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Clinical, Psychosocial, and Demographic Factors Are Associated With Overweight and Obesity in Early Adolescent Girls With Type 1 Diabetes

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Abstract

Purpose—The purpose of the study was to examine the differences in clinical, psychosocial, and demographic factors by sex and weight status.

Methods—Baseline data were analyzed from 318 adolescents (mean age = 12.3 ± 1.1 years, 55.0% female, 62.7% white) with type 1 diabetes (T1D) from a multisite clinical trial. Differences were examined between normal weight (body mass index ≥5th and <85th percentile) and overweight/obese (body mass index ≥85th percentile) boys and girls with T1D in clinical, psychosocial, and demographic factors. Descriptive and multiple logistic regression analyses were used.

Results—Overweight/obesity was prevalent (39.0%) and common in girls (42.6%) and boys (33.1%). In bivariate analyses, overweight/obese girls had parents with lower educational attainment, longer diabetes duration, and significantly worse self-management and psychosocial health as compared with normal weight girls. There were no differences between overweight/obese and normal weight girls in A1C, therapy type, race/ethnicity, or household income. No significant differences were found between normal weight and overweight/obese boys. In

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multivariate analysis, parental educational attainment (master or higher vs high school diploma or less) and perceived stress were significantly associated with overweight/ obesity in girls. Longer duration of T1D bordered statistical significance.

Conclusions—Overweight/obesity is prevalent among adolescents with T1D. Clinical, psychosocial, and demographic factors are associated with overweight/obesity in girls but not boys. Greater attention to weight status and aspects of health that are germane to adolescents with T1D is warranted.

Overweight and obesity (body mass index [BMI] ≥85th percentile) in adolescents with type 1 diabetes (T1D) has become an important clinical and public health concern.[1] The prevalence of overweight and obesity in adolescents with T1D now mirror that of the general population of adolescents, approximately 39%, and the rate of overweight and obesity among adolescents with T1D has more than tripled over the past few decades.[1-3] Youth with T1D have a higher prevalence of overweight (22% vs 16%) but not obesity (13% vs 17%) than do their peers without diabetes,[4] and girls with T1D have a higher prevalence of overweight than do boys with T1D.[5,6] Reasons for these rates of overweight and obesity in adolescents with T1D are unclear but may be related to the concomitant increase in the use of intensive insulin regimens, gene-environment interactions, and/or lifestyle factors.[7-9]

Overweight/obesity and the associated cardiometabolic risk factors in adolescents with T1D account for significant cardiovascular consequences, including high blood pressure, abnormal lipid profile, coronary artery disease, myocardial infarction, stroke, and poor glycemic control.[10-12] Excess weight is associated with insulin resistance typically characteristic of type 2 diabetes. Several researchers have reported cases of dual diagnosis with type 2 diabetes, or "double diabetes."[8,13]

In addition to the physiologic and clinical complications associated with overweight/obesity, adolescents with T1D constitute a vulnerable population at risk of adverse psychosocial health and poor diabetes self-management, which may in turn be further adversely affected by overweight/obesity. For instance, adolescents with T1D are at increased risk for psychosocial problems, such as anxiety and depression, as compared with adolescents without T1D.[14,15] Furthermore, the transition into early adolescence is often marked by poorer self-management, higher levels of diabetes-related stress, and lower quality of life (QOL) when compared with younger children and adults with T1D.[16-18] Additionally, research conducted among adolescents with T1D has demonstrated that, compared with boys, girls are at greater risk of poorer self-management and QOL.[19,20] Adolescent girls with T1D have lower life satisfaction, QOL, and health perceptions than do adolescents without T1D,[21] and among adolescents without T1D, QOL has been shown to improve with weight loss.[22] Family-related factors are also important since adolescents with T1D report low diabetes-specific family functioning and high conflict, particularly among older adolescents.[23,24] Less is known regarding the impact of T1D on self-worth and close friendships, but deleterious relationships have been observed between these factors and BMI among adolescents without T1D.[25,26]

Given that early adolescence is a complex time of navigating social norms, expectations, and identity, examining the associations of these clinical, psychosocial, and demographic factors with weight status is necessary to determine if overweight/obesity is also a concern. Indeed, overweight/obesity has been shown to amplify these psychosocial and family functioning issues among adolescents without T1D,[27-30] yet little is known about how weight status may affect these relationships in adolescents with T1D. Additionally, prior research has indicated sex differences in weight status such that girls with T1D are at higher risk of overweight/obesity than are boys.[5,6] Thus these relationships were also examined by sex. Collectively, the information presented here may point to specific areas for intervention and populations that could benefit from interventions focused on obtaining additional educational and psychological support.

The purpose of this study was to examine the differences in clinical, psychosocial, and demographic factors by sex and weight status. This study sought to address the following research questions: (1) What is the prevalence of overweight and obesity in the sample? and (2) What are the associations of clinical factors (A1C, duration of diabetes, therapy type), psychosocial factors (self-worth, close friendships, perceived stress, depressive symptoms, self-management, QOL, family functioning), and demographic factors (race/ethnicity, parent educational attainment, and household income) by sex and weight status in a sample of early adolescents with T1D?

Methods

A cross-sectional descriptive comparative design was used to analyze baseline participant data from a multisite randomized clinical trial that determined the effect of an Internet-based coping skills training program (TEENCOPE™) versus an Internet-based education program (Managing Diabetes) for adolescents with T1D. The primary end points of the randomized controlled trial were A1C, QOL, and family conflict, with secondary end points of stress, coping, self-efficacy, social competence, and family support.

Procedures

A convenience sample of adolescents with T1D was recruited from 4 diabetes clinical sites in the United States: the University of Arizona, The Children's Hospital of Philadelphia, University of Miami, and Yale University. Inclusion criteria were early adolescents aged 11 to 14 years who were diagnosed with T1D for at least 6 months, had no other significant health problems, were school grade appropriate for age within 1 year, were able to speak and write English, and had access to high-speed Internet at home or school or in the community (eg, public library). More information regarding the study design and methods can be found in previous publications.[31,32]

Informed consent from parents and assent from adolescents were obtained. At the time of study enrollment, adolescents' parents completed a demographic and socioeconomic data collection form. Adolescents were provided instructions for online collection of psychosocial data. Research assistants collected A1C levels, height, and weight by chart review. The study received Institutional Review Board approval form each of the 4 sites.

In the randomized controlled trial, a total of 518 patients were approached for participation in the study. Of those, 114 declined to participate, resulting in 406 consenting participants.

Eight of these participants did not meet the eligibility criteria, and an additional 78 passively withdrew from the study by not completing the baseline data collection. Thus, a total of 320 participants were enrolled in the randomized controlled trial and completed the baseline data; 2 participants were missing height and/or weight data and therefore excluded from these analyses.[31]

Measures

Demographic Data—The demographic data collection form was completed by parents/ guardians and included sociodemographic information regarding race/ethnicity, parent education, and household income. For the purpose of these analyses, the highest level of parent educational attainment within a family was used. Five strata defined educational attainment: high school degree or less (no college); some college or associate degree; bachelor degree; and master, professional, or doctoral degree. These categories are similar to those used for the National Health and Nutrition Examination Survey reporting of weight differentials.[33]

Clinical Data—Research assistants collected clinical data, including A1C, therapy type, and date of diagnosis, using a data collection form. Bayer Diagnostics DCA2000 was used to determine A1C levels in most settings. Three percent of the A1C levels were obtained in outside laboratories, and these results were not significantly different from those from the DCA, so these data were combined.[31] Duration of diabetes was calculated by subtracting the date of diagnosis from the date that the adolescent consented to participate in the study. Type of therapy included insulin pump, conventional injections, or basal-bolus injections. Both injection types were combined into a single group for analysis.

Body Mass Index—Clinic staff measured height and weight. Height was measured by a wall-mounted stadiometer and weight by a calibrated floor scale. Research assistants collected the latest height and weight measurements during the medical chart review. BMI was calculated from the height and weight and computed as weight (kilograms) divided by the square of height (meters). Weight status was categorized for age and sex percentile according to the 2000 BMI growth charts of the Centers for Disease Control and Prevention.[34] Participants were dichotomized into normal weight (BMI ≥5th to <85th percentile) and overweight/ obese (BMI ≥85th percentile).[35] Due to a small number of adolescents meeting criteria for obesity (n = 45), overweight and obese were combined into 1 category. Two participants were excluded from analyses due to being underweight (BMI <5th percentile). Mean age- and sex-specific BMI cutoffs for overweight/obesity in boys and girls were BMI ≥21.3 and BMI ≥21.9, respectively.

Psychosocial—The participants completed 7 psychosocial instruments, and all data were collected online. Assessment of self-worth and close friendships were measured with sub-scales from the Self-Perception Profile for Adolescents,[36] a widely used instrument for adolescents that consists of a self-evaluation of several domains of personal competence. Higher scores reflect greater perceived competence. Cronbach α for this sample was 0.75.

Stress was measured with the Perceived Stress Scale, a 14-item self-report scale that determines the degree to which respondents view their lives to be stressful.[37] Higher scores are indicative of greater perceived stress. Cronbach α in this sample was 0.80.

The Children's Depression Inventory is a 27-item scale that measures the degree of depressive symptomatology in youth. These depressive symptoms include disturbance in mood and self-evaluation, hedonic capacity, vegetative functions, and interpersonal behaviors[38]; higher scores reflect greater depressive symptoms. A score of 12 was interpreted as the criterion score for depression in this study. One item that assesses suicidal ideation was eliminated due to the nature of online data collection—specifically, the inherent inability for an investigator to immediately respond to a subject's positive endorsement of suicidal ideation. Cronbach α in this sample was 0.90.

Self-management: The Self-management of Type 1 Diabetes in Adolescents Scale was used to measure adolescents' self-management activities, processes, and goals.[39] In this study, data from subscales that measured diabetes care activities, communication, and problem solving were used, with higher values indicating greater frequency of performing diabetes management activities. The reliability estimates in this sample ranged from 0.70 to 0.80.

Quality of Life: The Pediatric Quality of Life Inventory is a widely used 15-item instrument that assesses global health-related QOL.[40] An adolescent-specific supplemental measure of the inventory to assess diabetes-specific QOL was also used.[41] Higher scores reflect better overall QOL, and the instrument has demonstrated high reliability and validity.[40,42] In the sample, Cronbach α was 0.87 for the global measure and 0.90 for the diabetes-specific measure.

Family Functioning: Two subscales of the Diabetes Family Behavior Scale[43]—family support (guidance and control) and family warmth and caring—were used to measure diabetes-specific family behaviors that have assisted or hindered an adolescent to follow a diabetes care regimen. Internal consistency reliability was adequate for the 2 subscales: family support (α = 0.81) and family warmth and caring (α = 0.77).

The revised Diabetes Family Conflict Scale has 19 items and was used to measure diabetes treatment conflict that arises from diabetes care.[44] The conflict scale was adapted from a previous measure[45] and is used to assess the degree of conflict among family members on diabetes management activities. Higher scores indicate greater family conflict regarding diabetes care. Cronbach α in this sample was 0.87.

Power Analysis—A power analysis was conducted prior to analysis to determine if the study had adequate power to detect domain-specific differences in groups (eg, normal weight vs overweight/obesity in clinical factors among the overall sample and in sex-specific analysis). Because multiple independent variables were considered, Green's formula was used to calculate the sample size necessary for a correlation and regression analyses: $N > 50 + 8m$ (where m is the number of independent variables).[46] Thus, with a maximum of 4 independent variables required to detect differences in the psychosocial domain, a total of 82 participants were required.

Analyses—Data were checked for distribution, outliers, and missing data. The normality of the data was acceptable, as assessed by kurtosis and skewness analysis. Frequencies, means with standard deviations, and medians with inter-quartile ranges were calculated for categorical and continuous variables. Comparisons between boys and girls in terms of weight status were evaluated with chi-square tests, analysis of variance, *t* tests, and Wilcoxon rank-sum tests, when appropriate. If multicollinearity ($r \geq 0.6$) between variables was evident, the variable with the highest value was removed in subsequent analyses. The bivariate findings that were significantly associated with weight status were entered individually into multiple logistic regression models stratified and analyzed individually by demographic, clinical, psychosocial, self-management, QOL, and family functioning domains. For exploratory purposes, those domain-specific significant findings were then entered simultaneously into a final, fully adjusted logistic regression model to determine the relative importance of each factor on weight status. All analyses were reported as 2-tailed, with an alpha level of 0.05, and all analyses were conducted with STATA 13.0 (STATA, College Station, Texas).

Results

The mean age of the sample (N = 318) was 12.3 ± 1.1 years, and the majority of the sample was female (55.0%). Participants self-identified their race/ethnicity as white–non-Hispanic/ non-Latino (62.9%), white–Hispanic/ Latino (20.1%), black or African American (7.9%), and other (9.7%). The mean A1C was 8.3% ± 1.5%, and the mean duration of diabetes was 5.0 ± 3.5 years. Additional sample characteristics are presented in Table 1.

The mean BMI of the sample was 21.2 ± 4.0 kg/m^2. Overall, 61.0% of the sample was normal weight, 24.8% overweight, and 14.2% obese (39.0% overweight/obese). Stratified by sex, girls and boys both had a high prevalence of overweight (25.6% and 20.5%) and obesity (17.0% and 12.6%, respectively).

There was no significant difference between overweight/obese and normal weight adolescents by race/ ethnicity for boys ($\chi^2 = 4.09$, $P = .13$) or girls ($\chi^2 = 4.11$, $P = .13$). Girls who were overweight/obese had parents with lower educational attainment ($P < .01$) but not lower income ($\chi^2 = 4.78$, $P = .09$) when compared with girls who were normal weight. There were no significant differences in educational attainment or income between normal weight and overweight/obese boys. Overweight/ obese adolescents had significantly higher A1C levels (8.6% ± 1.6%) relative to normal weight adolescents (8.2 ± 1.4%; $P = .03$), but this was attenuated when stratified by girls ($P = .23$) and boys ($P = .36$). There were also significant differences in diabetes duration only for girls such that overweight/obese girls had diabetes for a greater number of years relative to normal weight girls (5.7 vs 4.3 years, $P < .01$, respectively). There were no significant differences between overweight/ obesity and normal weight status in type of therapy for girls ($F = 1.58$, $P = .21$) or boys ($F = 0.44$, $P = .65$).

Differences in clinical, self-management, and psychosocial factors by weight status in the overall sample and by sex are presented in Table 2. In brief, girls who were overweight/ obese exhibited significantly lower psychosocial functioning ($P = .001$-$.04$), self-management (P = .01-.02), QOL (P = .01), and family functioning (P = .01-.04) as compared with normal weight girls. No significant differences in clinical, self-management, or psychosocial factors were found between normal weight and overweight/obese boys; thus, subsequent logistic regression analyses were conducted among only girls.

Factors Associated With Overweight/ Obesity in Girls

The multiple logistic regression odds ratios (ORs; 95% CI) for overweight/obesity are presented in Table 3, stratified by demographic, clinical, self-management, and psychosocial factors. In terms of parental educational attainment, a girl had 4.38 times the odds of overweight/ obesity if her parent had a high school degree or lower (vs master degree or higher). Those with a longer duration of T1D and higher perceived stress had 13% and 7% higher odds of overweight/obesity, respectively. Factors associated with a lower risk of overweight/obesity status included performing diabetes self-management activities and better general QOL. When all other factors were controlled in the full model, only parental educational attainment (high school degree or lower vs master degree or higher; OR = 3.85 [95% CI: 1.30-11.42], P = .02) and perceived stress (OR = 1.07 [95% CI: 1.01-1.13], P = .02) were significantly associated with overweight/obesity in girls. Longer duration of T1D bordered statistical significance (OR = 1.10 [95% CI: 1.00-1.22], P = .058; model R^2 = 0.12).

Discussion

In this geographically and ethnically/racially diverse sample of early adolescents with T1D in the United States, a high prevalence of overweight/obesity (39.0%) was observed. Sex-based differences were striking such that overweight/obese girls with T1D exhibited significantly lower psychosocial functioning (self-worth, close friendships, perceived stress, and depressive symptomatology), self-management, QOL, family functioning, and longer duration of diabetes and had parents with lower educational attainment relative to normal weight girls with T1D. However, when other factors were considered, only low parental educational attainment, longer duration of T1D, higher perceived stress, poorer performance of diabetes self-management activities, and poorer QOL were associated with higher odds of overweight/obesity in girls with T1D. In contrast, there were no statistically or clinically significant associations between these factors and weight status as examined in boys.

The results from this study indicate that overweight and obesity are prevalent overall (24.8% and 14.2%; total, 39.0%) and by sex in both girls (25.6% and 17.0%; total, 42.6%) and boys (20.5% and 12.6%; total, 33.1%) with T1D. The prevalence of overweight/obesity in the studied sample is congruent with other domestic and international estimates of overweight/ obesity in adolescents with T1D.[2-5,9,47] This accumulating evidence suggests that overweight/obesity in adolescents with T1D is a growing public health concern, with rates now corresponding to those in the general adolescent population.

Prior research has demonstrated significant sex variation in psychosocial factors between adolescent boys and girls. For instance, adolescent girls with T1D had lower QOL than boys, including greater worries, lower life satisfaction, and worse health perceptions.[19-21]

Additionally, overweight/obese adolescents without T1D are at risk for adverse psychosocial health versus normal weight adolescents, and girls are more at risk than boys.[27,28] Yet, only 2 other studies integrated weight status and psychosocial health in adolescents with T1D. In a large international cohort of adolescents with T1D (n = 2101), greater BMI was linearly associated with poorer QOL, including lower satisfaction and worse health perceptions,[20] suggesting that BMI is a risk factor for poor psychosocial health. In a smaller study of adolescents with T1D (n = 46) versus those without T1D (n = 27), examination of group and sex revealed that higher BMI was significantly associated with poorer self-esteem and body image and lower levels of social support in adolescents with T1D, particularly girls.[48] The results from this study add to this evidence, demonstrating that overweight/obese girls with T1D had lower QOL, greater perceived stress, and poorer performance of diabetes self-management activities than did normal weight girls. Even in the fully adjusted model, girls with higher perceived stress had 7% higher odds of being overweight/ obese. Possible explanations for the sex variation in the findings could be related to earlier hormonal and pubertal changes observed in teenage girls.[49] In addition to altered physical appearance, early adolescents must cope with changes to identity, friendships, and expectations that can be particularly challenging for girls,[50] especially for those who are overweight or obese.[29] Thus, overweight and obesity among girls who have T1D may present a compounding effect on psychosocial health. Correspondingly, while not tested in the study, stress-induced weight gain may be the result of T1D diagnosis and management.

The most predominant factor associated with overweight/obesity in the sample was lower parental educational attainment. After adjusting for all other variables, girls whose parents had no college experience were almost 4 times as likely to be overweight/obese than girls whose parents had master, professional, or doctoral degrees. Although this relationship has not been examined among adolescents with T1D, this finding is consistent with several other studies conducted among adolescents in the general population that showed an inverse relationship between parental educational attainment and overweight/obesity in girls.[30,51] Although one cannot determine the directionality of these observations, results of longitudinal studies have indicated that higher parental educational attainment is associated with lower BMI over time[30]; thus, higher education may be a protective factor for high BMI. Possible explanations include that parents with less educational attainment may be less knowledgeable about the role of healthy lifestyle behaviors in contributing to weight loss.[52] Adolescents whose parents have lower educational attainment may also live in more “obesogenic” environments that do not facilitate healthy lifestyles (eg, lack of access to parks, playgrounds and safe neighborhoods), and parents may not be able to afford or support their children’s participation in after-school sports or clubs.[51,53] Furthermore, children of less educated parents are more likely to eat unhealthy foods and consume more calories from energy-rich foods and drinks.[52] Noticeable was the absence of a relationship between parental education attainment and overweight/obese boys, suggesting that overweight/obesity risk for this subgroup may be independent of parental educational attainment.

In the analysis, longer duration of T1D was the only clinical characteristic associated with higher odds of overweight/obesity in girls, and it bordered statistical significance in the fully adjusted model. This relationship has not been reported previously. In a study of 12 774 adolescents with T1D, adolescents who had a shorter duration of T1D and lower A1C and those who used insulin pump therapy demonstrated higher BMI over time.[54] The investigators concluded that the increase in BMI appeared to be an effect of intensified insulin treatment, but their results were not stratified by sex. The results reported in this study do not support these findings, and in the bivariate analysis for the overall sample, normal weight adolescents had lower A1C levels than overweight/obese adolescents did, but this finding was no longer significant when examined by sex and weight status. Such conflicting findings indicate the need for further research into the various risk factors of overweight/ obesity and those that may be the result of overweight/ obesity, as well as the importance of sex-based differences in weight status. Indeed, other critical obesity-related risk behaviors—including physical activity, sedentary behavior, healthy eating, and sleep—ought to be examined to understand which behaviors to target to maximize the reduction in overweight/obesity in adolescents with T1D.[7]

Clinical Implications

Given the prevalence of overweight/obesity in adolescents with T1D, more effective preventive efforts for overweight/obesity are warranted in the treatment and management of this population. Researchers and practitioners are investigating the use of traditional type 2 diabetes medications, including metformin and GLP-1 agonists (eg, exenatide, exenatide LAR, liraglutide), to promote minor weight loss and improve glycemic control in overweight/obese adolescents with T1D.[55,56] While these therapies have demonstrated preliminary efficacy for short-term weight loss,[57,58] the adoption of a healthy lifestyle remains a core component in the prevention and treatment of obesity. In this regard, additional research is needed to assess the combined effect of healthy lifestyle interventions and safety and efficacy of metformin/ GLP-1 agonists on weight loss in adolescents with T1D, paying particular attention to hypoglycemia and gastrointestinal adverse effects.

With regard to behavioral risk factors, diabetes care providers should integrate knowledge pertaining to weight status, self-management, and psychosocial health into clinical practice, as well as promote healthy eating and physical activity. Specifically, in diabetes clinics and school health offices, providers should be attentive to concerns about QOL, higher perceived stress, and poorer performance of diabetes self-management activities among overweight/ obese girls with T1D, as these factors may be modifiable. Indeed, early adolescence is a time when T1D self-management skills are learned and lifelong behavioral habits are formed[59,60]; thus, it may be feasible to intervene at this stage of development. Families of overweight/obese girls with T1D may also benefit from education pertaining to the importance of family support in helping them follow a diabetes care regimen. Providers can also be knowledgeable about other predictors of overweight/obesity, including adolescents who have had diabetes for a long duration (>5 years) and those whose families have lower parental education. However, obesity is a multifactorial public health problem, and many of these factors are not easily remediable within the context of a diabetes visit. Thus, these suggestions call for a collaborative approach encompassing families, adolescents with T1D, and professionals in the home, school, and clinical settings.

This study has several limitations that must be considered in the interpretation of the findings. First, the cross-sectional nature of the study does not allow for determination of causation or elucidation as to the mechanisms of weight gain and the tested associations. Similarly, the directionality of the observations is unclear: overweight and obesity in youth with T1D may affect self-management and psychosocial health, or psychosocial health and self-management may contribute to health patterns leading to overweight or obesity. More research is indicated in this respect. Second, it was not advisable to stratify weight status by normal weight, overweight, and obese categories due to lack of power. Third, the sample was above current standards (A1C <7.5%) but in fairly good metabolic control (mean A1C, 8.3% ± 1.5%), which may limit generalizability of findings to other populations, but it is worth noting that there were no statistically significant differences between A1C and girls' or boys' weight status. Finally, more than half the sample had a household income ≥$80 000, which may limit the generalizability of the findings to other populations.

Conclusion

These results suggest that overweight/obese girls comprise a subgroup of adolescents with T1D who are at risk of deleterious self-management and psychosocial health, especially those with longer duration of T1D and in families with lower parental education. Because the need for better metabolic control to prevent complications remains prominent, greater focus on preventing weight gain from both a physiologic and a behavioral standpoint is needed. Greater attention to weight status and aspects of self-management and psychosocial health that are germane to adolescents with T1D is warranted, particularly among overweight/obese girls with T1D. Collectively, these results suggest the need for further research to examine a broader array of factors associated with overweight/obesity in adolescents with T1D, including those related to clinical, genetic, metabolic, behavioral, cultural, demographic, and environmental factors.

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Table 1

Demographic and Anthropometric Sample Characteristics (N = 318)

Characteristic	n (%)
Age, y	12.3 ± 1.1[a]
Female	176 (55)
Race/ethnicity	
White, non-Hispanic/Latino	200 (62.9)
White, Hispanic/Latino	64 (20.1)
Multiracial/other	54 (17.0)
A1C, %	8.3 ± 1.5[a]
Duration of diabetes, y	5.0 ± 3.5[a]
Type of therapy	
Pump	190 (59.4)
Basal injections	78 (24.4)
Conventional injections	52 (16.3)
Parent education[b]	
High school diploma or no diploma	100 (31.9)
Associate degree or some college	66 (21.0)
Bachelor degree	89 (28.3)
Master, professional, or doctoral degree	59 (18.8)
No. of siblings	
0	28 (8.8)
1	138 (43.4)
2	95 (29.9)
3+	57 (17.9)
Annual income	
<$40 000	65 (21.0)
≥$40 000 to <$80 000	87 (28.2)
≥$80 000	157 (50.8)
BMI	21.2 ± 4.0[a]
Normal weight: ≥5th to <85th percentile	194 (61.0)
Overweight: ≥85th to <95th percentile	79 (24.8)
Obese: ≥95th percentile	45 (14.2)

Abbreviation: BMI, body mass index (kg/m^2).

[a]Mean ± SD.

[b]Defined as the parent with the highest level of educational attainment.

Table 2

Clinical, Self-management, and Psychosocial Factors by Body Mass Index Weight Status[a]

		Overall Sample (N = 318)			Girls (n = 176)			Boys (n = 142)		
Characteristic	**Scale Range**	**Normal (n = 194)**	**Overweight / Obese (n = 124)**	***P***	**Normal (n = 101)**	**Overweight / Obese (n = 75)**	***P***	**Normal (n = 95)**	**Overweight / Obese (n = 47)**	***P***
Clinical factors										
A1C, %		8.2	8.6	.03	8.3	8.6	.23	8.1	8.4	.36
Duration of diabetes, y		4.7	5.5	<.05	4.3	5.7	<.01	5.2	5.0	.72
Self-management[b]										
Diabetes care activities	0–45	32.8	31.4	.03	33.4	31.3	.01	32.3	31.4	.38
Diabetes communication	0–30	18.0	17.5	.40	18.4	17.1	.08	17.7	18.0	.37
Diabetes problem solving	0–21	14.6	14.3	.44	14.8	14.1	.23	14.4	14.5	.89
Psychosocial										
Self-worth[b]	5–20	16.9	16.2	.07	17.3	15.7	<.01	16.5	16.9	.36
Close friendship[b]	5–20	17.2	17.0	.54	18.0	17.1	.04	16.4	16.3	.81
Perceived stress	0–56	20.5	22.5	.03	20.2	24.5	<.01	20.6	19.6	.44
Depression[c]	0–52	5.7	7.0	.10	4.6	8.2	<.01	6.8	5.3	.29
Quality of life[b]										
Diabetes-specific HRQOL	0–100	65.0	62.1	.11	65.9	59.6	<.01	64.8	64.3	.84
General quality of life	0–100	81.6	79.9	.18	82.7	78.2	.01	80.8	81.6	.67
Family factors										
Diabetes family support[b]	47–235	166.3	164.3	.35	168.1	161.1	.01	164.7	168.7	.21
Diabetes family warmth/caring[b]	15–75	57.0	56.5	.56	57.7	55.2	.04	56.4	58.3	.19
Diabetes family conflict	19–57	26.0	26.9	.18	26.0	27.7	.05	26.0	25.6	.66

Abbreviation: HRQOL, health-related quality of life.

[a]Normal and overweight/obesity values presented as means.

[b]Lower value indicates inferior score.

[c]The clinical cutoff for depression was 12.

Table 3

Factors Associated With Overweight/Obesity in Girls (n = 176)

Characteristic[a]	Odds Ratio (95% CI)	*P* Value
Demographic: parental education attainment[b]		
Master degree or higher	Reference	
Bachelor degree	1.62 (0.55–4.79)	.38
Associate degree or some college	1.58 (0.48–5.21)	.45
High school diploma or less	4.38 (1.54–12.50)	<.01
Clinical: duration of type 1 diabetes	1.13 (1.03–1.23)	.01
Psychosocial[c]		
Close friendship[d]	0.93 (0.83–1.05)	.24
Perceived stress	1.07 (1.02–1.11)	<.01
Quality of life[e]: general quality of life[d]	0.97 (0.94–0.99)	.02
Family factors		
Diabetes family support[d]	0.98 (0.94–1.02)	.38
Diabetes warmth and caring[d]	0.97 (0.93–1.00)	.09
Self-management: diabetes care activities[d]	0.94 (0.89–0.99)	.02

[a]If applicable, findings adjusted for only variables within each category.

[b]Defined as the parent with the highest level of educational attainment.

[c]Depression and self-worth not included in analysis due to multicollinearity (≥0.6).

[d]Lower value indicates inferior score.

[e]Diabetes-specific quality of life not included in analysis due to multicollinearity (0.66).