)	0.02
Current (no change)	-0.41 (-0.92, 0.11)	0.12	-1.42 (-1.62, -1.22)	<0.001
Current → Former	5.01 (4.18, 5.83)	<0.001	5.64 (3.80, 7.48)	<0.001
Former → Current	-2.17 (-3.79, -0.56)	0.01	-3.84 (-5.79, -1.88)	<0.001
Never → Current	0.56 (-2.26, 3.38)	0.70	0.26 (-2.48, 2.99)	0.85

*Adjusted for age, baseline body mass index at the beginning of each 4-year period, and all of the variables in the Table simultaneously. Among persons with normal-weight at baseline (BMI<25 kg/m2), average 4-year absolute and relative weight-gain (5^{th}, 95^{th} percentiles) were +2.38lbs (-3.62, +10.1) and +1.98% (-2.93, +7.41), respectively. Among persons who were overweight at baseline (BMI 25-30 kg/m2), corresponding values were +4.71lbs (-4.87, +14.8) and +3.13% (-3.03, +9.57).

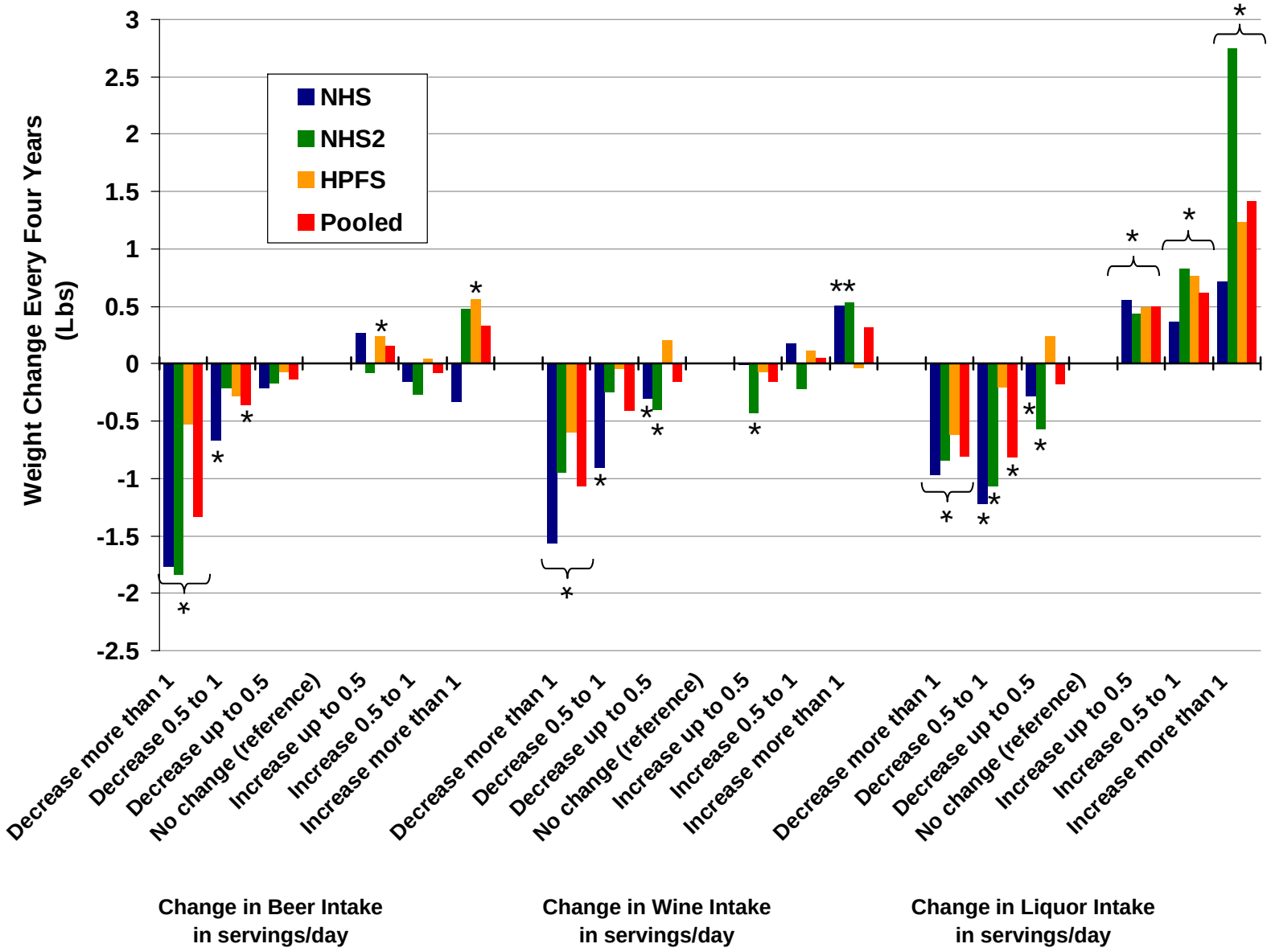
†Summed changes of the dietary habits associated with weight change in Table 2, derived by summing the ordinal values for quintiles of change of each dietary habit in ascending (1 to 5) or descending (5 to 1) order for habits inversely or positively associated with weight-gain, respectively.

‡Differences in weight-change are for increased alcohol or television watching; the inverse difference would be associated with decreased alcohol or television watching.

§Based on absolute levels due to limited serial assessments in each cohort to assess sleep change in each 4-year period.

¶Based on NHS2 and HPFS; limited serial assessments did not allow assessment of changes in television watching in NHS.

To convert lb to kg, divide by 0.45.



Supplementary Figure

Supplementary Figure Legend. Multivariable-adjusted relationships of changes in intake of alcoholic beverages with weight-change each 4 years among 50,422 women in the Nurses Health Study (NHS) followed from 1986-2006, 47,898 women in the Nurses Health Study 2 (NHS2) followed from 1991-2003, and 22,557 men in the Health Professionals Follow-up Study (HPFS) followed from 1986-2006. Changes in beer, wine, and liquor use were each evaluated and compared to the reference category of no change in use. All weight-changes are adjusted for age, baseline body mass index, sleep duration, and changes in smoking, physical activity, television-watching, 15 dietary factors, and each of the types of alcoholic beverages simultaneously. $p<0.05$ compared to the reference category of no change in use. To convert pounds to kilograms, divide by 0.45.