A descriptive study of individuals successful at long-term maintenance of substantial weight loss[1,2]

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ABSTRACT The National Weight Control Registry (NWCR) is, to the best of our knowledge, the largest study of individuals successful at long-term maintenance of weight loss. Despite extensive histories of overweight, the 629 women and 155 men in the registry lost an average of 30 kg and maintained a required minimum weight loss of 13.6 kg for 5 y. A little over one-half of the sample lost weight through formal programs; the remainder lost weight on their own. Both groups reported having used both diet and exercise to lose weight and nearly 77% of the sample reported that a triggering event had preceded their successful weight loss. Mean (± SD) current consumption reported by registry members was 5778 ± 2200 kJ/d, with 24 ± 9% of energy from fat. Members also appear to be highly active: they reported expending ≈11 830 kJ/wk through physical activity. Surprisingly, 42% of the sample reported that maintaining their weight loss was less difficult than losing weight. Nearly all registry members indicated that weight loss led to improvements in their level of energy, physical mobility, general mood, self-confidence, and physical health. In summary, the NWCR identified a large sample of individuals who were highly successful at maintaining weight loss. Future prospective studies will determine variables that predict continued maintenance of weight loss. *Am J Clin Nutr* 1997;66:239–46.

KEY WORDS Weight loss, weight maintenance, diet, obesity, physical activity, energy expenditure, National Weight Control Registry

INTRODUCTION

Behavioral treatments for obesity have substantial initial effectiveness: patients lose an average of 0.5 kg/wk during 16–20 wk of treatment (1). Unfortunately, long-term follow-up indicates that most patients return to their baseline weights within 3–5 y after the end of treatment (2). The lack of consistent long-term success in maintenance of weight loss led researchers to call for innovative methods of enhancing long-term outcome of behavioral weight-loss programs (1, 3).

One potential means for increasing understanding of the factors required for successful weight maintenance is to study individuals who have been successful at losing weight and keeping it off. Surprisingly little is known about such successful losers, perhaps because of their relative rarity in university-based studies of weight loss and maintenance. The few studies that examined successful weight maintainers in university-based programs found consistent correlations between use of physical activity, self-monitoring, and maintenance of weight loss (4). However, patients who enter such programs are probably not representative of all individuals seeking to lose weight (5). Thus, it is not clear to what extent these findings hold true for individuals who have lost weight through means other than university-based programs.

Another approach to studying individuals successful at weight loss and maintenance was shown by studies that identified and extensively interviewed small samples of such individuals (6–8). Using open-ended questions or semistructured interviews, such studies found that successful weight maintainers reported regular physical activity and self-monitoring as a means of weight loss or weight maintenance. Data from these studies also indicated that successful dieters possess coping skills that enable them to respond to cravings or stressful situations in ways that maintain their diets (7, 8). Unfortunately, the small sample sizes and qualitative data that are characteristic of these studies limit the generalizability of their findings.

The purposes of the current study were to identify a large sample of individuals who were successful at long-term maintenance of substantial weight loss and to use quantitative measures to describe their weight-loss and weight-maintenance strategies. To enroll in the National Weight Control Registry (NWCR), participants must have lost ≥ 13.6 kg (30 lb) and have maintained the loss for ≥1 y. On average, our 784 participants far exceeded these minimum criteria: participants lost an average of 30 kg and maintained the minimum 13.6-kg loss for an average of 5.5 y. Their responses to a comprehensive packet of questionnaires were used to describe the demographic and behavioral characteristics of a large sample of individuals who were highly successful at maintenance of weight loss.

SUBJECTS AND METHODS

Subjects

Subjects were 629 women and 155 men currently enrolled in the NWCR. To be eligible for enrollment, an individual must

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be aged ≥ 18 y, have lost ≥ 13.6 kg (30 lb), and maintained the weight loss for ≥ 1 y.

Procedures

Prospective subjects were recruited through coverage of the NWCR provided by local and national media sources, mailings sent by several commercial weight-loss programs to their current members, and articles placed in health newsletters and magazines. Individuals inquiring about entry into the registry were asked first to complete informed consent forms and to provide documentation of their weight loss (*see* below). On return of this information to researchers, baseline questionnaire packets were mailed to eligible subjects.

Entry into the registry was based on self-reported height, weight, and weight change, which have been shown to be quite accurate in other studies (9,10). To increase the veracity of self-reports in this study, subjects were asked to provide documentation of weight loss (either "before and after" photographs or names of individuals able to verify the weight loss). Thirty-five percent (274) of the sample provided "before and after" photographs; 42% (332) provided names of doctors, weight-loss counselors, or other individuals able to verify that the weight loss had occurred; 4% (33) provided both photographs and names; and 19% (145) were unable to provide any source of documentation. Subjects unable to provide documentation did not differ significantly from others with respect to the primary variables under investigation; therefore, they were included in the sample.

Measures

Registry members were asked a series of questions about demographic and weight characteristics, weight-loss methods and strategies, weight-maintenance methods and strategies, and the effect of weight loss and maintenance on selected aspects of their lives. The sections below describe measures used to assess each of these variables.

Demographic and weight characteristics

All subjects completed a questionnaire requesting standard demographic information (age, education level, and marital status) and details about weight history (age at onset of overweight, parental weight status, maximum lifetime weight, current weight, and duration of the required minimum 13.6-kg weight loss). Weight information was used to calculate maximum lifetime body mass index (BMI; in kg/m^2), current BMI, change in BMI (maximum lifetime BMI minus current BMI), and change in body weight (maximum lifetime weight minus current body weight) for each subject.

Weight-loss methods

All subjects indicated whether they had lost weight through a formal program or on their own and then indicated whether they had modified their dietary intake, physical activity level, or both to achieve the weight loss. If dietary modification was used as a weight-loss technique, subjects were asked to respond yes or no to a series of statements about techniques used to limit dietary intake, eg, "limited quantity of all foods eaten," "limited intake of certain types of food," "counted calories," "limited percentage of daily energy from fat," "followed exchange-system diet," and "used a liquid formula." All subjects who reported modifying their physical activity to achieve weight loss were asked to indicate where they typically exercised (home or work), with whom they typically exercised (an exercise group, friend, or family member) and, by using a list provided, the type of exercise in which they typically engaged (walking, aerobic dancing, competitive sports, swimming, and other).

Subjects were also asked to report any events they believed precipitated their successful weight loss. Subject responses were coded into 11 event types (eg, doctor's advice to lose weight was coded as a medical event; negative remarks from others about the subject's weight were coded as an emotional event).

Weight-maintenance methods

The next section of the questionnaire asked subjects what they were doing currently to maintain their weight loss. Dietary intake during maintenance was assessed by using a scannable version of the Block food-frequency questionnaire (11). Subjects were given a standardized list of 100 foods and asked to estimate their usual serving sizes and the frequency with which they consumed each food during the past year.

The current eating patterns of registry members were explored by asking subjects to indicate whether they were currently using restriction of food intake as a maintenance strategy. Those who reported using intake restriction answered a series of yes or no questions about techniques used to limit food intake. Subjects were also asked to report the average number of times per day they ate (including all meals and snacks) and how often they ate at restaurants in an average week.

To assess current levels of physical activity, we asked all subjects to complete the Paffenbarger physical activity questionnaire, which asks for information about walking, stair climbing, and recreational activities engaged in during the past week (12). Total flights of stairs climbed, total blocks walked, and the frequency, duration, and intensity level (light, medium, or heavy) of each recreational activity were used to provide an estimate of current energy expenditure through physical activity.

Finally, members were asked to indicate how often they currently weighed themselves (less than once per month, less than once per week, once per week, once per day, or several times per day).

Previous weight-loss attempts

Total lifetime weight loss was assessed by asking subjects to indicate the number of times they had intentionally lost 4.5–8.6, 8.7–22.3, 22.4–35.9, 36.0–45.0, and > 45.1 kg (10–19, 20–49, 50–79, 80–99, and 100 lb). Response options were 0, 1–2, 3–5, 6–10, and > 10 times. A lifetime weight-loss score was calculated for each subject by multiplying the midpoint of the number of times endorsed by the midpoint of each weight-loss category (13). Registry members were also asked to compare their successful weight loss with previous unsuccessful weight losses with respect to such variables as level of commitment and strictness of dietary and exercise strategies used.

Difficulty of weight loss and weight maintenance

Using a 7-point scale (1 = extremely easy; 7 = extremely hard), subjects rated the difficulty of their successful weight

loss and weight maintenance. Additionally, a variable was created for each subject to assess his or her difficulty with weight maintenance relative to difficulty of weight loss. This variable was calculated by subtracting the subject's rating of maintenance difficulty from his or her rating of weight-loss difficulty. A positive score indicated that losing weight was more difficult than maintaining weight whereas a negative score indicated that maintaining was more difficult than losing weight. A score of zero indicated that weight-loss and maintenance were equally easy or difficult.

Effect of weight loss on other areas of life

Using a 5-point Likert-like scale (1 = very much worsened; 5 = very much improved), subjects rated the effect of successful weight maintenance on their general physical well-being, social interactions with others, and overall mood and psychologic well-being.

Statistics

Data are expressed as means ± SDs. Between-group comparisons (men compared with women) were made with use of unpaired *t* tests or chi-square tests. These analyses were done with SPSS FOR WINDOWS, version 6.1.2 (SPSS Inc, Chicago).

RESULTS

Characteristics of subjects

Selected characteristics of registry members are shown in **Table 1**. Eighty percent of the subjects were women, 97% were white, 67% were currently married, and ≈54% had an undergraduate or graduate college degree. Although the minimum weight loss required for entry into the registry was 13.6 kg, many registry participants lost more. On average, participants lost 30 kg (28.7 ± 13.61 kg in women and 35 ± 13.64 kg in men) and 14% of registry members (n = 111) lost ≥ 45.4 kg (100 lb). Similarly, although the minimum duration of weight maintenance was 1 y, registry members had, on average, maintained the minimum weight loss for 5.5 y and 16% of the sample maintained a loss of ≥ 13.6 kg for ≥ 10 y.

Registry members were considerably overweight before their successful weight loss, as evidenced by their average maximum lifetime BMI of 35 (women's and men's lifetime maximum BMI, 34.6 ± 6.8 and 37.2 ± 8.5, respectively). After their substantial weight loss, however, registry members were within the normal to moderately overweight range (women's and men's current BMI, 24.1 ± 4 and 26.4 ± 4, respectively).

Most of the registry participants had childhood-onset obesity; ≈46% of the sample reported that they first became overweight at ≤ 11 y of age and 25.3% became overweight at 12–18 y. Only 28.3% of the sample became overweight at

TABLE 1
Characteristics of registry members

	Women (n = 629)	Men (n = 155)	Total sample (n = 784)
Education (%)			
High school or less	20.5	9.7[1]	18.4
Some college	28.5	25.2	27.8
College or university degree	24.8	27.7	25.4
Graduate degree	26.2	37.4	28.4
Marital status (%)			
Married	67.6	66.5	67.3
Separated or divorced	11.8	8.4	11.1
Single	20.7	25.2	21.6
Ethnic status (%)			
White	97.1	96.1	96.9
African American	1.4	1.3	1.4
Asian	0.2	0.0	0.1
Hispanic	1.0	1.9	1.1
Other	0.4	0.6	0.4
Weight-loss method (%)			
On own	40.1	63.2[1]	44.6
Formal program	59.9	36.8	55.4
Age	44.35 ± 11.54[2]	49.08 ± 11.93[1]	45.29 ± 11.77
Change in weight (kg)	28.66 ± 13.61	35.40 ± 20.67[1]	30.00 ± 15.49
Change in BMI (kg/m^2)	10.49 ± 4.98	10.88 ± 6.17	10.57 ± 5.23
Duration of weight loss (y)	5.50 ± 6.80	5.84 ± 6.92	5.57 ± 6.82
Maximum weight (kg)	94.64 ± 19.31	121.02 ± 30.09[1]	99.85 ± 24.25
Maximum BMI (kg/m^2)	34.60 ± 6.83	37.23 ± 8.54[1]	35.12 ± 7.27
Current weight (kg)	65.97 ± 11.35	85.62 ± 15.07[1]	69.85 ± 14.47
Current BMI (kg/m^2)	24.11 ± 3.91	26.35 ± 4.03[1]	24.56 ± 4.03

[1] Significantly different from women, $P < 0.001$.
[2] $\bar{x}$ ± SD.

≥ 18 y and thus would be considered to have adult-onset obesity. A large proportion of registry members also reported a family history of overweight; 46% of the sample indicated that one biologic parent was overweight and 26.8% indicated that both biologic parents were overweight.

Methods used to lose weight

Approximately 55% of the sample reported that they used a formal program or professional assistance (eg, Weight Watchers, Overeaters Anonymous, or individual sessions with a psychologist or registered dietitian) to lose weight. The remaining 45% reported that they had lost weight on their own. Significantly more women than men used a formal program or professional assistance to lose weight (60% compared with 37%, $n = 784$; $\chi^2_1 = 26.99$, $P < 0.001$).

In response to questions about the methods used to lose weight, 89% of the sample reported modifying both dietary intake and physical activity levels to achieve their successful weight loss. Much smaller proportions reported exclusive use of one or the other (10% used dietary modification only; 1% used modification of activity level only). In subjects who reported modifying food intake to lose weight (**Table 2**), the three most widely used methods were to limit intake of certain types or classes of foods (87.6%), to limit quantities of food eaten (44.2%), and to count calories (43.7%). Women were significantly more likely than men to report they limited quantities of food eaten ($n = 773$; $\chi^2_1 = 11.31$, $P = 0.0008$) and used the exchange (diabetic) diet ($n = 773$; $\chi^2_1 = 13.33$, $P = 0.0002$).

Approximately 20% of the sample used liquid formula as part of their weight-loss effort. Seventy-one percent of these subjects substituted formula for all meals for an average of 19.47 ± 11.84 wk. Men were marginally more likely than women to report using liquid formula during their successful weight loss ($n = 773$; $\chi^2_1 = 3.54$, $P = 0.06$). Few members of the registry reported using medication (4.3%) or surgery (1.3%) as weight-loss strategies.

As noted above, almost every member of the registry reported using changes in physical activity level as part of their weight-loss effort. Ninety-two percent of the sample reported that they exercised at home during their weight loss and about one-third of the sample regularly exercised with a group (31.3%) or friend (40.3%). On average, registry members engaged in one to two types of activity to lose weight. Women were more likely than men to have engaged in walking ($n = 704$; $\chi^2_1 = 20.82$, $P = 0.0001$) and aerobic dancing ($n = 704$; $\chi^2_1 = 46.63$, $P = 0.0001$) and less likely than men to have engaged in competitive sports ($n = 704$; $\chi^2_1 = 9.18$, $P = 0.002$) and weightlifting ($n = 704$; $\chi^2_1 = 8.55$, $P = 0.003$). Women were marginally more likely than men to have used swimming as exercise ($n = 705$; $\chi^2_1 = 3.66$, $P = 0.06$).

Nearly 77% of the registry reported that there was a triggering event or incident that preceded their successful weight loss (**Table 3**) and women and men were equally likely to report occurrence of such an event ($n = 672$; $\chi^2_1 = 2.34$, $P = 0.13$). Thirty-two percent of the sample described either a medical trigger (eg, varicose veins, sleep apnea, low back pain, fatigue, and aching legs) or an emotional trigger (eg, "husband left me and my lawyer told me it was because I was fat") as a precursor to weight loss. Men were significantly more likely than women to report occurrence of a medical trigger ($n = 598$; $\chi^2_1 = 12.93$, $P = 0.0003$) or that they "just decided to do it" ($n = 191$; $\chi^2_1 = 4.05$, $P = 0.04$). Women were more likely than men to report occurrence of an emotional trigger ($n = 598$; $\chi^2_1 = 9.46$, $P = 0.002$) and were marginally more likely to report a lifestyle trigger, eg, "25th anniversary was approaching and I wanted to look good for it" ($n = 598$; $\chi^2_1 = 3.42$, $P = 0.06$).

Weight maintenance

Current mean energy and nutrient intakes for registry members are shown in **Table 4**. Subjects reported consuming 5778 ± 2200 kJ/d and men consumed significantly more than did women (7218 ± 2706 kJ compared with 5426 ± 1900 kJ;

TABLE 2
Dietary strategies used to achieve weight loss[1]

Strategy	Women ($n = 623$)	Men ($n = 150$)	Total sample ($n = 773$)
		%	
Restricted intake of certain types or classes of foods	87.8	86.7	87.6
Ate all foods but limited quantity	47.2	32.0[2]	44.2
Counted calories	44.8	39.3	43.7
Limited percentage of daily energy from fat	31.1	36.7	33.1
Counted fat grams	25.7	21.3	25.2
Followed exchange (diabetic) diet	25.2	11.3[2]	22.5
Used liquid formula	19.1	26.0[3]	20.4
Ate only one or two types of food	5.1	6.7	5.5

[1] Percentages add up to > 100 because some subjects used more than one strategy.
[2] Significantly different from women, $P = 0.0002$.
[3] Nearly significantly different from women, $P = 0.06$.

TABLE 3
Weight-loss triggering events reported[1]

Trigger	Women ($n = 475$)	Men ($n = 123$)	Total sample ($n = 598$)
		%	
Medical	28.8	47.2[2]	32.4
Emotional	34.7	20.3[2]	31.7
Lifestyle	28.2	18.7[2]	26.2
Ongoing discontent	33.3	39.0	11.0
"Just decided to do it"	19.3	34.1[2]	7.2
Received impetus or inspiration from another	13.3	14.6	4.3
Weight incident	12.7	4.9	3.5
Saw self in mirror or photograph	11.3	4.9	3.2
Weight-loss program became available	5.3	0.0	1.3
Desire for increased fitness or mobility	4.0	2.4	1.2
Clothing incident	1.3	0.0	0.3

[1] Percentages add up to > 100 because some subjects had more than one triggering event.
[2] Significantly different from women, $P < 0.05$.

TABLE 4
Eating and exercise habits of registry members[1]

	Women (n = 629)	Men (n = 155)	Total sample (n = 784)
		%	
Food-frequency questionnaire (11)			
Energy intake (kJ/d)	5426 ± 1900	7218 ± 2706[2]	5778 ± 2200
Energy from fat (%)	24 ± 9	23 ± 8	24 ± 9
Energy from protein (%)	19 ± 4	18 ± 4	19 ± 4
Energy from carbohydrate (%)	55 ± 10	56 ± 10	56 ± 10
Meal patterns			
Eating episodes/d	4.95 ± 3.21	4.54 ± 1.57	4.87 ± 2.97
Fast-food meals/wk	0.72 ± 1.42	0.82 ± 1.82	0.74 ± 1.50
Restaurant meals/wk (excluding fast-food meals)	2.35 ± 2.39	2.92 ± 2.88	2.46 ± 2.50
Total restaurant meals/wk (fast-food and other)	3.07 ± 2.70	3.73 ± 3.26	3.20 ± 2.83
Exercise energy (12)			
Total energy (kJ/wk)	11 168 ± 10 638	14 601 ± 14 920[2]	11 830 ± 11 682
Energy expended in			
Stairs climbed (kJ)	777 ± 824	844 ± 805	790 ± 820
Blocks walked (kJ)	4427 ± 6127	5194 ± 11 040	4572 ± 7350
Light activity (kJ)	979 ± 3099	710 ± 2879	926 ± 3057
Medium activity (kJ)	2096 ± 4070	2666 ± 5210	2206 ± 4318
Heavy activity (kJ)	2888 ± 5893	5185 ± 7751[2]	3336 ± 6363

[1] $\bar{x}$ ± SD.
[2] Significantly different from women, $P < 0.001$.

$P = 0.001$). Women obtained a marginally higher proportion of daily energy from fat than did men (25 ± 9% compared with 23 ± 8%; $P = 0.06$) but men and women both reported a dietary fat intake well below the recommended amount of 30% (14). In fact, 33% of the sample (31.5% of women and 39.4% of men) reported eating ≤ 20% of daily energy in the form of fat.

The strategy most frequently used to limit dietary intake during maintenance was to limit intake of certain foods (92%). At least one-third of the registry also endorsed use of the following strategies: limiting quantities of food eaten (49.2%), limiting the percentage of daily energy from fat (38.1%), counting calories (35.5%), and counting fat grams (30%). Women were significantly more likely than men to eat all foods but to limit quantity (n = 770; chi-square (1) = 9.28, P = 0.002), to count fat grams (n = 770; $\chi^2_1 = 5.17$, $P = 0.02$), and to follow an exchange (diabetic) diet (n = 769; $\chi^2_1 = 5.60$, P = 0.02).

Current meal patterns reported by registry members suggest a habit of eating regular meals, including occasional meals eaten at restaurants (Table 4). On average, subjects reported eating nearly five times per day and only a small proportion of the sample ate less than twice per day, a finding similar to that in epidemiologic studies of dietary and eating habits in the general US population (15, 16). Registry members ate < 1 meal/wk in fast-food restaurants and ≈2.5 meals/wk in non-fast-food restaurants. Thus, the majority of meals eaten by registry members were prepared or eaten at home.

The self-report data provided by registry members about levels of current physical activity suggest that members are very active (Table 4). On average, subjects reported expending 11 830 ± 11 682 kJ/wk through physical activity. This is roughly the equivalent of walking 45.1 km/wk (28 miles/wk). Men expended significantly more energy than women (14 601 ± 14 920 compared with 11 168 ± 10 638 kJ; $P <$ 0.002). This difference in expenditure appears to have been due primarily to the amount of energy expended through heavy-intensity activities. That is, men reported expending 5185 ± 7751 kJ/wk through heavy-intensity activities whereas women reported expending 2888 ± 5893 kJ/wk ($P < 0.001$).

For the purpose of reducing body weight, the American College of Sports Medicine (ACSM) (17) recommends a minimum weekly exercise goal of 1000 kcal (4184 kJ) expended through physical activity. Seventy-two percent of the registry sample (71% of women and 79% of men) met or exceeded this minimum recommendation. The ACSM also recommends expenditure of 2000 kcal/wk (8368 kJ/wk) as an optimal physical activity level. This goal was met or exceeded by 52% of the registry sample (50% of women and 62% of men).

Types of activities currently engaged in by registry members were explored by determining, within levels of medium- and heavy-intensity activities, the four activities most frequently reported by subjects. In the 282 subjects who reported engaging in at least one medium-intensity activity, stationary or road cycling was the activity most frequently reported (48.1%), followed by aerobics (25.6%), walking or running on a treadmill (11.5%), and hiking or backpacking (2.8%). In the 287 subjects who engaged in at least one heavy-intensity activity, weightlifting (35.6%) was the most frequently cited. Running or jogging (19%), Stair stepper use (15.5%), and step aerobics (12.5%) were also frequently endorsed heavy-intensity activities.

Finally, subjects were asked to indicate how often they weighed themselves. Thirty-eight percent of the sample reported weighing themselves daily and 6.5% weighed themselves more than once per day. Nearly one-third of the sample (31%) reported weighing themselves once per week and 24% weighed themselves less than once per week. Thus, 75% of registry members weighed themselves at least once per week. No sex differences were observed in frequency of self-weighing (n = 783; $\chi^2_4 = 1.23$, $P = 0.87$).

Previous weight-loss attempts

Nearly 91% of the sample reported that they tried to lose weight previously and significantly more women than men reported previous weight-loss attempts (93% compared with 79%, $n = 784$; $\chi^2_1 = 32.83$, $P = 0.0001$). The extensive weight-loss histories of these subjects were reflected in their total lifetime weight-loss scores: subjects who had tried to lose weight previously reported a mean lifetime loss of 564.68 ± 470.08 kg (269.57 ± 217.25 lb). This average value is substantially higher than that reported in other studies of weight-loss patients. For example, Kuehnel and Wadden (18) reported a mean lifetime weight loss of ≈187kg (85 lb) in their sample of obese nonbingers and Venditti et al (13) reported a mean lifetime loss of 402 kg (183 lb) in their sample of obese women. Weight-cycling scores for men and women in the NWCR were not significantly different.

When asked to compare their successful weight-loss experience with previous weight-loss attempts, registry members reported that they had greater social reasons, health reasons, or both, for losing weight this time than they had earlier. Eighty-two percent were more committed to making behavioral changes and 72.4% were more committed to losing weight. Additionally, subjects used more intensive approaches to weight loss on the successful attempt. Thus, 81.3% of registry members said they used exercise more and 63% said they used a stricter dietary approach than they had on previous attempts.

Difficulty of weight loss and weight maintenance

When asked to rate the difficulty of their successful weight loss on a 7-point scale (1 = extremely easy; 7 = extremely hard), 25.7% of registry members described their achievement of weight loss as easy, 31.4% described it as moderately hard, and 42.7% described it as hard. Using a similar scale, about one-third of the sample rated weight maintenance as easy (30.3%), 37.3% rated it as moderately easy, and the remaining 32.4% rated it as hard. Significantly more men than women reported that weight loss was easy (36.8 compared with 23.9%, $n = 782$; $\chi^2_2 = 10.88$, $P = 0.004$) but there were no significant differences in the proportions of men and women describing maintenance as easy, moderately easy, or hard ($n = 784$; $\chi^2_2 = 2.18$, $P = 0.34$).

Examination of subjects' perceptions of the relative difficulty of weight maintenance (rating of weight-loss difficulty minus rating of weight-maintenance difficulty) indicated that 42% of the sample felt that weight maintenance was less difficult than weight loss, a surprising result in light of the widespread perception that weight maintenance is more difficult than weight loss. A little over 33% of the sample rated the two processes as equally difficult or easy and only 25% of the sample found weight maintenance to be more difficult than weight loss. There were no sex differences in the proportions of subjects rating weight maintenance more, less, or as difficult as weight loss ($n = 782$; $\chi^2_2 = 0.211$, $P = 0.89$).

Effect of weight loss on other areas of life

The effect of successful weight loss on other areas of registry members' lives was assessed by asking subjects to use a 5-point Likert-like scale (1 = much worse since I lost weight; 5 = much better since I lost weight) to indicate the effect of weight loss and maintenance on interactions with others, general health and well-being, self-confidence, and time spent thinking about food and weight. As shown in **Table 5**, registry members reported that many life areas improved as a consequence of their weight loss. At least 85% of the sample reported improvements in their general quality of life, level of energy, physical mobility, general mood, self-confidence, and physical health. No more than 1.6% of the sample ($n = 13$) reported a worsening in any of these areas. At least 50% of the sample reported improvements in the following areas as a result of their weight loss: interactions with same- and opposite-sex friends and strangers, time spent interacting with others, job performance, and hobbies. No more than 1.3% ($n = 10$) of the sample reported worsening in any of these areas as a result of weight loss. No significant sex differences were observed for these effects.

Although subjects' reports of the effect of weight loss on other life areas were primarily positive, a minority of registry members reported problematic changes in certain areas. For example, 20% of the sample indicated a worsening in time spent thinking about weight and 14% reported a worsening in time spent thinking about food. Additionally, 6% of the sample reported that successful weight loss and maintenance had worsened their relationship with their spouse. Again, no sex differences were observed for these effects.

DISCUSSION

The NWCR is, to the best of our knowledge, the largest database ever assembled on individuals successful at long-term maintenance of weight loss. By any definition, participants in the registry are successful losers; on average, they reduced their body weight by 29% (dropping from a lifetime maximum BMI of 35 to a current BMI of 25) and maintained the minimum 13.6-kg weight loss for an average of 5.5 y. Thus, many participants successfully changed their body-weight status from obese to normal. This magnitude of weight loss is par-

TABLE 5
Effect of weight loss on other areas of life[1]

Area of life	Improved	No difference	Worsened
		%	
Quality of life	95.3	4.3	0.4
Level of energy	92.4	6.7	0.9
Mobility	92.3	7.1	0.6
General mood	91.4	6.9	1.6
Self-confidence	90.9	9.0	0.1
Physical health	85.8	12.9	1.3
Interactions with			
Opposite sex	65.2	32.9	0.9
Same sex	50.2	46.8	0.4
Strangers	69.5	30.4	0.1
Time spent interacting with others	59.1	39.6	1.3
Job performance	54.5	45.0	0.6
Hobbies	49.1	36.7	0.4
Interactions with parents	32.8	65.0	2.2
Interactions with spouse	56.3	37.3	5.9
Time spent thinking about			
Food	49.1	36.7	14.2
Weight	51.0	28.6	20.4

[1] $n = 784$.

ticularly impressive in light of an apparent predisposition to obesity: 70% of the sample had childhood-onset obesity and nearly 73% had at least one overweight parent.

Our data show that successful weight loss and maintenance were achievable through a variety of methods. Approximately one-half of the subjects lost weight without any formal assistance and an equal number used commercial or self-help programs. Although the most frequently endorsed method for restricting food intake was to limit intake of certain types of foods, many different strategies (Table 2) were used by various proportions of the registry. Likewise, members typically engaged in several different physical activities during the time of their weight loss (data not shown). Similar variety also occurred in participants' reports of methods used for weight maintenance. Registry members used many different strategies to control their dietary intake and sustained high levels of regular exercise through many different physical activities. This great diversity in strategies suggests that individuals may be more likely to lose and maintain weight if, rather than attempting to use one standard set of strategies they selectively choose their means of restricting dietary intake and increasing activity levels.

Despite the diversity of dietary strategies and physical activities used by registry members, some common factors were observed across our sample. Perhaps most important, nearly every member of the registry reported using a combination of diet plus exercise to both lose weight and maintain weight loss. This finding supports the growing literature on the relation between exercise and weight control (4) and provides further evidence that long-term maintenance of weight loss is facilitated by regular physical activity.

To control food intake, participants used a variety of strategies but few seemed to use any extreme strategies, eg, eating only one or two types of foods. Moreover, the strategies chosen appeared to produce energy intakes well below national averages. Similarly, registry members' engagement in a variety of physical activities resulted in an average weekly energy expenditure that met or exceeded recommended levels (17). This expenditure was achieved primarily through moderate- or heavy-intensity activities, which were engaged in by $> 50\%$ of the registry members.

Concerns can be raised about the accuracy of self-reported data on dietary intake and exercise. Subjects tend to underestimate how much they eat and overestimate their levels of activity (19) and the limitations of semiquantitative instruments such as food-frequency questionnaires are well documented (20). Future studies using the doubly labeled water method will more accurately quantify the energy intake and expenditure of registry participants.

However, NWCR members appeared to consume less fat and to exercise more than subjects in standard behavioral weight-control studies, which, presumably, are prone to levels of subject and measurement error similar to the levels of error that may be present in our data. For example, several studies showed that at the posttreatment phase of a standard behavioral weight-loss program (while participants are very successful at weight loss), patients reported consuming amounts of dietary fat as high as 30–34% of total daily energy intake (3, 21, 22). Similarly, posttreatment assessment of physical activity levels is likely to show relatively modest increases in energy expenditure, to levels of 5000–5800 kJ/wk (21–23). Our subjects' reports of obtaining 24% of daily energy from fat and expending 11 830 kJ/wk in physical activity, while likely containing some error, still suggest that these successful losers made substantial changes in their eating and exercise behaviors.

In addition to using dietary restrictions and regular exercise to lose weight, $\approx 75\%$ of subjects in the registry sample said that they weigh themselves more than once per week and 50% of registry members reported they still count calories, dietary fat grams, or both calories and fat grams to maintain their weight loss. Thus, self-monitoring appears to be an important ongoing strategy for many of these successful losers.

Interestingly, a large proportion of registry members reported that successful weight loss was preceded by occurrence of a triggering event or critical incident. Colvin and Olson (6) also noted a high incidence of such events in successful weight maintainers in their study. As in that study, male NWCR members were more likely than female registry participants to describe incidents that were medical in nature; unlike in that study, women in the NWCR were just as likely as men to report occurrence of any triggering event. The causal relation between triggering events and successful weight loss and maintenance remains unclear. Further research using prospective designs may be helpful in determining whether such events trigger initiation of weight loss and maintenance, strengthen the resolve of someone who has already initiated a weight-control attempt, or are simply correlates of such efforts.

Our study also sought to examine the effect of successful weight loss and maintenance on other areas of registry members' lives. Most subjects reported that weight loss greatly improved their quality of life, health and well-being, mood, mobility, and level of energy. Although the effects of weight loss were primarily positive, two negative changes were noted. Specifically, a minority of members reported a worsening in time spent thinking about food and weight. Such a change was noted previously in studies of the psychologic effects of extreme weight loss (24).

Our results also provide other basic information about successful weight loss. Whereas some investigators noted that a family history of overweight may make weight loss extremely difficult (25), a large proportion of our sample reported a childhood history, a family history, or both, of overweight. Likewise, although some obesity researchers have suggested that setting relatively modest diet, exercise, and weight-loss goals may improve long-term weight maintenance (1), our subjects achieved their weight loss and successful maintenance only after using dietary and exercise strategies that were more intensive than those used in previous weight-loss attempts.

Finally, the discouraging outcome rates of university-based interventions can lead to the conclusion that keeping off lost weight is the most difficult aspect of weight loss and maintenance. Much to our surprise, a large proportion of NWCR participants reported that weight maintenance was less difficult than losing weight. Further research is needed to determine the environmental and individual variables that made weight maintenance relatively easy for these individuals.

The NWCR is the largest study ever of individuals who were highly successful at long-term maintenance of weight loss. Although the large sample size and use of quantitative outcome measures are strengths of this study, several caveats are in order. First, the recruitment methods used (advertisements and mailings) are not likely to have resulted in random sampling of

the general population of successful maintainers of weight loss, and so it is not clear to what extent the findings of this study can be generalized to all individuals successful at weight loss and maintenance. For example, 97% of registry members are white and only 1.4% are African American. We have no way of ascertaining whether such a distribution of ethnic groups is representative of the population of successful weight-loss maintainers and suspect that the current distribution is due to sampling bias. Similarly, we believe that the relatively high level of education in this sample reflects the magazines and newspapers used to recruit subjects for the project, eg, *USA Today* and *Weight Watchers* magazine. Plans are currently being made to explore study hypotheses in a more representative sample.

Second, the design of this study was cross-sectional so we are limited with respect to conclusions that can be drawn about the causal relation between weight maintenance and the many variables discussed above. We plan to follow our successful maintainers of weight loss over time and to determine prospectively the variables that predict continued maintenance of weight loss and regaining of weight.

In summary, the NWCR provides evidence that weight loss achieved through use of diet and exercise can be maintained for long periods. Although the actual prevalence rate of successful weight loss and maintenance remains unclear, our data clearly showed that some individuals are highly successful at losing weight and keeping it off. Future studies will seek to determine the actual prevalence of successful weight loss in the general population and to examine environmental and individual variables that influence continued maintenance of weight.

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