

Prevalence and Predictors of Weight-Loss Maintenance in a Biracial Cohort

Results from the Coronary Artery Risk Development in Young Adults Study

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Background: Few population-based studies have examined the behavioral and psychosocial predictors of long-term weight-loss maintenance.

Purpose: The goal of this study was to determine the prevalence and predictors of weight-loss maintenance in a biracial cohort of younger adults.

Methods: This study examined a population-based sample of overweight/obese African-American and white men and women who had $\geq 5\%$ weight loss between 1995 and 2000. Subsequent changes in weight, physical activity, and behavioral and psychosocial factors were examined between 2000 and 2005. Analyses were conducted in 2008–2009.

Results: Among the 1869 overweight/obese individuals without major disease in 1995, a total of 536 (29%) lost $\geq 5\%$ between 1995 and 2000. Among those who lost weight, 34% ($n=180$) maintained at least 75% of their weight loss between 2000 and 2005, whereas 66% subsequently regained. Higher odds of successful weight-loss maintenance were related to African-American race (OR=1.7, $p=0.03$); smoking (OR=3.4, $p=0.0001$); history of diabetes (OR=2.2, $p=0.04$); increases in moderate physical activity between 2000 and 2005 (OR=1.4, $p=0.005$); increases in emotional support over the same period (OR=1.6, $p=0.01$); and less sugar-sweetened soft drink consumption in 2005 (OR=0.8, $p=0.006$).

Conclusions: One third of overweight men and women who lost weight were able to maintain 75% or more of their weight loss over 5 years. Interventions to promote weight-loss maintenance may benefit from targeting increased physical activity and emotional support and decreased sugar-sweetened soft drink consumption.

Introduction

Given the importance of obesity as a public health problem, it is surprising how little is known about the prevalence and predictors of long-term weight-loss maintenance. Weight-loss trials have shown that most patients regain weight after treatment

termination,¹ but the average individual who continues to participate in a clinical trial maintains a weight loss of about 3% of initial body weight for up to 5 years after treatment.² Analyses^{3–9} examining predictors of treatment outcomes have identified some behaviors that appear to improve success, including continued consumption of a low-calorie, low-fat diet; increased physical activity; and self-monitoring. Psychosocial correlates of better weight-loss maintenance also have been recognized,^{8,10–16} including lower levels of depressive symptoms, stress, and disinhibition and higher levels of restraint and self-efficacy.

Much of the clinical trial literature, however, has been limited by short-term follow-up (2 years or less); small sample sizes; high drop-out rates; and lack of intent-to-

treat analyses. Moreover, clinical trials have generally evaluated specific short-term treatment approaches in individuals attending weekly weight-loss programs. Individuals who seek assistance for weight loss tend to be heavier,¹⁷ have more medical problems,^{18,19} and have higher percentages of binge eating²⁰ than individuals in the general population. Because the individuals who attend clinical weight-loss treatments may be more difficult to treat, and clinical trials have generally evaluated specific short-term treatment methods (e.g., meal replacements, pharmacotherapy, very low-calorie diets),¹ the results from such programs may not represent the true prevalence or typical methods for weight-loss maintenance in the general population. Moreover, although cohort studies of larger samples ($n > 5000$) of successful weight losers exist (e.g., the National Weight Control Registry²¹), these data are based on self-selected samples, and include primarily women, whites, and educated individuals; thus, the findings may not generalize to the population at large.

Only a few empirical studies have attempted to estimate the prevalence of long-term weight-loss maintenance in the general U.S. population. Prevalence estimates of successful maintenance after weight loss have ranged from 58.9% in the National Health and Nutrition Examination Survey (NHANES, 1999–2002)²²; 47% in a random-digit-dial survey²³; and 20% in the Nurses Health Study.⁷ Overall, these studies suggest that sustaining weight loss may be possible for a substantial subset of the general population. However, existing population-based studies have been based on self-reported weights and included a limited array of behavioral and psychosocial measures. Clearly, to better understand the prevalence and predictors of long-term weight control, further research is needed in both men and women that includes more diverse samples, measured weights, multiple follow-ups, and comprehensive assessments.

The Coronary Artery Risk Development in Young Adults (CARDIA) Study enrolled more than 5000 African-American and white women and men, aged 18–30 years, in 1985–1986 and has followed the cohort for more than 20 years, recording serial measurements of weight and behavioral and psychosocial factors. Prior research in CARDIA has examined predictors of weight loss over 2 years of follow-up.²⁴ Weight loss generally was associated with greater baseline fatness, lower baseline physical fitness level, self-perception of being overweight, dieting, and previous weight loss and regain. Other CARDIA papers have examined predictors of weight increases over time. In these studies, limited physical activity,^{25,26} greater fast-food consumption²⁷ and less dissatisfaction with body size²⁸ were identified as significant predictors of weight gain.

The purpose of the present study was to determine the prevalence of successful weight loss and maintenance in the CARDIA cohort and to identify the strongest demographic, behavioral, and psychosocial predictors of 5-year weight-loss maintenance. It was hypothesized that among individuals who had lost 5% or more of their body weight, those with higher levels of physical activity; better dietary intake (e.g., fewer sugar-sweetened beverages, less fast-food consumption); and less depressive symptoms would be most likely to maintain at least 75% of their weight loss over 5 years of follow-up.

Methods

Sample

The CARDIA study is a multicenter, longitudinal study of the development and determinants of cardiovascular disease over time among African-American and white adult men and women. The first CARDIA examination took place in 1985–1986 and included 5115 women and men. Sampling was designed to achieve balanced representation among white and African-American men and women; age groups (18–30 years); and education levels. Subsequent to baseline, the cohort was reexamined at Years 2, 5, 7, 10, 15, and 20 (spanning 1987–2005). All examinations were approved by IRBs at each institution. Details of the study design have been published elsewhere.²⁹

To be included in the current study, participants had to have been overweight or obese ($BMI \geq 25$) and without self-reported major disease in 1995. Of the 3950 participants who were assessed in 1995, a total of 2432 were overweight/obese; of these, 14 were eliminated because of pregnancy between 1995 and 2005 and 549 were eliminated because of a reported illness that potentially could have caused involuntary weight loss over the same time span, including one or more of the following: kidney failure ($n=14$); cirrhosis ($n=1$); cancers ($n=68$); hyperthyroidism ($n=32$); digestive diseases ($n=86$); tuberculosis in past year ($n=84$); HIV ($n=11$); and/or any reported medical problems interfering with exercise ($n=402$; predominantly reflecting recent injuries, surgeries, or chronic pain). The remaining 1869 made up the final sample in the current study.

The weight loss of these 1869 participants was examined between 1995 and 2000 and then weight-loss maintenance between 2000 and 2005 (note that in the current study, calendar years [i.e., 2000, 2005] are used rather than CARDIA assessment years [i.e., Year 15, Year 20] to refer to study time points).

Overall retention for the 1995, 2000, and 2005 examinations was 78.5%, 74%, and 72% of surviving participants, respectively (approximately 2.5% were deceased as of the 2000 examination and 3.4% in 2005).^{30,31} Whites, nonsmokers, more educated participants, and slightly older participants were more likely to return for these exams than African Americans, smokers, those with less education, and younger participants.³² There was no significant relationship with BMI and exam retention.

Measures

As the main purpose of the present study was to examine variables associated with weight-loss maintenance versus regain, assessments occurred after participants' initial weight loss (between 1995

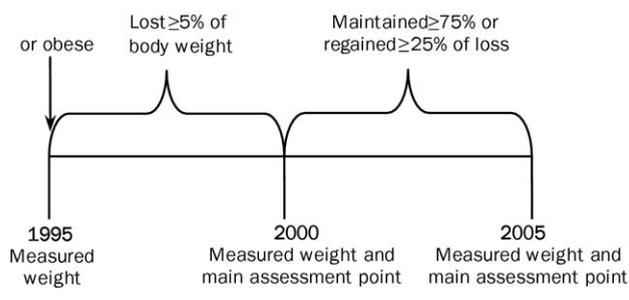


Figure 1. Scheme for assessing weight loss maintenance in overweight or obese participants who had lost $\geq 5\%$ of their body weight between 1995 and 2000, and maintained $\geq 75\%$ of the weight loss between 2000 and 2005. Weight regain was defined as regaining $>25\%$ of weight loss. All participants were without self-reported major disease or pregnancy in 1995.

and 2000) at the 2000 and 2005 examinations. Some variables (anger and coping) were assessed in the 2000 exam only, and others (i.e., diet history) in the 2005 examination only, as indicated in the sections that follow.

Outcome Definitions

Weight-loss maintainers were defined as participants who were overweight or obese in 1995 (and without pregnancy or major medical illnesses affecting weight); had lost $\geq 5\%$ by 2000; and had maintained 75% of their weight loss by 2005. A 5% weight-loss criterion was chosen, as this has been shown in numerous studies to be associated with substantial health benefits³³ and has been recommended by the IOM as the weight-loss criterion for evaluating success of weight-loss programs³⁴; this criterion has also been used in other epidemiologic research examining weight-loss maintenance.⁷ Although successful weight control can involve some weight regain, successful weight loss further was defined as maintaining $\geq 75\%$ of the weight loss for 5 years to identify a relatively weight-stable group of weight-loss maintainers.^{13,35} Regainers were defined as individuals who were overweight or obese in 1995 (and without pregnancy or major medical illnesses affecting weight); had lost $\geq 5\%$ by 2000; but had regained $>25\%$ of their weight loss by 2005 (Figure 1). Note that the terms *weight-loss maintainer* and *regainer* are used to denote these groups, but intentionality of weight changes should not be inferred by the use of these terms.

Weight, height, demographics. Weight and height were measured in light clothing and without shoes at the 1995, 2000, and 2005 examinations using calibrated equipment. BMI was calculated using standard formula. Demographic and medical information collected at the 2000 and 2005 examinations were used in analyses. At these time points, all participants were interviewed by trained personnel about their medical history and current use of cigarettes and alcoholic beverages. In 2005, participants also were asked whether they had ever had bariatric surgery. Voluntary versus involuntary weight loss and weight cycling between assessment points was not directly assessed.

Leisure time physical activity. The CARDIA physical activity questionnaire³⁶ was administered in both 2000 and 2005. Total physical activity was expressed in exercise units as a product of intensity \times frequency \times 100, to yield a total activity score.

Dietary intake. Diet variables were selected based on previous research in weight-loss maintenance^{21,37} and included calorie intake, percentage of calories from fat, and fast-food and soft drink consumption using a diet history questionnaire administered in 2005.^{31,38,39} Fast-food habits were assessed in 2000 and 2005.³¹

Psychosocial measures. Depressive symptomatology was assessed in both 2000 and 2005 using the 20-item Center for Epidemiologic Studies depression scale (CES-D).⁴⁰ The shortened version of the SF-36 was used to assess quality of life in the 2000 and 2005 examinations.⁴¹ Social network was measured in 2000 and 2005.⁴² Social support was measured also in 2000 and 2005 using eight items drawn from the MacArthur Network.⁴³ Anger was assessed in 2000 only, using the State-Trait Anger Expression Inventory-2.^{44,45} Coping was assessed in 2000 only, using the Reactive Responding Measure.⁴⁶ Sleep disturbances were assessed in 2000 and 2005 using questions from the Sleep Heart Health Study⁴⁷ pertaining to excessive daytime sleepiness, trouble falling asleep, and frequent awakening.

Statistics

All analyses were performed using SAS version 9.2. Initial univariate *t* tests and chi-square analyses were conducted to compare groups on demographic and weight-related characteristics. Participants with missing weight data in the final assessment point (2000; $n=85$) were classified as weight regainers to provide a conservative estimate of the prevalence of successful weight-loss maintenance, but analyses that excluded these 85 individuals revealed similar findings. A three-step process was used to identify the most robust set of predictors of weight-loss maintenance versus weight regain. First, initial multivariate ANOVA for repeated measures was used to examine changes over time (between 2000 and 2005) in each variable and interactions with group (Maintainer versus Regainer), both with and without adjusting for demographic variables affecting weight (race, smoking status, age, gender, marital status, dieting history, 1995 BMI, and percentage weight loss since 1995).

Second, variables that were found to be significant or approached significance ($p < 0.15$; see Table 2) in these initial adjusted models were entered into a stepwise analysis within predefined categories (i.e., demographic; smoking; physical activity; macronutrient [% of calories from carbohydrate, protein]; dietary components [fast food, diet soft drink, sugar-sweetened soft drinks]; psychosocial; and sleep). Third, variables that were significant ($p < 0.05$) within each predefined category in the stepwise analyses were added individually to a sequential hierarchic model to see whether its inclusion improved the fit of the model using a significant likelihood ratio chi-square. The sequential order in the hierarchic model was based on previous research on variables affecting weight-loss maintenance^{21,37} and was as follows: (1) demographic and smoking; (2) physical activity; (3) diet (either macronutrient or specific dietary components, such as fast food or soft drinks; each was analyzed in separate models); (4) psychosocial variables; and (5) sleep variables.

A sensitivity analysis also was conducted using an inverse weighting probability model in which the presence and absence in the final analysis was included as a dependent variable. However, accounting for missingness as an independent variable in the final model did not appreciably influence the findings; thus, only results from the completers' analyses are presented here.

Table 1. Comparison of those who maintained their weight loss and those who regained between 2000 and 2005 on demographic and weight-related variables in 2000

Variable	Weight-loss maintainer (n=180)	Weight regainer (n=356)	p-value
Demographic			
Age (years)	40.1±3.7	39.7±3.6	0.18
Female	47.5	46.0	0.75
White	36.3	41.7	0.22
African-American	63.7	58.2	
Married	47.2	48.2	0.84
High school educated or more	67.5	70.7	0.44
Weight/weight-loss information in 1995 and 2000 (M±SD)			
Weight (kg) in 1995	103.9±24.2	100.4±19.8	0.08
BMI in 1995	35.4±7.8	34.0±6.2	0.02
Weight (kg) at year 2000	92.3±19.0	90.6±17.3	0.29
BMI at year 2000	31.5±6.0	30.7±5.3	0.10
Weight loss (1995 wt [kg] – 2000 wt [kg])	11.6±9.0	9.9±6.0	0.007
Percentage weight loss ((1995 wt – 2000 wt)/1995 wt)	10.6±5.7	9.6±4.5	0.04

Note: Values are percentages unless otherwise mentioned. Weight regain = lost ≥5% between 1995 and 2000 and regained >5% between 2000 and 2005. Weight-loss maintenance = lost ≥5% between 1995 and 2000 and maintained ≥75% of that weight loss between 2000 and 2005. Weight and height in 1995, 2000, and 2005 were based on measured weights using calibrated equipment.

Results

Participants were 1869 nonpregnant overweight/obese individuals without major disease in 1995. They were, on average, aged 40.1±3.7 years, with 47% female, 39% white; 48% married; and 69% with a high school education or more. Of these 1869, a total of 536 (29%) lost at least 5% of their body weight between examinations in 1995 and 2000; of these, 180 (33.5%) maintained at least 75% of their weight loss between 2000 and 2005 and were classified as “weight-loss maintainers”; 356 (66.4%) had lost ≥5% but regained more than 25% of their weight loss during 2000–2005 and were classified as “weight regainers.” The maintainers and regainers were compared (below) to identify the characteristics in year 2000 that best distinguished these two groups.

Baseline (Year 2000) and Changes from 1995 to 2000 As Predictors of Subsequent Regain

Demographic characteristics and weight changes. Maintain-ers and regainers differed on a number of weight-related characteristics (Table 1). Moreover, a significantly greater proportion of weight-loss maintainers

than regainers self-reported a history of diabetes (7.5% vs 4.7%, respectively; $p=0.001$) but no significant differences were observed in reported history of high blood pressure (28% vs 21%, respectively; $p=0.19$).

Behavioral and psychosocial characteristics at year 2000. In general, the behavioral and psychosocial characteristics measured in the 2000 examination did not differ between those who subsequently gained or maintained their weight 5 years later (Table 2). However, a significantly greater proportion of weight-loss maintainers than regainers reported smoking in the 2000

examination (33% vs 23%, respectively; $p=0.0001$). Moreover, there was a trend for greater alcohol consumption in maintainers than regainers (7.4 vs 6.6 drinks/week, $p=0.09$; Table 2). Additionally, there were trends for maintainers to report engaging in slightly less physical activity initially and to report less prevalent awakenings at night (Table 2).

Change Between the 2000 and 2005 Examinations

Additional analyses compared changes between the 2000 and 2005 examinations for those who regained weight versus those who maintained their previous weight loss. During this time span, weight-loss maintainers continued to lose weight (4 kg loss) and further reduced their BMI from 31.5±6.0 to 30.4±6.5 whereas regainers increased to above baseline (8.8 kg gain) from a BMI of 30.7±5.3 to 33.6±6.4. In 2005, maintainers were lighter than regainers (88.5±18.7 vs 99.3±20.5 kg, $p=0.0001$) and were maintaining a weight loss of approximately 15% from 1995 compared with 1% weight regain above baseline for regainers.

Table 2. Mean behavioral and psychological characteristics at the 2000 and 2005 follow-up examinations

Characteristic	2000 Examination			2005 Examination		Significance		
	Maintainers	Regainers	p-value	Maintainers	Regainers	Group	Time	Group × time
Current smoker (%)	33.2	23.0	0.0001	23.6	15.8	0.0005	0.006	0.05
Physical activity								
Total	345.0±22.1	382.4±16.7	0.07	344.3±22.4	327.9±19.3	ns	ns	ns
High	203.2±16.9	238.4±12.8	0.10	199.1±17.2	205.8±14.8	ns	ns	ns
Moderate	141.8±8.4	143.9±6.3	0.14	145.2±8.5	122.1±7.3	ns	ns	0.08
Sleep (%)								
Daytime sleepiness	25	24	ns	30	31	ns	0.04	ns
Trouble falling asleep	23	19	ns	25	21	ns	ns	ns
Frequent awakenings	46	53	0.07	48	57	0.02	ns	ns
Psychosocial								
Quality of life: physical component	51.7±0.5	52.3±0.4	ns	50.3±0.5	49.9±0.5	ns	0.0001	ns
Quality of life: mental component	49.8±0.7	50.1±0.5	ns	50.9±0.7	51.1±0.5	ns	0.05	ns
Chronic burden	1.9±0.04	1.8±0.03	ns	1.7±0.05	1.7±0.04	ns	0.0001	ns
Social support: positive emotional	2.1±0.05	2.1±0.04	ns	2.0±0.05	2.1±0.04	ns	ns	0.10
Social support: negative emotional	2.0±0.1	2.1±0.03	ns	2.0±0.1	2.1±0.04	ns	ns	ns
Social network	7.3±0.2	7.5±0.1	ns	5.2±0.2	5.4±0.2	0.13	0.0001	ns
CES-D (Total)	10.0±0.6	10.0±0.4	ns	9.8±0.6	10.7±0.5	ns	ns	ns
Anger out	1.8±0.03	1.7±0.02	ns	—	—	0.14	—	—
Reactive responding: emotional	2.9±0.06	2.9±0.04	ns	—	—	ns	—	—
Reactive responding: goal	3.7±0.06	3.8±0.04	ns	—	—	0.13	—	—
Reactive responding: vigilance	2.8±0.05	2.8±0.04	ns	—	—	ns	—	—
Diet								
Total calories/day	—	—	—	2384±110.3	2580±101.3	ns	—	—
% kcal from fat/day	—	—	—	36.6±0.70	36.0±0.6	ns	—	—
% kcal from carbohydrates/day	—	—	—	45.1±0.81	46.8±0.70	0.10	—	—
% kcal from protein/day	—	—	—	16.1±0.30	15.3±0.30	0.08	—	—
Sugar-sweetened drinks (srv/day)	—	—	—	0.93±0.13	1.2±1.7	0.02	—	—
Diet beverages (srv/day)	—	—	—	1.4±0.20	0.99±0.18	0.08	—	—
Water (srv/day)	—	—	—	5.7±0.4	5.8±0.4	ns	—	—
Alcohol (srv/week)	7.7±0.9	6.6±0.6	0.09	7.2±0.9	7.2±0.8	ns	ns	ns
Fast food (srv/week)	3.4±0.04	3.3±0.03	ns	3.5±0.04	3.4±0.04	0.07	0.14	ns

Note: Unadjusted values are presented for ease in interpretation; p-values reflect analyses with adjustment for race, smoking status, age, gender, marital status, dieting history, and initial BMI and weight loss. p-values <0.15 are displayed in the table and denote variables that were entered into subsequent models. CES-D, Center for Epidemiologic Studies–Depression scale; ns, nonsignificant ($p>0.15$); srv, servings

Examining variables assessed in both the 2000 and 2005 examinations, there was a significantly greater reduction in smoking prevalence among regainers than maintainers ($p=0.05$; Table 2). There was also a trend ($p<0.08$) for maintainers to slightly increase their physical activity and for regainers to decrease their activity. Group main effects also were found for sleep (Table 2). Examining psychosocial characteristics, sev-

eral time effects were observed, including substantial declines in physical and mental quality of life scores (Table 2), but the maintainers and regainers had similar changes.

Table 2 also shows results of the diet history questionnaire administered in 2005. Maintainers consumed significantly ($p=0.02$) fewer daily servings of sugar-sweetened soft drinks than regainers and slightly more

Table 3. Odds of being in the weight-loss maintainers versus regain category

Factor	OR (95% CI)	p-value
African-American	1.7 (1.1, 3.0)	0.03
Female	0.9 (0.5, 1.4)	ns
Married (Nonmarried = ref)	0.9 (0.6, 1.6)	ns
BMI (year 1995)	0.9 (0.9, 1.0)	ns
Weight loss between 1995 and 2000	1.0 (0.9, 1.0)	ns
Smoker in 2000 and 2005 (Never-smokers = ref)	3.4 (1.9, 6.2)	0.0001
Dieting history	1.0 (0.9, 1.0)	ns
History of diabetes	2.2 (1.0, 5.1)	0.04
Increase in units of moderate activity (2000–2005)	1.4 (1.1, 1.7)	0.005
Soft drink consumption (servings/day; year 2005)	0.8 (0.7, .9)	0.006
Increases in emotional support (2000–2005)	1.6 (1.2, 2.7)	0.01

Note: Race, gender, marital status, dieting history, and history of diabetes, measured in 2000. Results based on sequential multiple regression in which demographic variables were entered first, followed by physical activity, dietary, and psychosocial variables. ns, nonsignificant ($p > 0.05$)

diet soft drinks, fewer calories from protein, and more fast food, but these latter trends were not significant. History of bariatric surgery was also assessed in 2005; four maintainers and no regainers reported ever having had bariatric surgery.

Multivariable Analyses

In models containing all variables that were significant or approached significance in univariate analyses, significant predictors of the odds of maintaining weight versus being a regainer included African-American race, history of diabetes, and current smoking at years 2000 and 2005, as well as increases in moderate physical activity between 2000 and 2005, increases in emotional support during the same time span, and less sugar-sweetened soft drink consumption in 2005 (Table 3). In analyses that included macronutrients (instead of foods) as the dietary block, similar findings were observed for changes in moderate activity (OR=1.3, 95% CI=1.1, 1.6, $p=0.007$) and emotional support (OR=1.6, 95% CI=1.1, 2.3, $p=0.01$); however, intake of macronutrients was not a significant predictor. Analyses excluding the four participants who reported a history of bariatric surgery revealed near identical findings.

Discussion

To our knowledge, the current study was the first to examine the prevalence of weight loss and maintenance in a diverse population-based cohort using prospectively measured weights. The first principal finding was that 29% (536 of 1869) of the overweight and obese population successfully lost a modest amount of weight ($\geq 5\%$) over a 5-year time span, with only four of these 536 participants having reported bariatric surgery. In a similarly aged population of women, the Nurses Health Study found that fewer (13%) overweight and obese women had successfully lost 5% or more of their body weight over a 2-year period (determined using self-reported weights). Although encouraging that nearly one third of overweight and obese individuals were successful at weight loss, more effective strategies may be needed to increase the proportion of overweight and obese individuals in the population who lose weight.

Although it is commonly believed, based on clinical trial outcomes,^{48,49} that very few individuals succeed at long-term weight-loss maintenance, 34% of the overweight individuals who had successfully lost weight in CARDIA were able to keep the weight off over 5 years. Using similar criteria but self-reported weights, the Nurses Health Study⁷ found that approximately 20% of those who had lost 5% or more kept it off over 2 years. In NHANES (1999–2002), 58.9% of participants reported keeping 10% or more weight loss off (within 5%) for 1 year, also based on self-reported weight. The prevalence of *both* successful weight loss and maintenance among overweight individuals was 10% in the current study, 15% in the Nurses Health study, and 18% in a random-digital survey.²³ As CARDIA is the only study that used measured weights, its estimates are potentially the most accurate. However, differences in the definitions used may also explain differences in the estimated prevalence. Nonetheless, these data and other national^{8,50} and international⁵¹ reports similarly suggest that successful weight-loss maintenance, although infrequent, may be more prevalent in the general population than commonly assumed.

Surprisingly, no significant differences were found in the prevalence of successful weight loss and maintenance across age and gender. In contrast, African Americans had higher odds of long-term weight-loss maintenance than whites. Another population-based study⁸ similarly found greater percentages of self-reported successful weight-loss maintenance in African Americans than whites. However, the NHANES study found no significant differences in prevalence between African Americans and whites, and lower prevalence in Mexican Americans.²² Some clinical weight-loss trials have shown

minorities to be somewhat less successful than nonminorities at weight loss^{52,53} but as successful⁵⁴ or more successful⁵⁵ at weight-loss maintenance. Findings from the current cohort study, which may be more generalizable than clinical trial data, suggest that long-term weight-loss maintenance is similar in men and women and better in African-American than white populations.

Examining predictors and correlates of weight-loss maintenance, physical activity emerged as a significant variable, a finding that is consistent with findings from both clinical trial⁵⁶ and epidemiologic⁷ studies. Lower sugar-sweetened soft drink consumption also was related to higher odds of successful weight-loss maintenance. Evidence is mixed on the role of sugar-sweetened beverages in the promotion of weight gain and obesity.^{57–63} A recent study that compared successful weight losers and normal-weight controls indicated that weight-loss maintainers consumed little in the way of sugar-sweetened beverages.⁶⁴ The current study's findings are consistent with these latter data and further suggest that limiting intake of sugar-sweetened beverages is characteristic of long-term successful weight losers.

The study has some limitations. Even though, to be conservative, individuals were excluded who had diseases that could promote unintentional weight loss or inhibit physical activity, intentionality of weight loss was not directly assessed in 2000 and, thus, prevalence estimates of successful weight control could be inflated. Studies that have assessed and excluded unintentional weight losers have reported similar prevalences as those in the current study.^{22,65} Nonetheless, the extent to which successful weight losers in the current study represent intentional versus unintentional weight losers remains unclear, so these results should be interpreted with caution. This is an observational study, so causality cannot be inferred. Moreover, although population-based, the current study was conducted with participants who have remained in CARDIA through 20 years of follow-up and who may differ in their motivation and/or weight change patterns than the population at large. Finally, the assessments done in the current study, although comprehensive, were not all administered at every examination and not every factor known or thought to be associated with successful weight control was measured (e.g., dietary restraint, disinhibition, self-efficacy, environmental factors). Also, because the measures were collected 5 years apart, the extent to which weight cycled in the interim years was unknown.

In summary, 29% of overweight and obese men and women successfully lost $\geq 5\%$ of their body weight over a 5-year time span, and 34% of those who lost weight were able to maintain their weight losses over the next 5 years; African Americans were more likely than whites to be

classified as a weight-loss maintainer. Public health interventions to promote weight-loss maintenance may benefit from targeting increased physical activity and emotional support, and decreased soft drink consumption.

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