Trying to Lose Weight, Losing Weight, and 9-Year Mortality in Overweight U.S. Adults With Diabetes

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OBJECTIVE — The aim of this study was to examine the relationships between intention to lose weight, actual weight loss, and all-cause mortality among overweight individuals with diabetes.

RESEARCH DESIGN AND METHODS — We performed a prospective analysis among 1,401 overweight diabetic adults aged ≥35 years sampled in the National Health Interview Survey. The previous year intention to lose weight and weight change were assessed by self-report. Nine-year mortality rates were examined according to intent to lose weight and weight loss, which were adjusted for age, sex, education, ethnicity, smoking, initial body weight, and diabetes complications.

RESULTS — Individuals trying to lose weight had a 23% lower mortality rate (hazard rate ratio [HRR] 0.77, 95% CI 0.61–0.99) than those who reported not trying to lose weight. This association was as strong for those who failed to lose weight (0.72, 0.55–0.96) as for those who succeeded in losing weight (0.83, 0.63–1.08). Trying to lose weight was beneficial for overweight (BMI 25–30 kg/m^2) individuals (0.62, 0.46–0.83) but not for obese (BMI >30) individuals (1.17, 0.72–1.92). Overall weight loss, without regard to intent, was associated with an increase of 22% (1.22, 0.99–1.50) in the mortality rate. This increase was largely explained by unintentional weight loss, which was associated with a 58% (1.58, 1.08–2.31) higher mortality rate.

CONCLUSIONS — Overweight diabetic adults trying to lose weight have a reduced risk of all-cause mortality, independent of whether they lose weight. Actual weight loss is associated with increased mortality only if the weight loss is unintentional.

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Weight loss is considered a key strategy to manage people with type 2 diabetes because even modest weight loss is associated with improved blood pressure, lipid concentrations, insulin sensitivity, and glycemic control (1,2). By reducing these risk factors, weight loss may reduce the high risk of vascular complications and death among individuals with diabetes (3). However, the physiological benefits of weight loss have been observed primarily in short-term studies, and little evidence exists showing that these benefits translate into increased longevity for people with type 2 diabetes. Even more troubling, studies that have examined the association of weight change with subsequent mortality, without assessing weight loss intention, generally find that losing weight is associated with increased rather than decreased mortality risk (4–11).

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Abbreviations: NHIS, National Health Interview Survey; RCT, randomized controlled trial.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

The primary limitation of the observational literature on weight change and mortality is the lack of information about weight loss intention (10,11). The weight-losing population includes an admixture of individuals losing weight on purpose and those who lose weight unintentionally. Unintentional weight loss is frequently associated with poor health. Thus, it is difficult to conclude from most studies of weight loss whether overweight adults with diabetes will lower their mortality risk by embarking on weight loss programs. In the only prospective study to assess intentional weight loss among individuals with diabetes, intentionally losing up to ~20 lb was associated with 25% lower all-cause and cardiovascular disease mortality (12). We recently found in the general population that intentional weight loss was associated with reduced mortality and that attempted weight loss was associated with reduced mortality independent of actual weight change (13). However, three other studies in the general population found equivocal associations between intentional weight loss and mortality (14–16).

In 1989, a special questionnaire module in the National Health Interview Survey (NHIS) examined weight loss practices and recent weight change among a nationally representative sample of individuals with diabetes (17). Vital status was followed through 1997 (18), providing an opportunity to examine the relationship between weight change and mortality rates while stratifying by weight loss intention.

RESEARCH DESIGN AND METHODS

— The NHIS is an ongoing nationwide survey of the health status, conditions, and behaviors of the U.S. noninstitutionalized population (17). The core NHIS uses multistage probability sampling to select ~45,000 households and 120,000 individuals annually. We used data from the 1989 supplement, in which 2,531 individuals age ≥18 years who reported physician-diagnosed diabe-

tes were asked about weight loss and other behaviors and services related to diabetes. The survey's response rate was 95%. Of the 2,531 respondents, we were able to link 2,459 to the National Death Index (18) through December 1997 (9 years). We used an algorithm provided by the National Center for Health Statistics to determine which matches should be classified as deaths.

We excluded 852 individuals whose BMI before weight loss was <25 kg/m^2, because weight loss is not typically indicated for such individuals. We also excluded 55 individuals aged <35 years because their mortality was extremely low. Of the remaining 1,552 individuals, we excluded 151 with missing data on weight loss or other covariates, leaving 1,401 for the analysis.

Measurements

Interviewers determined participants' age, race, sex, education, smoking status, self-rated health (5-point scale from excellent to poor), limitations in daily activity (unable, limited, not limited), and past year hospitalizations and doctor visits. Participants were also asked about insulin use, symptoms of peripheral neuropathy, history of physician diagnoses of heart disease, stroke, and diabetic retinopathy, and years since the diabetes diagnosis. Self-reported height and weight were used to compute their BMI before any weight change. To assess intentional weight loss, participants were asked, "Have you tried to lose weight in the past year?" (yes/no); "Is your weight now more, less, or about the same as a year ago?" (more/less/about the same); and "In the past year, about how much have you gained/lost?" (number of pounds).

Statistical analyses

To account for age differences across weight-change groups, we computed age-adjusted mortality rates using direct adjustment to the U.S. 2000 standard population ≥35 years. We used Cox proportional hazards regression to assess the relationship between weight loss intention, self-reported weight change, and all-cause mortality risk while adjusting for potentially confounding variables. We considered weight change as continuous and categorical (lost ≥20 lb, lost 1–19 lb, no change, gained 1–19 lb, gained ≥20 lb) variables. We also evaluated weight change with quadratic terms but did not find that it improved the fit of the models.

To compare mortality according to intentional weight loss, we categorized individuals into four groups with the first serving as the referent group: *1*) not trying to lose weight and had either stable weight or weight gain; *2*) not trying to lose weight but lost weight; *3*) trying to lose weight and had either stable weight or weight gain; and *4*) trying to lose weight and lost weight. We also evaluated mortality risk in which we merged the latter two groups into one, such that all individuals who were trying to lose weight were compared with the first group.

Multivariate models controlled for age, race, sex, education, smoking, "initial" BMI (BMI before weight change), measures of health status (self-rated health, functional limitations, heart disease, stroke, retinopathy, and neuropathy), measures of health care use (past year hospitalizations and doctor visits), insulin use, and years since diabetes diagnosis. We tested for interactions between weight loss and age (35–64 years; ≥65 years), sex, BMI (<30 or ≥30 kg/m^2), insulin use, diabetes duration, and any vascular disease (cardiovascular disease, stroke, retinopathy, or neuropathy symptoms). Analyses were weighted using SUDAAN (Research Triangle Institute, Research Triangle Park, NC) so that study estimates would statistically represent the U.S. noninstitutionalized adult overweight population with diabetes.

RESULTS — We estimate that 46% of overweight individuals with diabetes reported no weight change, 45% a weight loss, and 9% a weight gain (Table 1). Compared with individuals reporting no weight change, those with weight loss were younger, had higher BMI, were more likely to be women, were more likely to have been hospitalized in the past year, had been diagnosed with diabetes more recently, were less likely to use insulin (and more likely to take oral medications), and were more likely to report hypertension and neuropathy ($P < 0.05$). Individuals with weight gain reported worse health and were more likely to have functional limitations than those with no weight change, but these associations were not statistically significant. Race, education, smoking, number of doctor visits, and stroke were not associated with weight change.

Sixty-nine percent had tried to lose weight during the previous year (Table 1). Those trying to lose weight had a higher median weight loss (−5 lb) than those not trying to lose weight (0 lb). They were also more likely to be women, younger, had higher BMI, and were more likely to be on oral diabetic medications (and less likely to take insulin) than those not trying to lose weight. Additionally, they had been diagnosed with diabetes more recently and were more likely to have hypertension. There were no significant differences in race, education, smoking, self-rated health, functional limitations, or in the frequency of hospitalizations and doctor visits according to weight loss intent. Similarly, there were no differences in the prevalence of heart disease, stroke, retinal disease, or neuropathy symptoms.

Weight change and mortality

Compared with individuals having no weight change and controlled for age, sex, race, initial BMI, smoking, and education, those who lost any weight had a 22% (hazard rate ratio [HRR] 1.22, 95% CI 0.99–1.50) higher mortality rate and those losing at least 20 lb had a 40% higher mortality rate (1.40, 1.05–1.87) (Table 2). Findings were similar after additional control for baseline health status, health care use, diabetes-related complications, duration of disease, and insulin use. When we included weight change as a continuous variable in the Cox model, each 10-lb decrease was associated with an 8% (3–12%) increased mortality rate (data not shown).

Weight gainers did not have an appreciably higher mortality rate than those with stable weight (HRR 1.11, 95% CI 0.74–1.66) (Table 2). Mortality rates were nonsignificantly higher among those with >20-lb weight gain. Their mortality was 77% higher than those with stable weight (1.77, 0.97–3.23). The excess mortality in this group was attenuated in fully adjusted analyses (1.48, 0.82–2.68). Confidence intervals were broad for these comparisons because of the small number of deaths.

Weight loss intent and mortality

Compared with those who were not trying to lose weight and who had stable weight or weight gain, individuals with unintentional weight loss had a 58% higher mortality rate (HRR 1.58, 95% CI 1.08–2.31) (Table 3). Among all individ-

Table 1—*Demographic and health status characteristics of overweight and obese persons with diabetes*

		Actual weight change			Trying to lose weight	
	Total	None	Loss	Gain	No	Yes
n (%)	1,401	638 (45.6%)	629 (45.5%)	134 (8.9%)	427 (31.0%)	974 (69.0%)
Sex (% women)	57.6	52.5*	60.9	66.2	44.6	63.4†
Mean age (years)	61.2	62.1*	60.1	62.4	64.2	59.9†
Race (% nonwhite)	22.7	22.0	23.4	22.0	21.0	23.4
Current smoker (%)	19.7	17.7	22.5	16.1	23.2	18.2
Education (% <high school)	33.0	33.7	32.5	32.6	35.8	31.8
Mean baseline weight (lb)	196.3	190.9*	203.8	185.8	185.8	201.0†
Baseline BMI (kg/m^2)	31.6	30.5*	33.0	30.4	29.6	32.6†
Median weight change (lb)	0	0	−15	10	0	−5
Self-rated health (% fair or worse)	49.7	47.6	50.6	56.6	51.3	49.0
Any functional limitations (%)	56.3	54.6	56.6	63.4	58.1	55.5
Hospitalized past year (%)	23.8	19.7*	28.8	19.7	25.5	23.0
Doctor visits past year (mean)	9.8	8.3	10.9	10.1	9.6	9.6
Duration of disease (mean years)	10.5	11.5*	9.4	11.0	12.0	9.9†
Insulin use (%)	39.7	42.4*	36.1	44.3	44.0	37.8†
Oral medications (%)	54.0	51.2*	57.9	48.6	47.8	56.8†
Retinal disease (%)	24.5	21.8	27.1	25.2	21.5	25.8
Neuropathy symptoms (%)	39.0	33.7*	42.8	46.8	38.1	39.4
Hypertension (%)	65.6	61.8*	69.9	63.2	56.6	69.7†
Heart disease (%)	32.7	30.4*	36.0	27.2	32.5	32.7
Stroke (%)	8.8	8.7	9.0	8.4	9.9	8.3

All figures except *n* are weighted to be representative of the U.S. diabetic population in 1989. *Significant difference across weight change groups ($P < 0.05$); †significantly different from those trying to lose weight ($P < 0.05$).

uals not trying to lose weight, each 10 lb of weight loss was associated with a 22% increase in mortality rate (data not shown).

Individuals trying to lose weight had a 23% lower mortality rate (HRR 0.77, 95% CI 0.61–0.99) than those not trying to lose weight (with stable weights or weight gain) (Table 3). However, among those trying to lose weight, weight change itself was not associated with mortality. In other words, the lower mortality rate associated with trying to lose weight was as great for those who failed to lose weight (0.72, 0.55–0.96) as for those who succeeded in losing weight (0.83, 0.63–1.08).

When we excluded individuals who died during the first 2 years of follow-up ($n = 84$), we found similar associations between weight loss intent and mortality, although CIs for these analyses were broader due to the smaller number of deaths in the analysis. Of note, however, the association of unintentional weight loss and mortality was further attenuated (HRR 1.28, 95% CI 0.84–1.94). Similarly, when we excluded individuals with particularly large weight loss (>20% of body weight, $n = 68$), there was little change in mortality rates among those trying to lose weight, but the excess mortality rate associated with unintentional weight loss was attenuated (1.35, 0.91–2.00) relative to our primary analysis. Exclusion of individuals more likely to have type 1 diabetes, defined as being on insulin since diagnosis, did not alter our findings.

Table 2—*HRR for all-cause mortality associated with weight change and with degree of weight loss or gain among overweight and obese persons with diabetes*

	Weight change (median)	Prevalence (%)	Death rate (%/year)	Primary model* HRR (95% CI)	Fully adjusted† HRR (95% CI)
No weight change	0	45.6	3.0	1.0	1.0
Weight loss (lb)	−15	45.5	4.0	1.22 (0.99–1.50)	1.19 (0.96–1.47)
1–19	−10	26.4	3.6	1.11 (0.87–1.41)	1.09 (0.85–1.40)
≥20	−30	19.1	4.6	1.40 (1.05–1.87)	1.36 (1.03–1.80)
Weight gain (lb)	10	8.9	3.6	1.11 (0.74–1.66)	1.10 (0.72–1.67)
1–19	8	6.8	3.0	0.97 (0.62–1.53)	1.00 (0.61–1.63)
≥20	25	2.2	5.4	1.77 (0.97–3.23)	1.48 (0.82–2.68)

*Primary model adjusted for age, sex, race, smoking, education, and initial BMI; †fully adjusted model: initial BMI, age, race, sex, education, self-rated health, smoking, diabetes medications, duration of disease, functional limitations, hypertension, heart disease, stroke, retinal disease, neuropathy symptoms, hospital days, and doctor visits.

Table 3—*HRR for all-cause mortality associated with weight loss intent and weight change among overweight and obese persons with diabetes*

	Weight change (median)	Prevalence (%)	Death rate (%/year)	Primary model* HRR (95% CI)	Fully adjusted† HRR (95% CI)	Excluding first 2 years of mortality
Not trying to lose weight						
Stable weight/weight gain	0	23.0	3.6	1.0	1.0	1.0
Lost weight	−15	8.0	6.3	1.73 (1.20–2.48)	1.58 (1.08–2.31)	1.28 (0.84–1.94)
Trying to lose weight overall	−5	69.0	3.2	0.80 (0.63–1.01)	0.77 (0.61–0.99)	0.77 (0.58–1.01)
Stable weight/weight gain	0	31.5	2.8	0.74 (0.57–0.98)	0.72 (0.55–0.96)	0.77 (0.57–1.05)
Lost weight	−15	37.5	3.4	0.85 (0.66–1.11)	0.83 (0.63–1.08)	0.76 (0.56–1.04)

*Primary model adjusted for age, sex, race, smoking, education and initial BMI; †fully adjusted model: initial BMI, age, race, sex, education, self-rated health, smoking, diabetes medications, duration of disease, functional limitations, hypertension, heart disease, stroke, retinal disease, neuropathy symptoms, hospital days, and doctor visits.

We found no significant ($P > 0.05$) interactions of age, sex, obesity status, diabetes duration, insulin use, or vascular disease on the weight loss–mortality associations. However, we found that associations of weight loss and mortality tended to differ between overweight (BMI 25–29 kg/m^2) and obese (BMI ≥30 kg/m^2) individuals (data not shown). Specifically, compared with the referent group (not trying to lose weight with stable weight or weight gain), unintentional weight loss was associated with a higher relative mortality rate among obese (BMI ≥30 kg/m^2) individuals (HRR 3.29, 95% CI 1.55–6.98) than overweight (BMI 25–29 kg/m^2) individuals (1.20, 0.80–1.81). Trying to lose weight was associated with a lower mortality rate among overweight individuals (0.62, 0.46–0.83) but was not associated with mortality among obese individuals (1.17, 0.72–1.92). The association between trying to lose weight and lowered mortality among overweight individuals existed for those who succeeded (0.58, 0.43–0.84) as well as those who failed to lose weight (0.64, 0.42–0.97).

CONCLUSIONS — Using a national sample of overweight and obese adults with diabetes, we found a large difference in the mortality rate between individuals with unintentional weight loss (58% increase in mortality rate) and those with intentional weight loss (a nonsignificant 17% decrease). Our findings suggest that intentional weight loss is not harmful among individuals with diabetes, and the large body of research relating weight loss to increased mortality (4–11) may be spuriously influenced by unintentional weight loss.

An unexpected finding of our study was that intention to lose weight was associated with reduced mortality regardless of whether weight loss occurred. Individuals who reported trying to lose weight had a 23% lower mortality rate than those not trying to lose weight, and this benefit was as great for those who failed to lose weight as for those who succeeded. There are several possible explanations for this finding. First, trying to lose weight may be a marker of healthy behaviors, such as being more physically active or eating healthier foods, and these lifestyle behaviors may be more important determinants of health status than weight loss per se. Unfortunately, we had little information on the ways in which people lose weight in this population, but previous findings relating physical activity, lower fat intake, and higher fiber intake to better health support this idea (19–21).

A second possibility is that people who report "trying to lose weight" may be more likely to engage in positive health behaviors unrelated to weight (e.g., using seat belts, not smoking) or have more frequent contact with health care providers and preventive care practices, such as earlier screening and treatment for disease. Although our analyses controlled for smoking, health status, and health care use, as well as for exposure to diabetes education and nutritional counseling, there may be other fundamental differences between people who try to lose weight that we could not detect.

Our finding that losing weight per se was not associated with mortality reduction compared with those who failed to lose weight may be a reflection of poor long-term weight loss efficacy. In other words, weight loss attempts in an observational, population-based study such as this are likely to be heterogeneous and may not reflect what could be achieved with structured, clinical weight loss programs. Our study only assessed past year weight loss at one point in time, and thus, we were unable to compare people who succeeded in long-term weight maintenance with those who regained their weight the following year. Nevertheless, our finding demonstrates the need to consider weight loss intent and to continue to explore the possibility that lifestyle changes may be more important clinical and public health messages than weight loss itself.

We found a strong association between trying to lose weight and lower mortality rates among overweight (BMI 25–29.9 kg/m^2) individuals but surprisingly, no association with mortality among obese (BMI ≥30 kg/m^2) individuals. We suspect that because obese adults have greater levels of risk factors for cardiovascular or other early mortality than overweight individuals, typical weight loss attempts may not be powerful enough to influence mortality in this group. Alternatively, obese individuals may be more likely to receive other types of medical treatments that outweigh the effects of lifestyle-based weight loss attempts. We are unaware of data to support this, however, and recent findings from the Diabetes Prevention Program (22) found that the benefits of lifestyle-induced weight loss for diabetes prevention do not differ by baseline obesity status. Thus, our findings of differential effects by weight status should be examined in other studies.

Few studies have examined the relationship between intentional weight loss and mortality. In the first epidemiologic study of weight loss and mortality among diabetic individuals undergoing dietary counseling, Lean et al. (23) found that greater weight loss was associated with lower mortality. A subsequent study of

diabetic adults in the Cancer Prevention Study I associated moderate intentional weight loss with lower mortality (12). Similarly, we recently published findings from the general U.S. population (13) in which trying to lose weight was also associated with lower mortality independent of weight loss, and mortality rates were lowest among individuals with modest weight loss (19 lb). However, several other studies have found adverse or null associations of intentional weight loss (14–16). Previous studies, however, have not examined the independent association of weight loss intention, and it is possible that by categorizing such individuals along with individuals who did not try to lose weight, the benefit of weight loss was underestimated.

Our study has several limitations. Both body weight and weight loss were based on self-report, which is known to overestimate height, and underestimate weight (and BMI) compared with physical measurements. Previous studies, however, have found self-reports of weight change and intentional weight loss to be reliable and accurate (24,25). Additionally, we know of no data indicating that misclassification of body weight is associated with weight loss intent. If recall error were not associated with either weight loss intent or mortality, this would either have no effect or bias results toward the null, possibly leading to an underestimate of the benefits of intentional weight loss on mortality.

Observational studies have inherent limitations. We controlled for health status and health care use at baseline and attempted to account for underlying disease by excluding individuals who died in the initial years of follow-up or who had significant weight losses. However, we still cannot rule out selection bias or residual confounding due to improper or inadequate assessment of underlying health status. If present, this could lead to underestimates of both the benefit of intentional weight loss and the mortality risk associated with unintentional weight loss. Given that cardiovascular disease is the most common cause of death among individuals with diabetes, it is unfortunate that there have been no adequately controlled randomized controlled trials (RCTs) to examine the effects of weight loss on cardiovascular disease outcomes and mortality. We are reminded by the recent controversy related to the long-term effects of hormone replacement therapy (26,27) that RCTs are important to confirm the value of broadly used public health interventions.

In summary, we found that unintentional weight loss was associated with increased mortality among overweight diabetic U.S. adults and that trying to lose weight is associated with decreased mortality independent of actual weight change. Our study challenges previous concerns that intentional weight loss causes increased mortality but still leaves the relative importance of weight loss per se unclear. Instead, trying to lose weight may be beneficial even if such attempts are not successful. Our study highlights the importance of independently assessing weight loss intent in observational studies of weight loss. Further examination of this question may help determine whether changes in lifestyle behaviors are more important determinants of health status than weight loss itself. A clear answer to this question would have important implications for clinical as well as public health messages.

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