Type 1 diabetes (T1D) is a chronic illness characterized by the destruction of the beta cells of the pancreas, resulting in the absence of insulin. T1D requires complex and intensive daily management in order to reduce the risk of long-term complications (American Diabetes Association, 2013). In addition to T1D-specific health issues, youth in this population face similar issues as their non-diabetic peers, including the current pediatric overweight and obesity epidemic. In a study of the United States based SEARCH registry, an estimated 12.6% of youth with T1D are obese and 22.1% are overweight, as compared to 16.9% and 16.1%, respectively of the general population (Liu et al., 2010). Similar results were found in a comparison of the German/Austrian DPV registry and the United States based T1D Exchange, with 12% of both registries combined categorized as obese and 24% as overweight when compared to the WHO reference population (Dubose et al., 2015). In this comparison the United States had a slightly higher prevalence of obesity in youth with T1D greater than 6 years of age, likely associated with national differences in diet and lifestyle (Dubose et al., 2015).

With this trend in weight comes a host of complications- higher BMI is associated with increases in dyslipidemia, hemoglobin A1c (HbA1c) and unhealthy weight control behaviors along with increased use of antihypertensive and lipid lowering medications (Hanna, Weaver, Slaven, Stump, & Shieh, 2015; Purnell, Zinman, & Brunzell, 2013). In turn, chronic elevations in HbA1c are associated with microvascular and macrovascular complications (Nathan, 2014; The Diabetes Control and Complications Trial Research Group, 1993).

The purpose of this paper is to explore potential contributing factors to overweight and obesity in youth with T1D, including the risks and benefits of intensive insulin therapy, the effects of overweight and obesity on people with T1D and other factors that may be impacting weight management in adolescents with T1D. This literature review is complemented by qualitative data collected from two key informant interviews with adolescents with T1D.

Literature Review

Intensive Insulin therapy

The current standards of practice for people with T1D are self-monitoring of blood glucose and administration of intensive insulin therapy (IIT), either via multiple daily injections (MDI) or the use to an insulin pump to provide continuous subcutaneous insulin infusion (CSII) (American Diabetes Association, 2013). The Diabetes Control and Complications Trial (DCCT) established the benefits of IIT in 1993 in reducing long-term complications associated with diabetes ((The Diabetes Control and Complications Trial Research Group, 1993). In this study, IIT was associated with a decrease in HbA1c and decreased risks of development or progression of microvascular complications by 36-74% (Nathan, 2014; The Diabetes Control and Complications Trial Research Group, 1993). IIT was also associated with a 34% reduction in the development of hypercholesterolemia as well as a 41% reduction in cardiovascular and peripheral vascular events (The Diabetes Control and Complications Trial Research Group, 1993). In the Epidemiology of Diabetes Interventions and Complications (EDIC) trial, a follow
up study of the DCCT population, IIT was associated with less coronary calcification, and a lower incidence of myocardial infarction, stroke and cardiac death (Lachin, Orchard, & Nathan, 2014). HbA1c, a measure of average glycosylation of hemoglobin over 3 months, was shown to decrease to a new steady state after 6 months after the initiation of IIT. Additionally, 44% of individuals in the IIT group achieved an HbA1c value 1% below target during the follow up period, with an average glucose profile of 155 mg/dl as compared to the conventional treatment group which had an average glucose profile of 231 mg/dl (The Diabetes Control and Complications Trial Research Group, 1993). Although the EDIC trial revealed that IIT did not translate into all subjects being able to reach near-normal glycemic targets, an HbA1c value under 6.05%, but did translate into 44% of participants reaching that goal at least once during the follow up period and a median HbA1c of 7% over the quarterly follow up dates, as compared to 9% in those receiving conventional therapy (Nathan, 2014).

The results of the DCCT as well as those of EDIC study provided consistent, large-cohort data that demonstrated that achieving as close to the glycemic control of a population without diabetes reduced all of the microvascular and macrovascular complications of T1D (Nathan, 2014).

Despite its benefits, IIT was also associated with some adverse events, particularly surrounding hypoglycemia and weight gain. When compared to conventional therapies, there was a three-fold higher occurrence of severe hypoglycemia in those receiving IIT than those receiving conventional therapies (The Diabetes Control and Complications Trial Research Group, 1993). Additionally, when compared to conventional treatment, those receiving IIT had a 33% increase in the risk of becoming overweight, with a mean of 4.6 kg weight gain over those receiving conventional therapy (The Diabetes Control and Complications Trial Research Group, 1993). In the EDIC follow up, the incidence of severe hypoglycemia and weight gain were sustained (Epidemiology of diabetes interventions and complications research group, 1999). For youth with T1D the risk of hypoglycemia, both moderate and severe, is increased by having a lower HbA1c level (Gonder-frederick, Nyer, Shepard, & Vajda, 2011).

Impact of Overweight and Obesity on T1D

Increased BMI was associated with increased HbA1c in an international cohort of youth with T1D who had been diagnosed for at least one year (Dubose et al., 2015). In a follow up to the DCCT, individuals categorized as “excess gainers” (a BMI increase greater than or equal to 4.39 kg/m2) had greater increases in HbA1c despite increases in insulin dosing as compared to those who gained less weight. Additionally, excess gainers had increases in total cholesterol, LDL cholesterol and increased use of antihypertensive and lipid-lowering medications (Purnell et al., 2013).

Beyond the metabolic outcomes of overweight and obesity, there are also psychosocial impacts in this population. Although there are healthy ways to manage weight, such as exercise, increasing fruit and vegetable intake and limiting high-fat foods and sweets, there are also unhealthy weight management practices, including smoking, skipping meals, restricting food intake and fasting and very unhealthy weight control behaviors including diet pills, vomiting, insulin omission and the use of laxatives and diuretics. One study estimated that during a 12 month period with quarterly appointments, 80-81% of young adults with T1D participated in healthy weight control
behaviors, 25-34% participated unhealthy weight control behaviors and 3-12% participated in very unhealthy weight control behaviors; participants could participate in both healthy and unhealthy weight control behaviors at the same time (i.e. eating more vegetables and omitting insulin) (Hanna et al., 2015). Higher BMI was identified as a risk factor for participating in unhealthy weight control behaviors, particularly when coupled with depressive symptoms (Hanna et al., 2015).

Even when participating in healthy weight control behaviors, there are additional risks for people with T1D. Hypoglycemia is the most common acute side effect of T1D; severe hypoglycemia is life threatening and can result in loss of consciousness, seizures and death (Gonder-frederick et al., 2011). In a study of the German/Austrian DPV registry of youth with T1D, increased BMI was associated with increased risk of at least one episode of severe hypoglycemia per year (Dubose et al., 2015). As previously discussed, 88% people with T1D may experience disinhibited eating during hypoglycemia and may not stop eating until the symptoms of hypoglycemia cease (Merwin, 2014). This combination of increased frequency in hypoglycemia combined with the associated disinhibited eating may represent an opportunity for excess caloric intake and a feeling of loss of control, both of which are concerning for overweight or obese youth with T1D.

Although there is not significant data demonstrating that exercise improves HbA1c, there are other benefits including reduction of total cholesterol, BMI, triglycerides and improvements in overall well being (Kennedy et al., 2013; Quirk, Blake, Tennyson, Randell, & Glaizebrook, 2014). A mismatch in the combination of physical activity, food and insulin is the primary cause of hypoglycemia across all age groups (Gonder-frederick et al., 2011). A study of youth with T1D using continuous glucose monitoring (CGM) found that overnight and next-day hypoglycemia was 31% more likely in those who were physical active for more than 30 minutes in the previous afternoon (Metcalf et al., 2014). Fear of hypoglycemia was identified as the strongest barrier to physical activity in adults with T1D, a barrier that was associated with higher HbA1c levels and lower levels of overall well-being (Brazeau, Strychar, Rabasa-Lhoret, & Mirescu, 2008). An increased number of hypoglycemic episodes per year was statistically significantly associated with fear of hypoglycemia while an understanding of insulin pharmokinetics was associated with less fear of hypoglycemia (Brazeau et al., 2008).

Some weight control behaviors are specific to T1D, particularly insulin omission. Prior to diagnosis with T1D, individuals lose weight unintentionally, related to the lack of insulin, and following the introduction of exogenous insulin, gain that weight back (Quick, Byrd-Bredbenner, & Neumark-Sztainer, 2013). Regaining this weight is of concern for both medical professionals and individuals with T1D; the most rapid weight gain occurs within the first two weeks following diagnosis and although a portion of this weight is the result of rehydration, some of it can also be attributed to an increase in fat mass (Newfield, Cohen, Capparelli, & Shragg, 2009). The mechanism behind this weight gain is the role of insulin as an anabolic hormone that signals that blood glucose be taken up by tissues with glucose transporters, in particular GLUT4. One of the removal routes is the storage of glucose as fat which can result in large increases in weight over a short period of time (Quick et al., 2013). Thus, an omission of insulin prevents the absorption of glucose into targeted tissues, essentially purging the system of consumed carbohydrates, allowing those who omit insulin to eat without absorbing
unwanted calories (Jones, Lawson, Daneman, Olmsted, & Rodin, 2000; Merwin, 2014; Neumark-Sztainer et al., 2002; Quick et al., 2013)

Some research suggests that for individuals who viewed their pre-diagnosis weight loss positively, this weight regain over a short period of time may be concerning and negatively affect body image and self-esteem (Quick et al., 2013). The daily tasks of living for people with T1D lend themselves to the development of disordered eating behaviors; carefully planning food intake and insulin administration for food may lead some individuals to self-impose strict dietary rules that result in feelings of guilt when they are broken (Merwin, 2014). Equally, a diagnosis with T1D may create situations where self-imposed dietary rules are violated, particularly when hypoglycemia requires the ingestion of fast-acting carbohydrates, such as highly processed foods and desserts. Although medically necessary, an estimated 88% of people with T1D may experience dis-inhibited eating when they are experiencing, or think they are experiencing, hypoglycemia (Merwin, 2014). For some, this experience may result in feeling a loss of control or shame, potentially increasing the risk of weight-related insulin omission as a maladaptive compensatory strategy (Merwin, 2014; Quick et al., 2013). For individuals with T1D, diet non-adherence and body weight dissatisfaction are associated with “the most extreme and purposeful insulin omission” (Merwin, 2014; Peyrot, Rubin, Kruger, & Travis, 2010; Takii et al., 2010).

There is some evidence that females with T1D are more likely to participate in unhealthy weight control behaviors, subclinical eating disorders and clinical eating disorders than both their non-diabetic peers and males with T1D (Jones et al., 2000; Neumark-Sztainer et al., 2002), however, others found no differences between male and female youth with T1D in their involvement in weight control behaviors, including insulin omission (Hanna et al., 2015).

One study of adolescents with T1D suggests that unhealthy weight control behaviors are over twice as prevalent in females than males (37.9% v 15.9%) and that family cohesion was negatively associated with eating disorders in both males and females. Additionally, this study found that healthy weight control behaviors were associated with lower HbA1cs and that unhealthy weight control behaviors and disordered eating were associated with statistically significant elevations in HbA1cs regardless of gender (Neumark-Sztainer et al., 2002). In a cross sectional study of female youth with and without T1D, eating disorders meeting DSM-IV criteria were more prevalent (10% v 4%) as were sub-threshold eating disorders (14% v 8%). Mean HbA1c was also higher in those eating disorder meeting DSM-IV criteria than those without (9.4% v 8.6%) (Jones et al., 2000).

As youth with T1D continue to become more overweight and obese, it is necessary to learn more about how adolescents perceive the intersection of their diabetes and weight management, their barriers to health and what they need from providers to succeed in this challenge. The purpose of the following key informant interviews is to gain insight into how adolescents with T1D perceive weight management in order to inform current weight management education in this population and direct further research into this issue.

Methods
In order to gather both demographic data and qualitative information about perceptions of weight management in adolescents with T1D, a dual questionnaire and key informant interview approach was used. The key informants were recruited through social networks by a fellow graduate student researcher. In order to be included in this research, key informants were required to be between the ages of 13-16 and to have had T1D for at least one year. There were no requirements regarding HbA1c, weight status or weight history. Prior to participating in the interview, the key informants were given a 30-item questionnaire that included demographic data in addition to investigating insulin administration method (syringes, pens or pump), household structure, weight perception (very underweight to very overweight), previous and current attempts at weight loss, any lasting weight changes in the past year, previous methods of attempted or successful weight loss and a ranking of statements surrounding weight goals, food behaviors, insulin administration or restriction, type 1 diabetes and weight management and disrupted eating (Appendix A). The purpose of this questionnaire was to complement topics discussed in the interviews and to gather demographic data about the key informants and their diabetes management. It also gathered information on the key informants participation in healthy, unhealthy or very unhealthy weight control behaviors. The key informants were then given a document of open-ended questions on appetite, cravings, overall knowledge of weight management, how T1D and weight management efforts intersect, any barriers they had faced, and if there were ways to make weight management easier. The interview questions were adapted from a script developed for use in focus groups of adolescents with T1D.

Results

Questionnaire

Key informant A is a 13 year old, Hispanic male who was diagnosed with T1D at age 3. He uses a pump, is from a one household family and thinks his weight is “about right”. Within the past year he has not attempted to, or lost weight and sustained it. He reports that he has not attempted any healthy weight control behaviors, including dieting, exercising with the goal of weight loss, reduced calories, fat, carbohydrates or sugar sweetened beverages in order to lose weight or keep from gaining weight. Additionally he has not attempted any unhealthy or very unhealthy weight control behaviors, losing weight is not a priority for him.

Key informant B is a 16 year old, white male who was diagnosed at 18 months. He uses a pump, is from a one household family and considers his weight to be “about right or slightly overweight”. He reports that he has tried to “gain muscle and lose fat weight” with the purpose of “gaining lean muscle mass” and that he is currently trying to watch his weight. He has not had any sustained weight loss or weight gain within the past year. He says that he has attempted dieting, he exercises to lose or keep from gaining weight, watched what he ate in order to lose or keep from gaining weight, and sometimes eats foods lower in carbohydrates to lose or keep from gaining weight, including reducing sugar sweetened beverages. He reports that losing weight is often a goal of his, and that sometimes he skips meals and/or snacks and eats more when he is alone than with others. Additionally, he says that sometimes people tell him to take better care of his diabetes and that he alternates between eating very little and huge
amounts. He wrote into the questionnaire that he “hates being high” and has never tried to keep his blood sugars high in order to lose weight. He stated that he is “more focused on diabetes control than weight”.

Interview

Key Informant A described his appetite as “normal” although he stated, “when my blood sugar is low, I feel like I want to eat the entire fridge”. He described cravings as an “urge to eat something” but said that the only time he experienced cravings were when he was low, stating that “when I’m low, I’ll eat anything!” however he did not have specific food cravings. Additionally, the only food that he stated that he was unable to control how much he ate was cookies, or if his mother made desserts and identified that he could not get enough of sweet foods. He stated that he does not eat emotionally and has not eaten more than he thought he wanted. When asked about his knowledge of weight management, he acknowledged that “people have different perspectives on healthy eating” which could contribute to differences in weight management between people. Additionally, he stated, “people need to make sure that (weight management plans) fit their lifestyle” although he acknowledged that weight management is not currently a concern for him. He reports that he always adjusts his diabetes management to try to maintain numbers in range, especially when exercising, but owing to his lack of previous weight attempts, he is not sure of how his diabetes management is affected by weight loss management. He stated that “I exercise a lot, maybe that’s why for me, weight is not an issue” and that “maybe if people exercised more, weight would not be an issue.”

Key Informant B described his appetite as high and states that when his numbers are in range his appetite is normal for him, but when he is low he “can eat almost anything” and when he is high he has a “hard time eating anything”. He states that he has a strong urge to eat even following a recent meal when he is low or when he is at a “restaurant not geared for teenage meals”. When asked to further describe this, he states that he feels that sometimes “restaurants don’t give enough food on the plates.” He says that a craving is “an urge that you have to fulfill” and that he experiences cravings for Swedish Fish when he is low and then has favorite foods that he wants all the time such as “steak or Japanese food”. He says that his cravings are triggered by the “sight, smell and sounds of the grill”. In order to resolve these cravings, he chooses to eat the foods he is craving. He says that some foods that he can’t eat enough of are sweets, including “fudge and Christmas cookies- I love Christmas cookies, but I try to not eat after I’m full because I don’t like having a stomach ache.” He states that he cannot get enough of “sweet, salty, creamy and fatty” foods but that he doesn’t eat emotionally and the only times he has eaten more than he wanted to was “after sports”, but that within the past two weeks “the food that I’ve eaten was all food that I wanted and was the amount that I wanted”. He describes a weight management program as “maintaining a good body weight as well as having a good amount of muscle” and that weight management programs would differ between people in regards to their weight goals their current level of physical fitness and their eating habits. He states that both physical activity and a good diet are important and that “good exercise is built off of a good diet”. He says that weight management is a concern for him “not that I’m overweight or anything, it’s just that I would like to be as lean and as muscular as I can
be”. He says his diabetes management regimen is adjusted everyday depending on exercise and physically demanding tasks. He says that weight management “actually helps me to focus on what’s going into my body as well as the effect that certain foods will have on my body and blood sugar.” He doesn’t think that his diabetes would impact his efforts to lose weight but that his main concerns with a weight management plan would be surrounding his HbA1c and blood sugars. Currently he identifies blood glucose management as a struggle and that a way to handle these things would be “stricter control” but did not specify ways to achieve this. He says that when he has previously lost weight he has noticed “better blood sugar control and a better HbA1c” and that he continues to “watch my carb intake” as “the less carbs that are taken in, the less effect they have on the body”. He thinks that some unfavorable outcomes of previous weight loss attempts were “burning out and trying something and just flat out not liking it.” He thinks that a better strategy would be to “do more research before starting a weight loss plan”. He thinks that a way to make weight management easier would be to reduce carb intakes and to include daily carb totals in the pump setting. If he were to design a weight management structure for people with T1D it would include “lower carbs and lots of exercise” because “more exercise will help you lose weight and lower amounts of carbs will help it stay off”. The one thing that he would say to someone with T1D just starting a weight management plan would be to “always include exercise with a good diet.”

Discussion
Both key informants were diagnosed before age 4 and have had diabetes for over a decade. They also both use IIT, specifically CSII. Both key informants identified hypoglycemia as a situation where they had disinhibited eating and both experienced a loss of control of their eating when they encountered sweet foods, such as fudge or cookies. This disinhibited eating represents an opportunity for excess caloric intake, which could contribute to a disruption in the energy intake and expenditure balance. Their reports agree with the estimate that 88% of people with T1D experience disinhibited eating when they feel or think that they are experiencing a low blood sugar (Merwin et al, 2014).

Although both key informants are adolescent males, key informant A had never experienced issues with weight management and thus did not have responses for many of the questions surrounding his experiences with weight management and his diabetes. Key informant B had previous experiences with weight management but was more focused on gaining muscle mass and losing fat mass as opposed to losing weight. Key informant A has never participated in weight control behaviors, while key informant B participates in several behaviors, albeit healthy ones.

Both key informants discussed physical activity as a part of their lives, and thought it should be a part of a hypothetical weight management plan. Although there isn’t statistically significant data suggesting that exercise improves HbA1cs, there are other benefits including reduction of total cholesterol, BMI, triglycerides and improvements in overall well being (Kennedy et al., 2013; Quirk et al., 2014). However, physical activity is a contributing factor to hypoglycemia and was associated with increases in overnight and next day hypoglycemia (Metcalf et al., 2014). Insulin and exercise have independent, yet compounding effects on lowering blood glucose and can excessively
lower blood gluco-
ses if adjustments are not made, however it is estimated that only
48% of people with T1D understand the phar-
okinetics of insulin, a necessary step in
making adjustments to prevent hypoglycemia (Brazeau et al., 2008).
Both participants
discussed adjusting their diabetes management for physical activity,
suggesting that
they have an understanding of the actions of insulin and how it may interact
with exercise. Although exercise can provide many benefits to people with T1D,
including reductions in total cholesterol, BMI, triglycerides and increases in
overall well being
(Kennedy et al., 2013; Quirk et al., 2014) it is necessary to weight the positives
with the risks of hypoglycemia
(Gonder-frederick et al., 2011; Metcalf et al., 2014).

Finally, key informant B identified reducing his carbohydrate intake as a
weight control behavior, which is understandable considering the role of
insulin as an anabolic
hormone, promoting fat and carbohydrate storage, as well as muscle building.
Unfortunately, there is little research surrounding the use of lower carbohydrate
diets in T1D, the effects of these diets on weight, microvascular or cardiovascular
outcomes in this population or long-term adherence.

Limitations
As a set of two key informant interviews, the views presented are of two
individuals and may not be representative of the rest of the population.
Both interviewees are males who ranked their weight to be about right or
slightly overweight and some research suggests that unhealthy weight control behaviors
and eating disorders are more prevalent in females than males. Additionally, neither one of
these individuals perceived their weight to be more than slightly overweight, which is not
reflective of the subpopulations of the T1D youth population that are of particular
concern.

Strengths
Some strengths of this research are that both key informants are using IIT,
specifically CSII and thus are conducting weight management using a regimen that is
both best practice and a potential contributor to weight gain, thus allowing their views to
include. Both key informants perceive their weight to be normal and are not involved in
unhealthy or very unhealthy weight control behaviors and represent a majority of youth
with T1D in this regard.

Conclusions
These interviews indicate a need for further investigation into whether these
views are representative of the rest of the T1D population. Potential intervention
strategies that have emerged include increasing education and adherence to treatment
of hypoglycemia with fast acting carbohydrates and increase knowledge of insulin
pharmokinetics and dosing adjustments to reduce barriers to physical activity.

The perceptions that have emerged from these interviews have highlighted the
need for future research into several areas. First, focus groups and further qualitative
research should be conducted to determine whether or not the views of these two
individuals are representative of youth with T1D and how perceptions of weight
management may differ between genders, HbA1c levels and weight status. Additional
research should also be conducted into the mechanisms behind disinhibited eating
during hypoglycemia and its potential contribution to excess energy intake. Additionally, the use of lower carbohydrate diets in this population. The role of physical activity in weight management should also be further explored as it can present opportunities for both weight loss and weight gain.
Works Cited


Nathan, D. M. (2014). The Diabetes Control and Complications Trial/Epidemiology of
Appendix A

Weight Management and T1D Demographic Questionnaire

1. Today’s date is:

2. What is your birthdate?

3. What is your gender?
   ______ Female   ______ Male ______ Other

4. What is your race/ethnicity?

5. When were you first told by a doctor or a nurse that you had diabetes? This means when you were told about your diabetes diagnosis.

6. How do you take insulin? (Syringes, pens, pump).

7. Do you live or stay in more than one home on a regular basis? For example, if your parents are divorced or separated, this would include spending the weekend with your other parent. It would also include other relatives you might live or stay with on a regular basis (at least once per month).

8. How would you describe your weight? (Very underweight, slightly underweight, about the right weight, slightly overweight, very overweight)

9. Have you ever tried to lose weight?

10. Are you currently trying to lose weight?

11. In the past year, were there times when you lost eight pounds or more at a time, but did not gain back the weight?[1]

12. In the past year, were there times when you gained eight pounds or more at a time but did not get back later to your previous weight?[1]

13. Have you ever:
   a. Dieted to lose weight or to keep from gaining weight?
   b. Exercised to lose weight or to keep from gaining weight?
   c. Eaten less food or fewer calories to lose weight or to keep from gaining weight?
   d. Eaten foods low in fat to lose weight or keep from gaining weight?
e. Eaten foods low in carbohydrates to lose weight or keep from gaining weight?

f. Drank less or fewer sugar sweetened beverages to lose weight or keep from gaining weight?

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<tr>
<th><strong>Never</strong></th>
<th><strong>Rarely</strong></th>
<th><strong>Sometimes</strong></th>
<th><strong>Often</strong></th>
<th><strong>Usually</strong></th>
<th><strong>Always</strong></th>
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<td><strong>14.</strong> Losing weight is an important goal to me.</td>
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<td><strong>15.</strong> I skip meals and/or snacks.</td>
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<td><strong>16.</strong> Other people have told me that my eating is out of control.</td>
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<td><strong>17.</strong> When I overeat, I don’t take enough insulin to cover the food.</td>
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<td><strong>18.</strong> I eat more when I am alone than when I am with others.</td>
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<td><strong>19.</strong> I feel that it's difficult to lose weight and control my diabetes at the same time.</td>
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<td><strong>20.</strong> I avoid checking my blood sugar when I feel like it is out of range.</td>
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<td><strong>21.</strong> I make myself vomit.</td>
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<td><strong>22.</strong> I try to keep my blood sugar high so that I will lose weight.</td>
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<td><strong>23.</strong> I try to eat to the point of spilling ketones into my urine.</td>
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<td><strong>24.</strong> I feel fat when I take all of my insulin.</td>
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<td>25.</td>
<td>Other people tell me to take better care of my diabetes.</td>
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<td>26.</td>
<td>After I overeat, I skip my next insulin dose.</td>
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<td>27.</td>
<td>I feel that my eating is out of control.</td>
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<td>28.</td>
<td>I alternate between eating very little and eating huge amounts.</td>
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<td>29.</td>
<td>I would rather be thin than have good control of my diabetes.</td>
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30. | Is there any additional information you wish to provide or think would be important for us to know? |      |
Appendix B

Appetite
How would you describe your appetite in general?

How, if at all, has your appetite changed from when you’re BG is in range vs. not in range?

Do you ever find yourself having a strong urge to eat even when you’ve recently finished a snack or a meal? Can you tell me more about that? What kinds of situations, or for what kinds of foods, do you tend to have urges to eat even when you’ve recently eaten?

Can you give me an example of when that happened to you?

Cravings
Do you crave certain foods more when your BG is high or low? What has that been like? Have you craved any foods that you didn’t like or didn’t care about when you’re BG is in range? If yes: Tell me about that.

How would you describe a craving (if I had no idea what that was, what would you tell me?)

In what kinds of situations do you typically notice that you are craving certain foods?

Tell me about what the triggers are for your cravings? (Time of day? Emotions you are experiencing? Other?)

What types of foods do you typically crave?

What do you usually do about those cravings?

Have you found that there are some foods that taste so good that you can’t “just have one” --- as if you’re not totally in control of how much you eat? Can you tell me more about those kinds of experiences and what that has been like for you?


Tell us about the kinds of situations when you find this happening? (Home? Work? Socializing? Shopping? Events? Other?)

Can you think of anything else that might cause you to eat more than you thought you wanted? (Emotions: joy/loneliness? Comfort? When you’re with friends/in-laws/partner? Health issues: Fatigue/Nausea? Convenience: Lack of energy to shop for or prepare healthy meals? In the presence of foods? Social situations?) Please share a story if this applies to you.

Can you tell me about a specific time over the last 1-2 weeks when you felt like you were eating more than you thought you wanted? Can you describe that situation? What were you thinking and feeling?

What did you do about this? Why?

Overall Knowledge of Weight Management
Weight management contains two components: dieting and physical activity. Dieting includes the amount of calories you eat per day. Your body needs a certain amount of calories per day to be healthy. Eating above more than this amount of calories will cause you to gain weight, whereas eating below that amount will cause you to lose weight. Physical activity burns calories, so if you exercise, your body may need more calories.

What does weight management mean to you?

How does weight management differ between people?

What seems to be unique to an individual in weight management plans?

Which of these (and even other aspects) seem to be most important? Why?

How is weight management a concern for you?

**T1D Health vs. Overall Health/Weight Management**

As there are many changes related to weight loss, it is important to balance overall health and weight management goals with Type 1 diabetes management. There are extra tasks required in weight management in addition to the daily responsibilities for Type 1 diabetes management. Additionally, weight loss can disrupt the Type 1 diabetes management regimen, requiring adjustments.

How often do you adjust your diabetes regimen to try to maintain numbers in range?

How does weight loss management affect your diabetes management?

**Main Barriers Faced**

People with Type 1 diabetes may have additional barriers to weight management. Weight loss plans can disrupt a regimen that is already working with the T1D management.

What barriers have you faced with your weight loss plan due to your diabetes?

What concerns have you had with a weight management plan as it relates to your diabetes?

How did you handle these? Are these issues still a struggle?

**Past Weight Loss Attempts**

Most people have attempted to diet at one point or another in their lives. Past dieting plans should provide a way to reflect on what worked and did not work.

Can you describe some benefits or positive outcomes of past weight loss plans?

How do you continue to use these positive components today?

How or why did you come up with putting these in your plan?

Can you tell me about the unfavorable outcomes of past weight management plans?

What was your reaction to the failure of these aspects of your plan?
What ideas do you have to avoid those failures or adjust those aspects of your weight management plan?

**Ways Weight Management Could Be Made Easier**

Weight loss with Type 1 diabetes has many extra burdens. There are ways to minimize these problems and have a successful weight loss plan. Social support may help. Support and guidance from your treatment team on diabetes regimen changes can also help to minimize the problems faced by a person with T1D. Tools, such as a Continuous Glucose Monitor that gives readings every 5 minutes (approximately 288 times per day) and shows blood sugar trends can be helpful in adjusting the insulin dosage to correct for abnormal blood sugars and assist with weight management plans.

What ways have you found to make weight management easier?

What are some new or alternative ways to make it easier?

If you could design a structure for a weight management plan for people with Type 1 diabetes, what would it include? Why?

When designing the plan, what aspects would you specifically leave out or not include?

What would you say or suggest to someone with Type 1 diabetes just starting a weight management plan for the first time?

Is there anything else you would like to tell me?

**V. Summarize Knowledge to be Gained:** The prevalence of overweight and obese individuals living with Type 1 Diabetes has begun to parallel those of the general population yet there is limited research to inform guidelines on how to advise patients with T1D how to lose or management weight. The outcome of this work will inform future studies that may eventually provide a platform on which recommendations specific to the T1D population can be made in the context of weight maintenance and weight loss.