Intentional Weight Loss and 13-Year Diabetes Incidence in Overweight Adults

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Observational studies have established that obesity is associated with a substantially increased risk of developing type 2 diabetes.[1] Whether intentional weight loss reduces the risk of obese persons' developing diabetes remains unclear, however. Two randomized controlled trials for the primary prevention of type 2 diabetes in adults have included lifestyle intervention arms emphasizing modest weight loss.[2,3]

Relatively few observational studies have examined the association of weight loss with diabetes risk,[4] and no published observational study has differentiated the effects of intentional weight loss from those of unintentional weight loss. This is important because unintentional weight loss may be associated with the clinical onset of diabetes.[5] This is the first observational study to use data on weight-loss intention in examining the prospective relationship between weight change and the incidence of diabetes in overweight adults.

METHODS

We analyzed data from the first Cancer Prevention Study, a 13-year prospective study of more than 1 million participants conducted by the American Cancer Society.[6] In brief, this study used volunteer researchers who administered a baseline questionnaire (October 1959 through March 1960), conducted annual tracing of subjects, administered supplemental questionnaires (1961, 1963, and 1965), and completed a final follow-up questionnaire (October 1972). Death certificates were used to determine the exact cause of death.[7] Additional details of the study have been published elsewhere.[6,8]

From the 453 872 men and 589 811 women older than 30 years with complete baseline questionnaires, we excluded persons with a report of a previous diagnosis of diabetes, those who did not fill out their own baseline questionnaire, and those who were not overweight before baseline (prebaseline body mass index [BMI]<25 kg/m^2).

For each sex, we conducted 2 proportional hazards analyses[9] to examine associations between weight change and the incidence of diabetes mellitus during the following 13 years. Weight change was assessed at baseline. First, respondents were asked whether their weight had changed. If they said yes, they were asked whether the change was a gain or loss, about how many pounds the change was, and whether they had tried to bring about this change. No questions about weight or weight change were asked in any of the follow-up questionnaires.

An incident case of diabetes mellitus was determined by a report of diabetes on any of the questionnaires completed after baseline or by a death certificate listing diabetes as an underlying or contributing cause of death. The first analysis estimated diabetes incidence by 5 categories of weight change (no change, unintentional gain, unintentional loss, intentional gain, and intentional loss); the second examined diabetes incidence by 5 categories of intentional weight loss (losses of 0.1–19.9, 20.0–39.9, 40.0–59.9, 60.0–79.9, and ≥80 lb [0.1–9.0, 9.1–18.1, 18.2–27.1, 27.2–36.2, and ≥36.3 kg]).[9,10] At minimum, we adjusted all analyses for age and prebaseline BMI. Fully adjusted analyses included a number of other baseline characteristics potentially related to diabetes or weight change (see Table 1). We excluded anyone who was missing data on the exposure or for any of the covariates. Detailed definitions of covariates can be obtained from the authors.

RESULTS

Overall, the diabetes incidence rate was 598 per 100 000 person-years of follow-up for overweight men and 665 per 100 000 person years of follow-up for women (Table 1). At baseline, 13 545 (13.3%) of 101 285 men and 23 200 (20.8%) of 111 285 women had lost weight intentionally (Table 1). Men who had lost weight intentionally were protected against development of diabetes, compared with men who had reported that their weight had not changed (incidence density ratio [IDR]=0.79, 95% confidence interval [CI]=0.73, 0.86). Women who lost weight intentionally also had a lower rate of diabetes than did the referent group (IDR=0.72, 95% CI=0.68, 0.77).

Compared with overweight persons who had not lost weight, those who intentionally lost weight decreased their rate of diabetes as the amount of weight lost increased (Table 2). A test for linear trend proved positive for both men (P=.0156) and women (P=.0001). On average, for every 20 lb lost, men decreased their rate of diabetes by 11%; women decreased it by 17%.

DISCUSSION

We found that during a 13-year period, overweight men and women who reported intentional weight loss at baseline had a reduction in the rate of developing diabetes of about 25% compared with their counterparts who did not report intentional weight loss. The rate of diabetes decreased linearly with increasing amount of weight lost.

Our findings are supported by experiments showing that glycemic levels in obese persons improve after weight loss.[11] In addition, several epidemiological studies have reported that general weight loss (intent unknown) was associated with decreased incidence of diabetes.[1,12] However, at least 2 previous studies disagree with our findings.[13,14]

That studies disagree may be related to differences in study design. For example, our study was limited in several ways that

TABLE 1—Incidence of Diabetes Mellitus by Weight-Change Group: First Cancer Prevention Study, 1959–1972

	No change	Unintentional gain	Unintentional loss	Intentional gain	Intentional loss
		Men (n = 101 285)			
No.	73 745	7 962	5 479	554	13 545
Incident cases	3 857	523	287	30	812
Person-years	679 205	73 036	44 591	4 931	120 050
IDR adjusted for age and prebaseline BMI (95% CI)	1.00 (referent)	1.35 (1.24, 1.48)	0.95 (0.84, 1.07)	1.03 (0.72, 1.48)	0.78 (0.72, 0.84)
Fully adjusted IDR[a] (95% CI)	1.00 (referent)	1.33 (1.21, 1.46)	0.94 (0.84, 1.07)	1.02 (0.71, 1.45)	0.79 (0.73, 0.86)
		Women (n = 111 285)			
No.	70 278	10 479	6 478	850	23 200
Incident cases	4 290	870	343	66	1 368
Person-years	661 558	98 492	55 555	7 854	220 376
IDR adjusted for age and prebaseline BMI (95% CI)	1.00 (referent)	1.56 (1.45, 1.68)	0.88 (0.79, 0.98)	1.41 (1.10, 1.79)	0.70 (0.65, 0.74)
Fully adjusted IDR[a] (95% CI)	1.00 (referent)	1.40 (1.30, 1.51)	0.83 (0.74, 0.93)	1.17 (0.92, 1.49)	0.72 (0.68, 0.77)

Note. BMI = body mass index; IDR = incidence density ratio; CI = confidence interval.
[a]Adjusted for age; prebaseline BMI; race; educational level; dietary intakes of fats and carbohydrates; alcohol use; smoking frequency; exercise levels; history of heart disease, stroke, hypertension, cancer, or cirrhosis; symptoms including pain in chest, shortness of breath, fatigue, loss of appetite, blood in stool, or blood in urine; and general health status. Quadratic terms were also included for age and BMI.

TABLE 2—Incidence of Diabetes Mellitus by Amount of Intentional Weight Loss: First Cancer Prevention Study, 1959–1972

	None	0.1–19.9 lb (0.1–9.0 kg)	20.0–39.9 lb (9.1–18.1 kg)	40.0–59.9 lb (18.2–27.1 kg)	60.0–79.9 lb (27.2–36.2 kg)	≥80.0 lb (≥36.3 kg)
			Men (n = 87 290)			
Cases	3 857	358	354	87	9	4
Person-years	679 204	61 852	47 937	8 296	1 484	483
Age- and BMI-adjusted IDR (95% CI)	1.00 (referent)	0.82 (0.73, 0.91)	0.76 (0.67, 0.85)	0.74 (0.59, 0.92)	0.32 (0.16, 0.62)	0.34 (0.13, 0.92)
Fully adjusted IDR[a] (95% CI)	1.00 (referent)	0.85 (0.76, 0.95)	0.77 (0.68, 0.86)	0.74 (0.59, 0.93)	0.31 (0.16, 0.60)	0.36 (0.13, 0.98)
			Women (n = 93 478)			
Cases	4 290	548	587	181	37	15
Person-years	661 558	105 148	88 857	19 504	4 795	2 072
Age- and BMI-adjusted IDR (95% CI)	1.00 (referent)	0.75 (0.69, 0.82)	0.69 (0.63, 0.76)	0.6 4(0.55, 0.74)	0.41 (0.30, 0.57)	0.32 (0.19, 0.53)
Fully adjusted IDR[a] (95% CI)	1.00 (referent)	0.76 (0.70, 0.84)	0.72 (0.65, 0.78)	0.66 (0.57, 0.77)	0.47 (0.34, 0.66)	0.36[b] (0.21, 0.60)

Note. BMI = body mass index; IDR = incidence density ratio; CI = confidence interval.
[a]Adjusted for age; prebaseline BMI; race; educational level; dietary intakes of fats and carbohydrates; alcohol use; smoking frequency; exercise levels; history of heart disease, stroke, hypertension, cancer, or cirrhosis; symptoms including pain in chest, shortness of breath, fatigue, loss of appetite, blood in stool, or blood in urine; and general health status. Quadratic terms were also included for age and BMI. Test for linear trend was significant for both men ($P = .0156$) and women ($P = .0001$). For every 20 lb lost, the rate of diabetes decreased by 11% for men and 17% for women.

may have influenced our findings. First, we used self-reported diabetes along with death certificates to uncover cases of diabetes. We suspect that fewer than half of respondents with diabetes knew they had it.[15] Therefore, diabetes would be underreported in our study. This would not be expected to bias our results, however, unless weight change or weight change intention influences awareness of true diabetes status. If those who lost weight intentionally were diagnosed with diabetes at higher rates than those whose weight had not changed, the resulting bias (away from the null value) would lead us to report a stronger negative association between intentional weight loss and diabetes than actually exists. The bias would be toward the null value if the converse were true.

Second, weight loss was measured at only one point in time around baseline, and it is unclear whether this weight loss was sustained. Although studies of weight loss in the clinical setting indicate that weight loss is very difficult to maintain, one population-based study[16] found that half of persons who lost weight intentionally maintained that weight loss for at least 1 year, and 25% maintained the loss for at least 5 years. Some researchers suggest that even short-term weight loss may have longer-term benefits through restoration of B-cell capacity.[17] Third, our results might be different if we could completely control for residual confounding.

In conclusion, we found that intentional weight loss was associated with a reduction in the rate of developing diabetes. Ongoing analyses of randomized clinical trials can help determine whether intentional weight loss itself decreases the incidence of diabetes in overweight persons. ■

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Contributors

J.C. Will helped plan the analysis of data, analyzed the data, and wrote a substantial portion of the article. D.F. Williamson helped plan the analysis of data, reviewed results, and assisted in the writing of the article. E.S. Ford contributed to the interpretation of results and the writing of the article. E.E. Calle and M.J. Thun provided the first Cancer Prevention Study cohort data, contributed to the study design, and assisted in the writing of the article.

Human Participant Protection

No IRB approval was required for this study.

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