Weight-Loss Practices and Weight-Related Issues among Youth with Type 1 or Type 2 Diabetes

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Objective. To describe the weight-loss practices and weight-related issues reported by youth with diabetes, according to gender and diabetes type.

Research Design and Methods. 1,742 female and 1,615 male youth 10-21 years with type 1 or type 2 diabetes completed a SEARCH study visit where height, weight and GHb were measured. A survey assessed weight-related issues and weight-loss practices.

Results. Although more common in youth with type 2 diabetes, youth with type 1 diabetes also reported weight-related concerns and had elevated BMI. Among youth who had ever tried to lose weight (n=1,646), healthy weight-loss practices; diet (76.5%) and exercise (94.8%); were the most common, while unhealthy practices; fasting (8.6%), using diet aids (7.5%), vomiting or laxative use (2.3%), and skipping insulin doses (4.2%); were less common. In gender-specific multivariable models including age, race/ethnicity, diabetes type, BMI category, and glycemic control, obese females and overweight/obese males were more likely to report ever practicing any unhealthy weight-loss practice than normal weight youth. These practices were associated with poor glycemic control for females but not males. All unhealthy weight-loss practices except fasting were more common in females than males. Dieting, fasting, and using diet aids were all more common in youth with type 2 diabetes than those with type 1 diabetes.

Conclusions. Given the prevalence of overweight and obesity among youth with type 1 or type 2 diabetes, health care professionals caring for youth with diabetes need to pay particular attention to identifying youth, particularly females, with unhealthy weight-loss practices.
Diabetes mellitus is one of the three most prevalent chronic diseases of youth (1), with the majority of affected youth having type 1 diabetes (2). However, type 2 diabetes is being diagnosed more frequently in youth than has been reported in previous decades (2-4). While youth with type 2 diabetes are likely to be overweight or obese, the increase in overweight in the U.S. population is mirrored among youth with type 1 diabetes (5,6). Strategies used to lose or manage weight include those that are healthy, such as regular physical activity and following a healthy diet, as well as those that are unhealthy, such as using over-the-counter diet aids without physician’s advice, fasting, taking laxatives or diuretics, and vomiting. In 2005, 12.3% of ninth to twelfth graders went without eating for at least twenty-four hours, 6.3% used diet pills, powders or liquids, and 4.5% vomited or took laxatives to maintain or lose weight (7). Females were significantly more likely than males to use these unhealthy strategies; some racial/ethnic differences were observed.

Certain features of diabetes and its management, including weight gain following the initiation of insulin treatment, dietary restraint, and the knowledge that withholding insulin can cause weight loss, may trigger eating disturbances in youth with type 1 diabetes (8). Eating disorders have been associated with poor metabolic control and microvascular complications in type 1 diabetic youth (9-12). There is limited information about weight-related concerns among youth with type 2 diabetes. The American Diabetes Association (ADA) recommends that youth with type 2 diabetes implement lifestyle modifications to reduce their intake of high fat, high-energy foods and to increase physical activity to optimize glycemic control as well as their cardiovascular risk profile including their lipids and blood pressure (13). At the same time, medical nutrition therapy must take in to account the nutritional needs required to support normal growth and development during childhood and adolescence (13, 14).

In this paper, we describe the approaches to healthy and unhealthy weight-loss practices reported by youth with type 1 or type 2 diabetes by gender. In addition, we explore the associations between any unhealthy weight-loss practice, body weight perception, weight management goal, and worry about weight and glycemic control among youth with type 1 or type 2 diabetes by gender.

**RESEARCH DESIGN AND METHODS**

**Study Overview & Procedures**—SEARCH for Diabetes in Youth (SEARCH) is a multicenter study that began conducting population-based ascertainment of youth with clinically-diagnosed diabetes who were less than 20 years of age in 2001 and is continuing to enroll youth with newly diagnosed (incident) diabetes (15). SEARCH recruited youth from four geographically defined populations, Indian Health Service beneficiaries from four American Indian populations, and enrollees in several managed health care plans. Institutional review board(s) for each site approved the study protocol. At the time of the SEARCH study visit, informed consent was obtained, physical measurements and fasting blood samples were obtained from metabolically stable participants (no episodes of diabetic ketoacidosis during the previous month) after a minimum 8 hour overnight fast and questionnaires were administered. Non-fasting blood samples were obtained from participants that had not fasted or had not withheld their medications but agreed to give a blood sample.

**Body Mass Index Measures**—BMI (kilograms/meters$^2$) was calculated using height/weight measurements taken at the study visit. Percentiles for BMI z-scores...
specific to gender and age were assessed using algorithms prepared by the US Centers for Disease Control and Prevention (CDC) based on the 2000 CDC growth charts (16, 17). Youth with a BMI z-score ≥ 95 percentile were considered obese, 85-94.9 percentiles overweight, > 5th percentile to < 85th percentile healthy weight, and <5th percentile were considered underweight (18).

Weight-Related Issues—Youth ages 10 years and older described their current weight as very underweight, slightly underweight, about the right weight, slightly overweight, and very overweight (perception of weight); what they were trying to do about their weight as nothing, lose weight, gain weight, or trying to stay the same (weight management goal); whether they worried a lot about their weight (yes/no), and whether they had ever tried to lose weight (yes/no) using questions similar to the Youth Risk Behavior Surveillance System (YRBSS) (7, 19).

Weight-Loss Practices—Youth who reported ever trying to lose weight were asked if they had tried to do so by each of the following methods: (a) eating less food, fewer calories, or foods lower in fat (dieting); (b) exercising; (c) going without eating for more than 24 hours (fasting); (d) using diet pills, powders, or liquids without a doctor’s advice (diet aids); (e) vomiting or taking laxatives; or (f) skipping insulin doses. Response (f) was added to be specific to diabetes. Using terminology consistent with YRBSS publications, diet and exercise were considered “healthy”; fasting, using diet aids without a doctor’s advice, vomiting or taking laxatives, and skipping insulin doses were considered “unhealthy” (7,19). We created two dichotomous unhealthy composite measures; one that included fasting, diet aids, and vomiting or laxative use and a second with these three practices plus skipping insulin doses.

Other Variables—GHb was measured at the study visit and used to categorized glycemic control using the American Diabetes Association guidelines as good (GHb<8.0%), marginal (8.0-9.4%) and poor (≥ 9.5%) (20). Race/ethnicity was obtained through self-report using the standard census questions (21). Youth who reported Hispanic ethnicity were categorized as Hispanic; non-Hispanic youth were categorized by their race; and youth who reported multiple races or did not report race/ethnicity were categorized as other/unknown race/ethnicity. Highest parental education was based on the parent with the highest education as reported on a questionnaire. Type of diabetes was based on the clinical diagnosis by the physician. Youth with a clinical diagnosis of type 1 diabetes were much more likely to have a positive diabetes autoantibody and had much lower fasting c-peptide concentrations, than youth with a clinical diagnosis of type 2 diabetes (3).

Statistical Analysis—These analyses were restricted to youth with type 1 or type 2 diabetes that were at least 10 years of age at the time of their study visit. Of the 3,708 youth ≥ 10 years who completed a study visit whose diabetes was prevalent (2001) or incident (2002-2005), exclusions were made sequentially for having diabetes type other than type 1 or 2 or having type missing (n=39, 0.7%), height or weight missing (n=222, 4.2%), and for not answering the weight-related or weight-loss questions (n=90, 1.7%) for a final analytic sample of 3,357 youth.

Analyses, performed with SAS version 9.1 (SAS Institute, Cary, NC), were stratified by gender. We describe the demographic and clinical characteristics, and weight-related issues of all youth in the sample as well as the weight-loss practices of youth who had ever tried to lose weight by diabetes type within gender categories and then compare youth by gender, combining youth with type 1 and type 2 diabetes. Using multiple logistic regression, we calculated
adjusted odds ratios (OR) and 95% confidence intervals (CI) to explore the associations between diabetes type, gender, and weight-loss practices. Then, associations between demographic characteristics, diabetes type, BMI percentile categories, and glycemic control categories and outcomes of any unhealthy weight-loss practices and the three weight-related outcomes were examined among youth with measured GHb.

RESULTS

Study Population and Characteristics—The study population was comprised of 1,742 female and 1,615 male youth with a mean age of 15.0 years and a mean duration of diabetes of just over four years (Table 1). The majority (84.5%) of the participants had type 1 diabetes. About 43% of the participants were overweight or obese, 39% perceived they were slightly or very overweight, about one-quarter worried about their weight, and almost 40% were trying to lose weight. All of these characteristics varied by gender (p <0.0001). As expected, youth with type 2 were more likely than youth with type 1 diabetes to be overweight or obese. However, 37.0% of females and 32.0% of males with type 1 diabetes were overweight or obese. Of the youth with type 2 diabetes, 38% (n=125) of female and 34% (n=65) of males reported being on insulin.

Weight-Loss Practices—Just less than half of the youth surveyed reported ever trying to lose weight. Youth with type 2 diabetes were more likely than youth with type 1 diabetes to have ever tried to lose weight (90.5% vs. 52.4% for females; 79.3% vs. 32.1% for males) (Table 1). Of these 1,646 youth who reported ever trying to lose weight, healthy practices, including diet (76.5%) and exercise (94.8%), were very common. Females were more likely to report dieting (81% vs. 66%, p < 0.001) whereas males were more likely to report exercising (97% vs. 94%, p < 0.01) (Table 2). The prevalence of fasting was 8.6%, diet aid use was 7.5%, vomiting or laxative use was 2.3%, and skipping insulin doses (among insulin users) was 4.2%. Females were more likely than males to report any unhealthy weight-loss practices, including (p <0.01) and excluding (p <0.001) skipping insulin doses.

Dieting, fasting, and using diet aids were more common among type 2 diabetic youth than type 1 diabetic youth for both genders, while exercise, vomiting or laxative use and skipping insulin doses was equally prevalent for youth with either type (Table 1). Type 2 diabetic youth were more likely to report unhealthy weight-loss practices than type 1 diabetic youth for both genders. After adjustment for age, highest parental education, and race/ethnicity, type 2 diabetic females were more likely to diet and fast to lose weight than type 1 diabetic females (Table 2). While using diet aids, vomiting or laxative use, and skipping insulin were all more common among females with type 2 than type 1 diabetes, the smaller number of females with type 2 diabetes and the low prevalence of these practices limited our power to detect a difference by type. Only dieting was more common among males with type 2 versus type 1 diabetes. In the model with both genders combined, dieting, fasting, and using diet aids were all more common in youth with type 2 than with type 1 diabetes.

Correlates of Any Unhealthy Weight-Loss Practice and Weight-Related Issues—Separate multiple logistic regression analyses for females and males were used to identify the associations between the four outcomes (any unhealthy weight-loss practice, self-perception of overweight, trying to lose weight, worry about weight) and covariates (age category, BMI category, diabetes type, glycemic control, race/ethnicity) (Table 3). For both females and males, being obese or overweight (compared to healthy weight) was associated with all outcomes with two exceptions; being overweight was not
associated with any unhealthy weight-loss practice for females nor with worrying about weight for males.

Among females, all four outcomes were associated with increasing age and having type 2 compared to type 1 diabetes. Poor glycemic control (GHB > 9.5%) was associated with reporting any unhealthy weight-loss practice (OR=1.82; 95% CI 1.23, 2.70) and self-perception of overweight (OR=1.47; 95% CI 1.06, 2.04) but not with trying to lose weight or worry about weight. Race/ethnicity was only associated with perception of being overweight or obese (p=0.03). Among males, age was only associated with reporting any unhealthy weight-loss practice, with youth ≥ 19 years having a higher odds of ever reporting any practice compared to 10 to 12 year olds (OR=2.45; 95% CI 1.04, 5.77). Having type 2 diabetes was associated with all outcomes. There was no association between any outcome and glycemic control. Race/ethnicity was only associated with worrying about weight (p=0.01).

**DISCUSSION**

To our knowledge, this is the first report of weight-related issues and weight-loss practices comparing youth with type 1 and type 2 diabetes by gender. While desiring to lose weight, worrying about weight, and having ever tried to lose weight were very common and not unexpected findings among type 2 diabetic youth, these characteristics were not uncommon among type 1 diabetic youth either, particularly among females, of which 11% were obese. We found that reporting any unhealthy weight-loss practice was more common among type 1 than type 2 diabetic youth. Obese females and overweight/obese males were more likely to report any of these unhealthy practices than healthy weight youth. Among females but not males, there was an association between poor glycemic control and reporting any unhealthy weight-loss practice.

We compared the weight-loss practices of the 2,837 type 1 diabetic youth in SEARCH to results from diabetes clinic cohorts from Minnesota (n=143), eastern Canada (n=361), and Philadelphia (n=295) (9, 10, 22). Exercise for weight-loss was more common in SEARCH participants (females, 93.4%; males 96.9%) than among youth in Minnesota (89.9% and 47.9%, respectively) or Philadelphia (77.8% and 62.5%, respectively) for weight loss or maintenance (10, 22). In the Canadian study, only 12% of females reported dieting for weight loss compared with 79% in SEARCH. Of the unhealthy practices, for females and males, 7.4% and 1.4% from the Minnesota study and 6.7% and 2.6% in Philadelphia, respectively, reported fasting, as compared to 6.2% of females and 5.3% of males in SEARCH. Skipping insulin was more prevalent in the Minnesota (10.3%) than in the SEARCH (2.6%) or Philadelphia (1.5%) females but not for males (1.4%, 1.3%, and 1.3%, respectively). Skipping insulin was also more common in the female Canadian cohort, 11%, although they also included under-dosing in their measure (23). Disordered eating in the Minnesota study was also associated with poor glycemic control in both genders (10). In the Philadelphia cohort, older females with higher BMI and GHB used significantly more weight-control behaviors (22). In SEARCH, we found that glycemic control was associated with any unhealthy weight-loss practice females but not males. The composite measure that we used for any unhealthy weight-loss practice in the current paper differs from other studies. We found no published studies of weight-loss practices among type 2 diabetic youth to which we could compare our results.

The prevalence of healthy and unhealthy weight-loss practices reported by the SEARCH cohort could not be directly compared to YRBSS due to the subgroups
asked these questions (SEARCH – those who had ever tried to lose weight; YRBSS – for weight-loss or maintenance) and different time frames specified for these questions (SEARCH - ever; YRBSS – past 30 days). In general, healthy practices, diet and exercise, were more common among SEARCH participants for weight-loss than among YRBSS respondents for weight loss or maintenance (7). SEARCH males had a similar prevalence of unhealthy practices as those in YRBSS, whereas SEARCH females were more likely to fast and use vomiting or laxatives for weight-loss than females in YRBSS for weight loss or maintenance.

Of the youth ≥ 10 years in the SEARCH study cohort who completed a study visit, about 21% were overweight and 22% were obese. Data from the National Health and Nutrition Examination Survey (NHANES) for 2003-2006 demonstrated that 16.5% of U.S youth ages 12-19 years were overweight (BMI ≥ 85th - <95th percentile) and 17.6% were obese (BMI ≥ 95th percentile) while 15.0% and 17.0% of youth 6-11 years were overweight and obese, respectively (24). The higher prevalence of overweight and obesity among youth in SEARCH compared to the general U.S. population is to be expected given that 15% of youth in the SEARCH study have type 2 diabetes, a condition that is strongly associated with obesity.

Strengths and Limitations—Our study includes over 3,000 racially/ethnically diverse youth with diabetes, including over 500 youth with type 2 diabetes, likely the largest cohort of its kind in the United States. Our data allowed us to compare the weight-related issues and weight-loss practices of youth with type 1 to type 2 diabetes and by gender using the same methodology and survey questions. This study has several limitations. Since weight-loss practices may have occurred recently or in the distant past, we were not able to report associations between clinical indicators and individual weight-loss practice. Instead, we used a composite measure of “any unhealthy weight-loss practice” as a marker for a history of such unhealthy behavior. Additionally, we could not assume that the respondents’ current BMI category was reflective of their BMI at the time of these practices; nor whether these practices occurred before or after their diabetes diagnosis. While we characterized eating less food, fewer calories, or foods lower in fat as a healthy weight-loss practice, some youth may have over-restricted their food/calorie intake. Finally, despite extensive efforts to optimize recruitment, about 47% of eligible youth completed the SEARCH study visit (25).

Conclusions and Clinical Implications—In this cohort of youth with type 1 and type 2 diabetes, overweight and obesity were common and 60% of females and 38% of males reported ever trying to lose weight. Healthy weight-loss practices such as dieting and physical activity were quite common among these youth with type 1 and type 2 diabetes. Youth with type 2 diabetes were more likely than those with type 1 to report using any unhealthy weight-loss practice; females exhibited a higher prevalence of unhealthy practices than did males. Additionally, poor glycemic control was associated with reporting any unhealthy weight-loss practice and perceiving that they were overweight among females.

Given the high prevalence of overweight and obesity among type 2 diabetic youth, the increasing prevalence of these conditions in type 1 diabetic youth (5,6), and the pressures on some overweight and obese youth to lose weight, it is likely that their approaches to weight management will not always be healthy ones. Such practices may have a negative affect on their diabetes management, including their glycemic control, a risk factor for future complications. Physicians and other health care professionals
caring for diabetic youth, particularly females, need to identify those with unhealthy weight-loss practices and provide them with more healthy weight management strategies in the context of their ongoing diabetes management.

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Table 1. Demographic, clinical characteristics and weight related issues and practices of 3,357 youth 10 years of age and older and weight-loss practices reported by 1,646 youth who had ever tried to lose weight, by diabetes type and gender: SEARCH 2001-2005 cohorts.

|                               | Females |                              | Males |                              | P value for Gender† |
|-------------------------------|---------|-------------------------------|-------|-------------------------------|---------------------|
|                               | All     | Type 1                        | Type 2| All                           | Type 1             | Type 2 | P value for Type* |
| N = 1,742                     | N = 1,415| N = 327                       | N = 1,615| N = 1,422                    | N=193              |
| Mean age at study visit, years (± SD) | 15.0 (3.1) | 14.7 (3.1) | 16.1 (2.8) | <0.001                        | 15.0 (3.0) | 14.8 (3.0) | 16.5 (2.8) | <0.001 | 0.796 |
| Race/ethnicity                | <0.001  |                                | <0.001|                                | <0.001             |        |                |
| NH White                      | 1,086 (62.3) | 1031 (72.9) | 55 (16.8)   | 1,131 (70.0)                  | 1,085 (76.3) | 46 (23.8) |
| Hispanic                      | 238 (13.7) | 169 (11.9) | 69 (21.1)   | 216 (13.4)                    | 171 (12.0) | 45 (23.3) |
| Black                         | 241 (13.8) | 119 (8.4) | 122 (37.3)  | 140 (8.7)                     | 89 (6.3)   | 51 (26.4) |
| Asian / PI                    | 58 (3.3)  | 32 (2.3) | 26 (8.0)    | 34 (2.1)                      | 20 (1.4)   | 14 (7.3)  |
| Native American               | 58 (3.3)  | 11 (0.8) | 47 (14.4)   | 40 (2.5)                      | 10 (0.7)   | 30 (15.5) |
| Other/ Unknown                | 61 (3.5)  | 53 (3.8) | 8 (2.5)     | 54 (3.3)                      | 47 (3.3)   | 7 (3.6)   |
| Mean diabetes duration, years (± SD)* | 4.3 (4.1) | 4.8 (4.3) | 2.2 (1.9)   | <0.001                        | 4.0 (4.0) | 4.3 (4.1) | 1.8 (1.7) | <0.001 | 0.039 |
| Duration of Diabetes at study visit | <0.001  |                                | <0.001|                                | 0.181           |
| < 1 year                      | 412 (23.7) | 318 (22.5) | 95 (29.1)   | 415 (25.7)                    | 332 (23.4) | 83 (43.0) |
| 1 year - < 3 years            | 481 (27.6) | 334 (23.6) | 147 (45.0)  | 468 (29.0)                    | 396 (27.9) | 72 (37.3) |
| 3 year - < 6 years            | 344 (19.8) | 278 (19.7) | 66 (20.2)   | 315 (19.5)                    | 283 (19.9) | 32 (16.6) |
| ≥ 6 years                     | 505 (29.0) | 485 (34.3) | 19 (5.8)    | 417 (25.8)                    | 411 (28.9) | 6 (3.1)   |
| Highest parental education,   | <0.001  |                                | <0.001|                                | 0.371           |
| < High school graduate        | 117 (6.8)  | 59 (4.2) | 58 (18.0)   | 91 (5.7)                      | 62 (4.4)   | 29 (15.3) |
| High school graduate GED      | 323 (18.7) | 221 (15.7) | 102 (31.6)  | 291 (18.2)                    | 232 (16.5) | 59 (31.2) |
| Some college                  | 590 (34.1) | 487 (34.6) | 103 (31.9)  | 527 (33.0)                    | 457 (32.5) | 70 (37.0) |
| ≥ bachelor degree             | 701 (40.5) | 641 (45.5) | 60 (18.6)   | 687 (43.1)                    | 656 (46.6) | 31 (16.4) |
| BMI Percentile Category       | <0.001  |                                | <0.001|                                | <0.0001         |
| Obese                         | 413 (23.7) | 159 (11.2) | 254 (77.7)  | 333 (20.6)                    | 186 (13.1) | 147 (76.2) |
| Overweight                    | 404 (23.2) | 364 (25.7) | 40 (12.2)   | 293 (18.1)                    | 269 (18.9) | 24 (12.4) |
| Healthy                       | 905 (52.0) | 836 (59.1) | 31 (9.5)    | 972 (60.2)                    | 911 (64.1) | 21 (10.9) |
| Underweight                   | 20 (1.2)  | 56 (4.0) | 2 (0.6)     | 17 (1.1)                      | 56 (3.9)   | 1 (0.5)   |
| Self-perception of body weight| <0.001  |                                | <0.001|                                | <0.0001         |
| Very overweight               | 184 (10.6) | 59 (4.2) | 125 (38.2)  | 93 (5.8)                      | 33 (2.3)   | 60 (31.1) |
| Slightly overweight           | 640 (36.7) | 494 (34.9) | 146 (44.7)  | 391 (24.2)                    | 299 (21.0) | 92 (47.7) |
# Weight-Loss Practices and Weight-Related Issues

| About right | 815 (46.8) | 767 (54.2) | 48 (14.7) | 892 (55.2) | 858 (60.3) | 34 (17.6) |
|-------------|------------|------------|-----------|------------|------------|-----------|
| Slightly or very underweight | 103 (5.9) | 95 (6.7) | 8 (2.5) | 239 (14.8) | 232 (16.3) | 7 (3.6) |
| Worry about Weight | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Yes | 641 (36.8) | 432 (30.5) | 209 (64.1) | 249 (15.4) | 171 (12.0) | 78 (40.4) |
| No | 1,100 (63.2) | 983 (69.5) | 117 (35.9) | 1,366 (84.6) | 1,251 (88.0) | 115 (59.6) |
| Weight Management Goals | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Lose weight | 839 (48.2) | 570 (40.3) | 269 (82.3) | 457 (28.3) | 349 (22.4) | 138 (71.5) |
| Stay the same | 490 (28.1) | 461 (32.6) | 29 (8.9) | 447 (27.7) | 416 (29.3) | 31 (16.1) |
| Gain weight | 55 (3.2) | 50 (3.5) | 5 (1.5) | 242 (15.0) | 233 (16.4) | 9 (4.7) |
| Do nothing | 358 (20.5) | 334 (23.6) | 24 (7.3) | 469 (29.0) | 454 (31.9) | 15 (7.8) |
| Ever tried lose weight | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Yes | 1,037 (59.6) | 742 (52.4) | 295 (90.5) | 609 (37.7) | 456 (32.1) | 153 (79.3) |
| No | 704 (40.4) | 673 (47.6) | 31 (9.5) | 1,005 (62.3) | 965 (67.9) | 40 (20.7) |
| Weight-loss practices‡ | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Diet | 841 (81.1) | 586 (79.0) | 255 (86.4) | 403 (66.3) | 282 (62.0) | 121 (79.1) |
| Exercise | 971 (93.6) | 693 (93.4) | 278 (94.2) | 590 (96.9) | 442 (96.9) | 148 (96.7) |
| Fasting | 98 (9.5) | 46 (6.2) | 52 (17.6) | 44 (7.2) | 416 (29.3) | 31 (16.1) |
| Diet Pills | 98 (9.5) | 59 (8.0) | 39 (13.2) | 26 (4.3) | 13 (2.8) | 13 (8.5) |
| Vomiting/Lax | 31 (3.0) | 19 (2.6) | 12 (4.1) | 6 (1.0) | 3 (0.7) | 3 (2.0) |
| Skip Insulin § | 49 (5.9) | 39 (5.3) | 10 (3.3) | 7 (1.4) | 6 (1.3) | 1 (2.0) |
| Any fasting, diet pills, vomiting, or laxative use | 172 (16.6) | 96 (12.9) | 76 (25.8) | 67 (11.0) | 35 (7.7) | 32 (20.9) |
| Any of above or skip insulin | 193 (18.6) | 112 (15.0) | 81 (27.5) | 70 (11.5) | 38 (8.3) | 32 (20.9) |

Abbreviations: NH = non-Hispanic   PI = Pacific Islander  UW = underweight   GED=general equivalency degree (high school)

*P values derived from chi-square tests for categorical variables and t-tests for continuous variables, showing associations with diabetes type (type 1 vs. type 2 diabetes) stratified by gender.
† P values derived from chi-square tests for categorical variables and t-tests for continuous variables, showing associations with gender (type 1 and type 2 diabetes combined).
‡ Among youth who reported ever trying to lose weight
§ Among who reported ever trying to lose weight and were on insulin at the time of the study visit
Table 2. Associations between each healthy and unhealthy weight-loss practices and diabetes type, by gender, among 1,646 youth ≥ 10 years of age who had ever tried to lose weight [OR (95%CI)]*

|                      | Healthy Weight-Loss Practices | Unhealthy Weight-Loss Practices |
|----------------------|-------------------------------|--------------------------------|
|                      | Exercise          | Diet            | Fasting        | Diet Aids        | Vomit/Laxatives | Skip Insulin   |
| Females (n=1,037)†   |                  |                 |                |                  |                |                |
| Type 2 (Referent, type 1) | 1.41 (0.71-2.80) | 1.97 (1.26-3.07) | 2.43 (1.44-4.10) | 1.71 (0.98-2.96) | 2.34 (0.90-6.14) | 1.34 (0.56-3.17) |
| Males (n=609)†       |                  |                 |                |                  |                |                |
| Type 2 (Referent, type 1) | 1.42 (0.42-4.81) | 1.93 (1.17-3.19) | 1.80 (0.84-3.84) | ‡                | ‡               | ‡              |
| All Youth (n=1,646)§ |                  |                 |                |                  |                |                |
| Type 2 (Referent, type 1) | 1.40 (0.77-2.54) | 1.91 (1.37-2.67) | 2.22 (1.45-3.40) | 1.89 (1.18-3.02) | 2.06 (0.89-4.76) | 1.16 (0.52-2.59) |

* Logistic regression, modeling the probability of each weight-loss practice separately.
† Adjusted for respondents’ age category, highest parental education category, and race/ethnicity category. For these models, Asian/Pacific Islander youth, Native American youth, and youth of other race/ethnicity were combined into one group.
‡ Prevalence too low to generate models
§ Adjusted for co-variates in previous model (†) plus gender
Table 3. Prevalence and adjusted odds ratios for any unhealthy weight-loss practice, self-perception of overweight, trying to lose weight, and worry about weight by demographic characteristics, body mass index categories, glycemic control and diabetes type among 3,136 youth ≥ 10 years of age with type 1 or type 2 diabetes

| Outcomes for Logistic Regression Models by Gender | Any Unhealthy Weight-loss Practices* | Self Perception of Overweight† | Trying to Lose Weight‡ | Worry about Weight§ |
|-------------------------------------------------|-------------------------------------|------------------------------|------------------------|---------------------|
| FEMALES                                         |                                     |                              |                         |                     |
| BMI Percentile                                  |                                     |                              |                         |                     |
| Normal / UW                                     | 53.0                                | 6.4                          | 1.00                   | 20.0                |
| Overweight                                      | 23.0                                | 10.0                         | 1.32                   | 65.6                |
| Obese                                           | 24.0                                | 22.5                         | 1.71–4.37              | 89.4                |
| Age Category, Yrs.                              |                                     |                              |                         |                     |
| 10-12                                           | 31.6                                | 3.5                          | 1.00                   | 30.5                |
| 13-15                                           | 32.3                                | 8.8                          | 1.18–3.70              | 46.6                |
| 16-18                                           | 23.5                                | 19.2                         | 2.90–8.71              | 61.8                |
| ≥ 19                                            | 12.6                                | 20.7                         | 3.07–10.23             | 63.6                |
| Diabetes Type                                   |                                     |                              |                         |                     |
| Type 1                                          | 80.9                                | 7.9                          | 1.00                   | 38.8                |
| Type 2                                          | 19.1                                | 24.7                         | 1.11–2.99              | 83.1                |
| Glycemic Control†                                |                                     |                              |                         |                     |
| GHb < 8.0%                                      | 46.4                                | 9.5                          | 1.00                   | 46.9                |
| GHb 8.0-9.4%                                    | 29.9                                | 8.9                          | 0.76–1.78              | 41.6                |
| GHb > 9.5%                                      | 23.7                                | 17.0                         | 1.23–2.70              | 55.0                |
| MALES                                           |                                     |                              |                         |                     |
| BMI Percentile                                  |                                     |                              |                         |                     |
| Normal / UW                                     | 61.3                                | 1.7                          | 1.00                   | 7.7                 |
| Overweight                                      | 18.1                                | 5.5                          | 1.44–6.38              | 44.4                |
| Obese                                           | 20.6                                | 11.5                         | 2.22–9.56              | 82.1                |
| Age Category, Yrs.                              |                                     |                              |                         |                     |
| 10-12                                           | 29.4                                | 2.7                          | 1.00                   | 26.9                |
| 13-15                                           | 33.8                                | 3.7                          | 0.49–2.26              | 30.4                |
| 16-18                                           | 24.9                                | 5.0                          | 0.60–2.89              | 31.9                |
| ≥ 19                                            | 11.9                                | 9.4                          | 1.04–5.77              | 29.8                |
| Diabetes Type                                   |                                     |                              |                         |                     |
| Type 1                                          | 88.0                                | 2.7                          | 1.00                   | 23.1                |
| Type 2                                          | 12.0                                | 16.9                         | 1.09–4.75              | 77.6                |
| Glycemic Control†                                |                                     |                              |                         |                     |
| GHb < 8.0% | 50.6 | 4.4 | 1.00 | Referent | 33.0 | 1.00 | Referent | 30.7 | 1.00 | Referent | 14.7 | 1.00 | Referent |
| GHb 8.0-9.4% | 29.5 | 2.7 | 0.87 | 0.43–1.76 | 27.2 | 1.06 | 0.75–1.49 | 26.8 | 1.17 | 0.85–1.61 | 14.3 | 1.33 | 0.93–1.91 |
| GHb > 9.5% | 19.9 | 6.9 | 1.49 | 0.78–2.82 | 24.8 | 0.79 | 0.52–1.20 | 22.8 | 0.80 | 0.54–1.20 | 18.8 | 1.31 | 0.88–1.96 |

OR = odds ratio, CI = confidence intervals, UW = underweight, PI = Pacific Islander
* Includes 179 females and 67 males who reporting ever having tried to lose weight through fasting, using diet pills without a physician’s prescription, vomiting or laxative use, or skipping insulin versus all other youth.
† Includes 763 females and 451 males who describe themselves as slightly or very overweight
‡ Includes 779 females and 425 males who reported that they were trying to lose weight.
§ Includes 510 females and 234 males reported that they worried about their weight.
¶ Odds ratios are adjusted for race/ethnicity as well as all other variables in the model as shown in each column
# GHb was measured at the study visit and categorized as good (GHb<8.0%), marginal (8.0-9.4%) and poor (≥ 9.5%) glycemic control using the ADA recommendations (20).